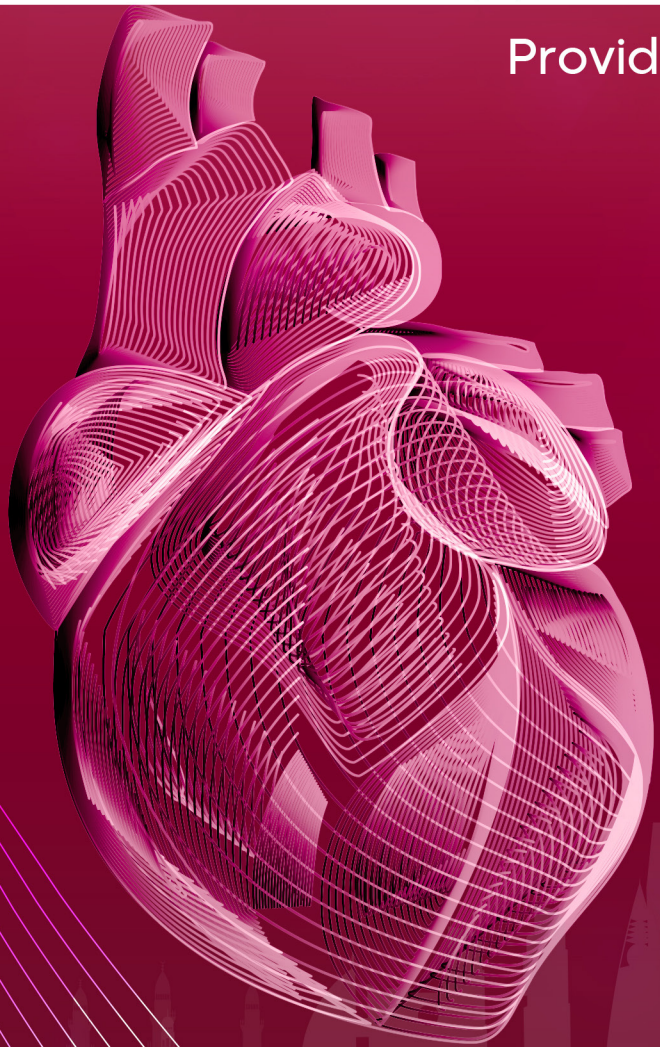
جمعية القلب السعودية
Saudi Heart Association
National Life Support Committee

SALSO

SALSO

SHA Advanced Life Support in Obstetrics

Provider Manual 2025



جمعية القلب السعودية
Saudi Heart Association

The Saudi Advanced Life Support in Obstetrics (SALSO) Provider Manual 2024

Preface

The Saudi Advanced Life Support in Obstetrics (SALSO) Provider Course aimed at helping health professionals acquire and retain the necessary knowledge and competencies to deal with maternity related emergencies safely and effectively.

The course includes mandatory readings, Pre recorded lectures, and practical workstations. Participants are evaluated through a pre & post online test and hands-on skill stations. Ultimately, each maternity care provider must rely on their professional judgment to determine the best course of action in emergency scenarios.

This course promotes a uniform team-based approach among physicians, residents, nurse midwives, registered nurses, and other members who are engaged in providing direct and indirect maternity care to enhance patient safety and positively influence maternal outcomes.

It features a blended classroom format, enabling learners to progress at their own pace through the online portion before participating in the instructor- led portion of the course.

This manual is composed of sixteen chapters, for each chapter, the learning objectives are specified and the most important elements are reviewed.

The content of this material is dedicated for the SALSO course, it is a summary of the latest evidence in the literature. For further details, you can refer to the references indicated in the last chapter.

Acknowledgements

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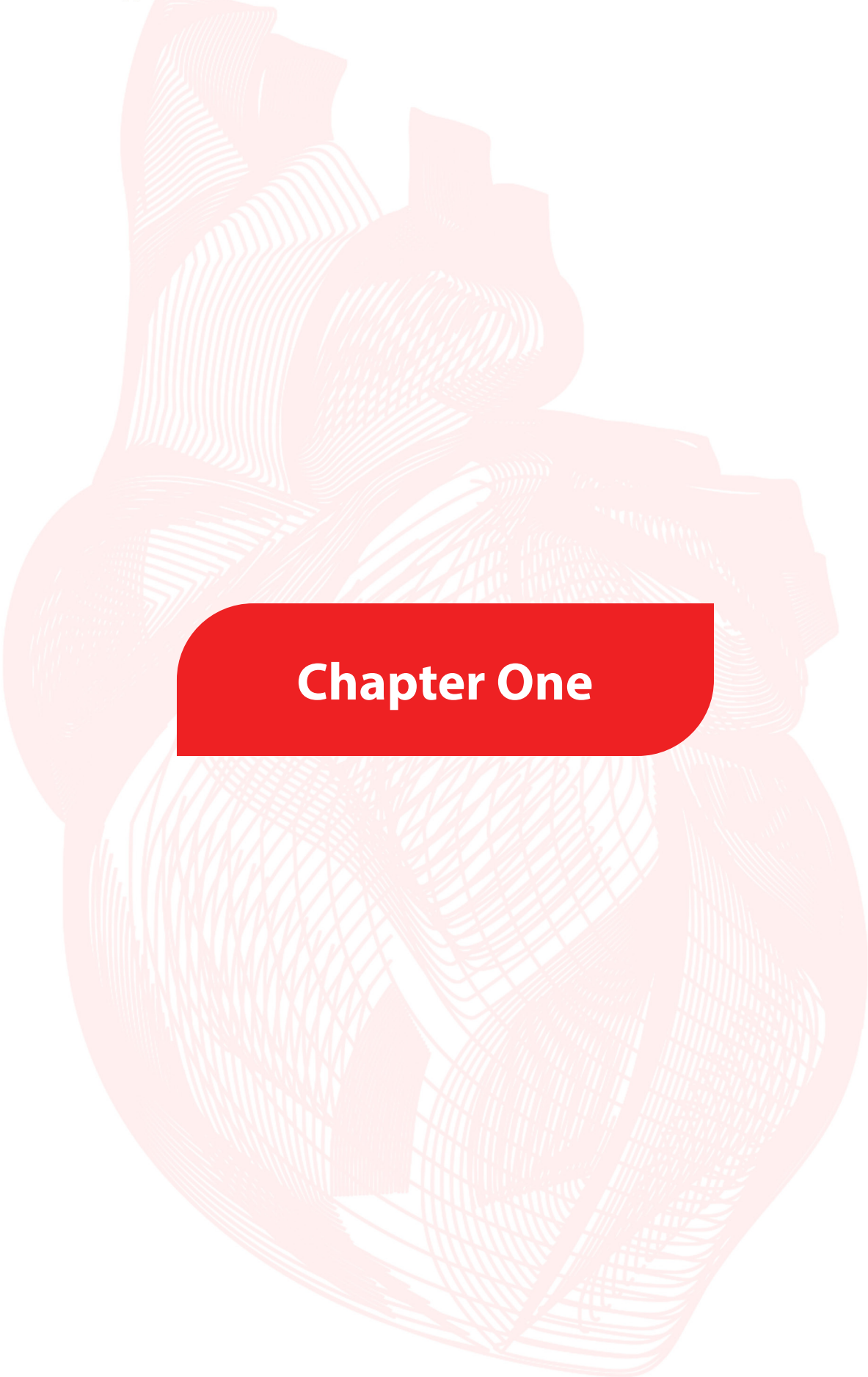
TABLE OF CONTENTS



Chapter One

Course Overview

Course Goal

The Saudi Advanced Life Support in Obstetrics (SALSO) aims to equip the entire maternity care team with the necessary knowledge and skills to effectively handle obstetric emergencies. This course promotes a standardized, team-based approach among physicians, residents, nurse midwives, registered nurses, and other maternity care team members to enhance patient safety and positively influence maternal outcomes.

Course Objectives

At the completion of the provider course, the participant should be able to:

1. Explore methods to manage pregnancy and birth related emergencies and standardizing the skills of maternity care providers.
2. Show knowledge and skill mastery through successful completion of pre & post online course exams, skills workstations, and group tests.
3. Manage different emergency obstetric situations demonstrating effective team communication strategies centered on patient safety.

Course Description

To help you achieve these objectives, the SALSO Provider Course includes

- Pre-course recorded lectures.
- Pre-course textbook.
- Skills station.
- Case based discussion.
- Simulation sessions with debriefing.
- Case scenario Group test stations.
- End of course evaluation.
- Pre and Post Course Online Test.

Chapter Two

Safety in Maternity Care

Learning Objectives:

Upon completing this chapter, participants will be able to:

1. Discuss the importance of patient safety and adopting a team-based approach in maternity care.
2. Know how to apply effective high performance team elements safety.
3. Identify the most common challenges in maternity care and discuss potential alleviation strategies.

Introduction

The goals of patient safety are to improve results and save lives by fostering cooperation, communication, and system development. It is described as "the prevention of harm to patients" by the Institute of Medicine. According to the CDC, 1,205 women lost their lives to maternal causes either during or 42 days after giving birth.

This is indicative of a sharp increase in the US maternal death rate over the past several years, which has gone from 17.4 per 100,000 live births in 2018 to 32.9 per 100,000 live births in 2021. In recent decades, there has also been an increase in the risk of severe maternal morbidity, which includes problems such major blood transfusions, eclampsia, hysterectomy, and heart failure.

These consequences are fifty times more prevalent than pregnancy-related death. The United Nations has set a Sustainable Development Goal to decrease the world's maternal death rate from 216 per 100,000 live births in 2015 to fewer than seventy per 100,000 births by 2030.

An interdisciplinary perinatal practice committee, continuous audit and feedback, team training, education on safety principles and fetal monitoring, and careful attention to matching clinical practices with current evidence and professional standards were all part of the comprehensive perinatal safety programs. Many health care systems and state collaborative embraced these strategies, which decreased adverse occurrences and liability claims.

The Joint Commission has mandated team training since 2003. Hospitals must adopt multidisciplinary team training methods when providing patient care" according to the National Safety Patient Goals.

Participation in this kind of education and training is mandatory for hospital healthcare workers. Maternity care requires so many clinicians that it is rare for a patient care team to consist entirely of the same individual's every time. The primary risk to patient safety is the variability across team members. Without a formidable team, even the most proficient specialist cannot perform their job. Since it is uncommon for teams to run together, it is beneficial to teach all healthcare staff uniform communication methods so that each doctor can contribute to the different teams they may meet.

Patient Safety Bundles

Patient safety bundles are sets of best practices that are supported by evidence and created by multidisciplinary specialists to address clinically specific issues in expectant and new mothers. To reduce maternal mortality inequalities in health and avoidable maternal death and morbidity, safety bundles are a critical first step. Patient safety bundles offer a methodical approach to enhancing both patient outcomes and care procedures.

With the longest history of implementing safety bundles, California has reduced maternal morbidity and death by using collaborative improvement methods to bring about change on a large scale. Using this strategy, health systems have also shown gains in results.

Bundles handle a wider range of maternal health care, whereas in the past they were mostly focused on inpatient treatment and treated emergencies like bleeding and hypertensive crisis. The standardization of preparedness, recognition, reaction, and reporting to enhance them are fundamental principles shared by all safety packages.

A minimal set of suggestions is included in each package, along with connections to a wealth of practical resources. However, much like checklists, a strong safety culture, interprofessional integration, effective communication techniques, and cultural humility are all necessary for successful implementation, in addition to substantial institutional support.

Readiness

To effectively capture self-identified race, ethnicity, and native language and make them available in the electronic medical record, every health system must:

- Inform all employees (inpatient, outpatient, and community-based) about the resources that the healthcare system offers for interpreting.
- Conduct prenatal racial and ethnic disparities and their underlying causes of education for the whole staff.
- Optimal procedures for group decision-making.
- Involve a variety of patient, family, and community advocates who can speak for significant community partnerships on leadership teams focused on quality and safety.

Recognition

All personnel, including families and patients:

- Educate staff members about unconscious prejudice.
- Give the mother patient prompt, easy access to health records (paper or electronic), at little or no cost, in an understandable manner that condenses the data most important to prenatal care and wellbeing.
- Give a way for staff, relatives, and patients to report instances of disrespect or poor communication as well as unequal treatment.

Response

During every clinical contact, make sure to:

- Follow best practices for shared decision making; and
- Respond promptly and individually to each complaint of disrespect or inequality.
- Talk about contraceptive alternatives and reproductive life plans at regular intervals across a woman's reproductive life, not only during or just after pregnancy.
- After giving delivery, create discharge navigation and coordination systems to make sure women receive the right follow-up care and know when to see their doctor again. Give them discharge instructions that cover what to do if a query or concern, who to contact, and what danger or warning signals to watch out for. Create discharge documents that consider the linguistic, cultural, and health literacy needs of the patients.

Reporting & Systems Learning

Establish a fair culture in every healthcare unit, with mechanisms for reporting, responding, and learning modelled after continuous safety culture initiatives.

- Create a disparities dashboard that tracks metrics related to processes and outcomes that are categorized based on race and ethnicity. Staff and leadership should get regular access to this data.
- Launch quality-improvement initiatives that focus on inequities in healthcare outcomes, treatment, and access.
- When performing multidisciplinary reviews of severe maternal morbidity, mortality, and other clinically significant metrics, consider the role of race, ethnicity, language, poverty, literacy, and other socioeconomic determinants of health, including racism at the interpersonal and systemic levels.
- Give the following a checkmark on the review sheet: Was the morbidity (yes/no/maybe) influenced by language barriers, racial/ethnic (implicit prejudice), or socioeconomic determinants of health? And if so, are there any system modifications that might be made to affect the result?

Alliance for Innovation on Maternity Health (AIM) -Supported Patient Safety

- Bundles and Safety Tools
- Patient Safety Bundles
- Maternal Mental Health: Depression and Anxiety
- Maternal Venous Thromboembolism Prevention
- Obstetric Care for Women with Opioid Use Disorder
- Obstetric Hemorrhage
- Postpartum Care Basics for Maternal Safety
- From Birth to the Comprehensive Postpartum Visit
- From Maternity to Well-Woman Care
- Prevention of Retained Vaginal Sponges After Birth
- Reduction of Peripartum Racial/Ethnic Disparities

- Safe Reduction of Primary Cesarean Birth
- Severe Hypertension in Pregnancy
- Patient Safety Tools
- Maternal Early Warning Criteria
- Patient Family and Staff Support After a Severe
- Maternal Event
- Severe Maternal Morbidity Review
- Summary After a Severe Maternal Event

Team Dynamics

Leadership

Any team member who can handle a given circumstance to the best of their ability can take the lead in an efficient team. A proficient team leader arranges the group, clarifies aims, involves everyone in decision-making, gives members the freedom to voice their opinions and raise issues, when necessary, actively encourages and supports productive collaboration, and adeptly handles disagreements.

- **Summary of Situations**
  The practice of continuously seeing and evaluating your surroundings to be aware of your position is known as situation monitoring.
  (STEP) = Patient Status, Team members, Environment, and objective Progress) "Knowing what is going on around you" and the circumstances influencing your job are two aspects of situation awareness.
  Each team member must have situation awareness and share pertinent information with the group for there to be shared mental models. By doing this, the team can make sure that everyone is "on the same page."
- **Exchange of Support One type of mutual support is task aid, where team members:**
  - Guard against circumstances where there is an excessive amount of work to be done.
  - Consider patient safety when making offers and requests for help.
  - Create an environment where it is expected that help will be actively looked for and provided.
- **Cross-monitoring**
  A technique for reducing errors that entails keeping an eye on what other team members are doing, acting as a safety net inside the group, making sure errors or oversights are at once and readily found, and "watching each other's back."
- **DESCR Program**
  A methodical strategy to provide constructive criticism and handle disagreement. involves defining the circumstance.
  - (D), Describing the specific situation
  - (E), Expressing concerns about the events.
  - (S), Suggesting alternative actions.
  - (C), Stating Consequences

- (R), Reaching consensus and agreement for moving forward.

- **Communication**

  Effective communication is prompt, thorough, concise, and clear.

  - **SBARQ**

    During a handoff or while explaining a change in a patient's condition, SBARQ is an essential approach for conveying vital information that must be addressed right away and taken urgently.

    - Situation: How is the patient doing?
    - Background: What is the context or patient history?
    - Assessment: What do I believe to be the issue?
    - Suggestion and Recommendation: How would I go about fixing it?
    - Questions and Inquiries: A chance to pose and receive any inquiries.

Table 2.1: SBARQ

Situation	Identify yourself and the patient and describe the present situation that prompted you to call. State the following: • Your name • Your unit • The patient's name and room number • Brief overview of the problem
Background	Give other information pertinent to the situation not the patient's entire history since admission, but circumstances leading up to the situation.
Assessment	State the problem and what you think is causing it.
Recommendation	State what you think will correct the problem, or what you need from the provider.
Question	Allow an opportunity to ask or answer any questions. Review specific concerns.
Resources Eberhardt, S. (2014); Institute for Healthcare Improvement (n. d.); Military Health System, U.S. Department of Defense (n. d.).	

With practice, the listener will be able to focus on the term "situation" and be ready for the next background information, evaluation, and advice. The issue I am calling about/concerned about is... In addition to helping the audience, SBARQ keeps presenters "on task" by reminding them of the value of being brief and providing their opinion and advice.

The sender will communicate more rapidly, and the recipient will expect receiving the information in an SBARQ format once this is a regular tool.

It might be beneficial to take a time to plan your SBARQ before starting the conversation by writing down the key points you want to address for each SBARQ part when you begin to utilize SBARQ as the framework for your communications.

The efficiency of your SBARQ-based communication will rise with usage and practice, and the amount of effort you need to spend planning it will decrease. Patients will receive better treatment and team communication will improve if you use SBARQ to "bring other team members up to speed."

- **Callout**
  A method for yelling out valuable information in an emergency or when help is desperately required.
- **Checkback**
  a closed-loop communication technique that makes use of many parties to confirm and validate information shared. As part of the approach, the information recipient restates what they understand from the information provided, giving the original informant a chance to clarify or deepen their knowledge. If it is thought that the recipient of the message misinterpreted the first exchange, the original informant is obliged to provide clarification and repeat the checkback procedure.
- **Two Challenge Rule**
  An approach to raising issues. involves voicing a viewpoint or issue at least twice, particularly if the first attempt was met with resistance or silence. It is recommended to frame the first "challenge" as a question that clarifies the issue and raises awareness of it, and to frame the second "challenge" as a statement that bolsters the worries.

  Adopt a more forceful strategy and make use of your boss or the chain of command. All team members are empowered under the two-challenge rule to "stop the line" if they perceive or learn of a critical safety lapse.
- **Power Words**
  The application of precise, predetermined language that clearly conveys danger, caution, and warning. They are meant to draw the attention of medical experts, and when they are included into a safety culture, they are typically associated with prearranged actions. Examples include phrases and words like "concerned," "uncomfortable," and "safety issue," but they may be any expression that conveys the need to change course, slow down, or raise awareness of a situation in some other way. They are employed to expressly convey an increasing degree of worry about any given subject.
  To draw the attention of the team or the doctor and make sure that everyone is paying attention, a member of the care team will use the term "concerned" when they say, "I am concerned about." When a nurse says to a hospitalist, "I am uncomfortable because," it suggests that the nurse thinks the hospitalist could have overlooked the expression of "concern," which is now heightened and potentially hazardous. Lastly, if someone raises the alarm about a safety concern, the present course of activity must halt and be assessed before moving forward.

Event Management

- **Briefs**

  A loosely organized discussion among team members with the goal of enhancing patient care by creating a strategy and ensuring agreement before taking any further action. This is a brief planning meeting before the event to talk about the creation of the team, assign key responsibilities, set the tone and expectations, and project possible outcomes and backup plans.

- **Huddles**

  A spontaneous reaction to evolving conditions when team members gather to reorganize and develop a mutual understanding of plan modifications.

- **Debriefs**

  A semi-structured discussion among team members to enhance care by analyzing performance right away with the goal of planning future enhancements and reiterating desired actions.

  Some crucial inquiries to consider are:

  - What worked successfully, and why?
  - What, and why, might have been done better?
  - What ought to be done differently in the future?

Malpractice Risk

A decrease in unfavourable obstetric outcomes has an added advantage. For doctors and hospitals who provide maternity care, this advantage is a reduction in malpractice damages. The largest malpractice damage lawsuits in the US are connected to births, and as a result, hospitals and doctors have stopped offering maternity care.

Risk management lowers the likelihood of malpractice lawsuits, lessens the amount of damages in a claim, and aids in preventing patient harm. Early case reporting is one risk management strategy that reduces claims. In conjunction with an apology and patient bargaining, it is employed as a case finding strategy.

Five C's of Risk Management

The Five C's can lower the likelihood of a malpractice lawsuit by providing better patient care.

- **Compassion**

  Frequently, patient discontent precedes legal action. It is challenging for patients to sue someone they like and who is concerned about them, though.

- **Communication**

  Getting to know patients better may lead to fewer legal disputes. Patients are pleased when they get adequate explanations about their symptoms and test findings. Simply sitting down and conversing with patients enhances their opinion of the healthcare provider's communication abilities.

  The following tactics might be used:

  - Encourage patients to ask questions.
  - Limit the quantity of information you provide.
  - Use teaches-back or show-me approaches.
  - Speak slowly and in a non-medical language.

  - Provide written resources to support your explanations.
- **Competence**
  To deliver the right care, the provider must be qualified and experienced. When necessary, a consultation or referral should be made.
- **Charting**
  The majority of claims are brought but are unsuccessful due to insufficient medical record proof. In a court of law, the medical record is the main witness. Documents must be fully completed, dated, and timed. Errors in recording should also be fixed.
- **Confession**
  Suit filings are more often motivated by a suspected cover-up. A provider's admission of mistake might soften the patient's opinion.

Simulations for better maternity care

Maternity care units or simulation labs are the two possible locations for the exercises. The patient care and system problems are more accurately replicated in the following simulations.

The ideas of cooperation and communication may also be practiced through simulations. Drills on a regular basis can be quite beneficial in low-income environments.

Chapter Three

Intrapartum Fetal Surveillance

Learning Objectives:

Upon completing this chapter, participants will be able to:

1. Describe the techniques of fetal surveillance.
2. Interpret electronic fetal heart rate monitoring.
3. Discuss the complications of abnormal fetal heart rate patterns.

Introduction

Intrapartum fetal surveillance may be done as intermittent auscultation or Electronic Fetal Monitoring (EFM). Intermittent auscultation is recommended in low risk pregnancy provided there is adequate staff and expertise. Electronic fetal monitoring has low predictive value and high rate of cesarean section. Using standardized definition, mnemonic, category classification and action may improve communication and outcome.

Table 3.1: DR C BRADO for Structured Intermittent Auscultation

DR	Define Risk (low or high)
C	Contractions (frequency, duration, intensity, resting tone)
BR	Baseline Rate (normal 110-160 bpm, bradycardia, tachycardia)
A	Accelerations (increases from baseline)
D	Decelerations (decreases from baseline)
O	Overall assessment (normal, indeterminate)

Electronic fetal monitoring should be evaluated along feto-maternal wellbeing, feto-maternal risk factors, and progress of labour. In this chapter electronic fetal monitoring (EFM) is used interchangeably with cardiotocography (CTG). Staff certification on CTG training will enhance communication and timely action. DR C BRAVADO is a tool used to identify the risks and the results of cardiotocography.

Table 3.2: DR C BRAVADO for Electronic Fetal Monitoring Tracings

DR	Define Risk (low or high)
C	Contractions (frequency, duration, intensity, resting tone)
BRA	Baseline Rate (normal 110-160 bpm, bradycardia, tachycardia)
V	Variability (absent, minimal, moderate, marked)
A	Accelerations
D	Decelerations (early, variable, late, prolonged)
O	Overall assessment (normal, indeterminate, abnormal)

Definitions

- **Electronic fetal monitoring:**
  Fetal cardiac activity record along maternal uterine contractions.
- **CTG:**
  Fetal cardiac activity record along maternal uterine contractions.
- **Baseline Rate:**
  Approximate mean FHR rounded to increments of 5 BPM during a 10-minute window, excluding accelerations and decelerations and periods of marked FHR variability (>25 BPM). There must be at least 2 minutes of identifiable baseline segment (not necessarily contiguous) in any 10-minute window, or the baseline for that period is indeterminate. In such cases, it may be necessary to refer to the previous 10-minute window for determination of the baseline
  - Bradycardia: Baseline rate <110 BPM for 10 minutes or longer
  - Tachycardia: Baseline rate >160 BPM for 10 minutes or longer
- **Baseline Variability:**
  Determined in a 10-minute window, excluding accelerations and decelerations. Baseline FHR variability is defined as fluctuations in the baseline FHR that are irregular in amplitude and frequency. The fluctuations are visually quantified as the amplitude of the peak-to-trough in BPM
  - Absent Variability: Amplitude range undetectable
  - Minimal Variability: Amplitude range visually detectable but ≤5 BPM
  - Moderate Variability: Amplitude range 6 to 25 BPM
  - Marked variability: Amplitude range >25 BPM
- **Acceleration:**
  Visually apparent abrupt increase in FHR. An abrupt increase is defined as an increase from the onset of acceleration to the peak in <30 seconds. To be called an acceleration, the peak must be ≥15 BPM, and the acceleration must last ≥15 seconds from the onset to return. Before 32 weeks' gestation, accelerations are defined as having a peak ≥10 BPM and duration of ≥10 seconds. An acceleration lasting ≥10 minutes is defined as a baseline change
  - Prolonged Acceleration: A prolonged acceleration is ≥2 minutes but <10 minutes in duration
- **Deceleration.**
  - Early Deceleration: Visually apparent, usually symmetrical, gradual decrease and return of the FHR associated with a uterine contraction. A gradual FHR decrease is defined as one from the onset to the FHR nadir ≥30 seconds. The decrease in FHR is calculated from the onset to the nadir of the deceleration. The nadir of the deceleration occurs at the same time as the peak of the contraction. In most cases the onset, nadir, and recovery of the deceleration is coincident with the beginning, peak, and ending of the contraction, respectively
  - Late Deceleration: Visually apparent, usually symmetrical, gradual decrease and return of the FHR associated with a uterine contraction. A gradual FHR decrease is defined as one from the onset to the FHR nadir ≥30 seconds. The decrease in FHR

is calculated from the onset to the nadir of the deceleration. The nadir of the deceleration is delayed in timing, with the nadir of the decelerations occurring after the peak of the contraction. In most cases the onset, nadir, and recovery of the decelerations occur after the beginning, peak, and ending of the contraction, respectively

- Variable Deceleration: Visually apparent abrupt decrease in the FHR. An abrupt decrease in the FHR is defined as from the onset of the deceleration to the beginning of the FHR nadir <30 seconds. The decrease in FHR is calculated from the onset to the nadir of the deceleration. The decrease in the FHR is ≥15 BPM, lasting ≥15 seconds and <2 minutes in duration. When variable decelerations are associated with uterine contractions, onset, depth, and duration commonly vary with successive uterine contractions. Variable decelerations can occur in the absence of contractions
- Prolonged Deceleration: Visually apparent decrease in FHR from the baseline that is ≥15 BPM, lasting ≥2 minutes, but <10 minutes. A deceleration that lasts ≥10 minutes is a baseline change
- Recurrent: Decelerations are defined as recurrent if they occur with ≥50% of uterine contractions in any 20-minute window
- Intermittent: Decelerations occurring with <50% of uterine contractions in any 20-minute segment

- **Sinusoidal:**
  Visually apparent, smooth, sine wavelike undulating pattern in FHR baseline with a frequency of 3-5 cycles/minute that persists for ≥20 minutes
  - Pseudo-sinusoidal: A pattern resembling the sinusoidal pattern but with more jagged saw-tooth appearance, rather than the smooth sine waveform Seldom exceeds 30 minutes and is characterized by normal patterns before and after
- **Normal Uterine Activity:**
  <= 5 contractions per 10 minutes, 30 minutes on mean
  - Tachysystole: increased the contractions to More than five contractions per 10 minutes, 30 minutes on mean

Decision of fetal monitoring with patient

Discuss fetal monitoring options with a woman as part of her antenatal care and document the discussions and decisions in her personalized care plan.Throughout labour, provide women with information on the fetal monitoring method being advised and the reasons for this advice.

A health care provider will support the woman's decision about fetal monitoring during labour. Include birthing companion(s) in these discussions if appropriate, and if that is what the woman wants. Document these discussions and decisions in the woman's notes.

Also; women and their birthing companion(s) are informed about what is happening if additional advice or review is being sought by the care team, for example from a senior midwife or obstetrician.

Explain to the woman that risk assessment is a continual process, and the advised method of fetal heart rate monitoring may change throughout the course of labour.

Intermittent auscultation

Offer women with a low risk of complications, fetal heart rate monitoring with intermittent auscultation when in established first stage of labour.

- Do this as follows:
    - Use either a Pinard stethoscope or doppler ultrasound
    - Carry out intermittent auscultation immediately after a palpated contraction for at least 1 minute, repeated at least once every 15 minutes, and record it as a single rate on a partogram and in the woman's notes record accelerations and decelerations, if heard palpate (and record on the partogram) the maternal pulse hourly, or more often if there are any concerns, to ensure differentiation between the maternal and fetal heartbeats.

Recommendations for Structured Intermittent Auscultation in Low-Risk Women

- Every 30 min in active first stage and every 15 min in active second stage
- Palpate the abdomen to determine the position of the fetus (Leopold maneuvers)
- Place the Doppler over the area of maximum intensity of fetal heart tones, generally over the fetal back
- Differentiate MHR from FHR by simultaneously palpating maternal radial artery or assessing the MHR electronically
- Palpate for uterine contraction during period of FHR auscultation to determine relationship of contraction to FHR
- Count baseline FHR between contractions and when the fetus is not moving. Count FHR for 15 to 60 seconds, per facility protocol, to determine the baseline rate
- Count FHR after uterine contraction using multiple consecutive 5- to 15-second intervals for 30 to 60 seconds to determine differences between baseline FHR and fetal response to contractions (this may be subject to hospital protocols).

If no fetal heartbeat is detected, offer urgent real-time ultrasound assessment to check fetal viability.

Once the woman has signs of, or is in confirmed second stage of labour:

- Perform intermittent auscultation immediately after a palpated contraction for at least 1 minute, repeated at least once every 5 minutes and record it as a single rate on a partogram and in the woman's notes
- Palpate the woman's pulse simultaneously to differentiate between the maternal and fetal heart rates
- If there are concerns about differentiating between the 2 heart rates, seek help and consider changing the method of fetal heart rate monitoring.
- If, on intermittent auscultation, there is an increase in the fetal heart rate (as plotted on the partogram) of 20 beats a minute or more from the start of labour, or a deceleration is heard:
- Carry out intermittent auscultation more frequently (for example, after 3 consecutive

contractions) carry out a full review, considering the whole clinical picture including antenatal and existing or new intrapartum risk factors, maternal observations, contraction frequency (including hypertonus) and the progress of labour.

Table 3.3: Summary of Advantages and Disadvantages of Systematic Intermittent Auscultation

Category	Characteristics
Advantages	• Non-invasive • Can be used anytime FHR is audible • Detects baseline and rhythm • Detects increases and decreases from FHR baseline • Allows freedom of movement • Less costly equipment than Continuous electronic fetal monitoring (CEFM) • Increased bedside attendance by provider • Evidence indicates outcomes are comparable with those of CEFM • Lower incidence of cesarean delivery when used
Disadvantages	• Does not produce a tracing • May miss some cardiac events as not continuous • Requires skill and training • For low-risk patients • Ability to hear fetal heart sounds may be limited in obese patients, active patients (maternal and fetal), increased amniotic fluid, and with uterine contractions • Requires 1:1 nurse-to-patient ratio
If fetal heart rate concerns are confirmed:	• Summon help • Advise continuous CTG monitoring, and explain to the woman and her birth companion(s) why it is recommended, and the implications for her choices of type and place of care • Transfer the woman from midwifery-led to obstetric-led care, providing that it is safe and appropriate to do so. • Return to intermittent auscultation if continuous CTG monitoring has been started because of concerns arising from intermittent auscultation but the CTG trace is normal after 20 minutes, unless the woman decides to remain on continuous CTG monitoring.

Table 3.4: Strategies for the Successful Implementation of Structured Intermittent Auscultation:

Availability of skilled personnel when performing the procedures.
Development of organizational policies to support SIA, detailing procedures and evaluation frequency.
Prompt clinical interventions in response to concerning findings.
Maintaining a nurse-to-patient ratio of 1:1.
Provision of tools for documenting SIA findings.
Resources availability of auscultation devices.
Fostering an environment that supports the common practice of childbirth and decreases the useless interventions

Continuous electronic fetal monitoring (CEFM) /CTG- Indication

- Offer continuous CTG monitoring as part of fetal assessment if any antenatal or intrapartum risk factors for fetal compromise are present.
- **Antenatal risk factors**
  - Offer continuous cardiotocography (CTG) monitoring to women in labour if it is in their personalized care plan.
  - Offer continuous CTG monitoring for women in labour who have any of the following antenatal maternal risk factors:
  - Previous caesarean birth or other full thickness uterine scar
  - Any hypertensive disorder needing medication.
  - Prolonged ruptured membranes (but women who are already in established labour at 24 hours after their membranes ruptured do not need CTG unless there are other concerns).
  - Any vaginal blood loss other than a show suspected chorioamnionitis or maternal sepsis.
  - Pre-existing diabetes (type 1 or type 2) and gestational diabetes requiring medication.
  - Non-cephalic presentation (including breech, transverse, oblique and cord), including while a decision is made about mode of birth fetal growth restriction (estimated fetal weight below 3rd centile).
  - Small for gestational age (estimated fetal weight below 10th centile) with other high-risk features such as abnormal doppler scan results, reduced liquor volume or reduced growth velocity
  - Advanced gestational age (more than 42+0 weeks at the onset of established labour)

- Anhydramnios or polyhydramnios reduced fetal movements in the 24 hours before the onset of regular contractions. Consider continuous CTG monitoring if, based on clinical assessment and multidisciplinary review, there are concerns about other antenatal factors not listed above that may lead to fetal compromise.
- Consider the recommendations for fetal monitoring for women who are considered to be at higher risk of complications during labour because of existing medical conditions or obstetric complications or for women with multiple pregnancies.

- **Intrapartum risk factors**
  - Be aware that intrapartum risk factors may increase the risk of fetal compromise, and that intrapartum risk factors that develop as labour progresses are particularly concerning.
  - Offer continuous CTG monitoring for women who have or develop any of the following new intrapartum risk factors:
  - Contractions that last longer than 2 minutes, or 5 or more contractions in 10 minutes
  - The presence meconium
    - When assessing risk at any time during labour, be aware that the presence of meconium: can indicate possible fetal compromise, and may lead to complications, such as meconium aspiration syndrome.
    - Consider the character of the meconium as part of the overall clinical assessment, in conjunction with other antenatal or intrapartum risk factors, and discuss the option of CTG monitoring with the woman.
    - Recognize that the type of monitoring method used is the woman's choice, and support her decision. Be aware that meconium is more common post-term, but should still trigger a full risk assessment and discussion with the woman about the option of CTG monitoring.

  - Maternal pyrexia (a temperature of 38°C or above on a single reading or 37.5°C or above on 2 consecutive occasions 1 hour apart).
  - Suspected chorioamnionitis or sepsis
  - Pain reported by the woman that appears, based on her description or her previous experience, to differ from the pain normally associated with contractions
  - Fresh vaginal bleeding that develops in labour
  - Blood-stained liquor not associated with vaginal examination, that is likely to be uterine in origin (and may indicate suspected antepartum haemorrhage)
  - Maternal pulse over 120 beats a minute on 2 occasions 30 minutes apart
  - Severe hypertension (a single reading of either systolic blood pressure of 160 mmHg or more or diastolic blood pressure of 110 mmHg or more, measured between contractions)
  - Hypertension (either systolic blood pressure of 140 mmHg or more or diastolic blood pressure of 90 mmHg or more on 2 consecutive readings taken 30 minutes apart,

measured between contractions)

- A reading of 2+ of protein on urinalysis and a single reading of either raised systolic blood pressure (140 mmHg or more) or raised diastolic blood pressure (90 mmHg or more)
- Confirmed delay in the first or second stage of labour
- Insertion of regional analgesia (for example, an epidural)
- Use of oxytocin.

- Consider continuous CTG monitoring if, based on clinical assessment and multidisciplinary review, there are concerns about other intrapartum factors not listed above that may lead to fetal compromise.

Electronic fetal monitoring -features

- Review the previous fetal heart rate monitoring results, including any previous CTG traces, as part of the hourly risk assessment and in conjunction with other antenatal or intrapartum risk factors and determine if there are any changes in baseline fetal heart rate, variability or decelerations.
- If there are changes in the fetal heart rate pattern over time which indicate a change in the baby's condition, review antenatal or intrapartum risk factors for hypoxia. When reviewing a CTG trace, assess and document:
  - Contractions
  - Baseline fetal heart rate
  - Variability
  - Presence or absence of decelerations (and characteristics of decelerations if present)
  - Presence of accelerations.

Electronic fetal monitoring -interpretation

- When interpreting how the baby is coping with labour, consider maternal, fetal and labour factors as well as CTG changes.
- Advice about her care during labour and birth will be based on an assessment of several factors, including her preferences, her condition and the condition of her baby, as well as the findings from the CTG.
- Fetal heart rate monitoring is a tool to provide guidance on fetal condition, and not a standalone diagnostic tool; the findings from monitoring need to be looked at together with the developing clinical picture for both woman and baby.
- Initial assessment will be followed by ongoing assessment of risks, feto-maternal wellbeing and EFM changes.
- Ongoing risk assessment

  Carry out a full assessment of the woman and her baby every hour. At each assessment include:

  - Maternal antenatal risk factors for fetal compromise
  - Fetal antenatal risk factors for fetal compromise
  - New or developing intrapartum risk factors

  - Progress in labour including characteristics of contractions (frequency, strength and duration).
  - Fetal heart rate monitoring, including changes to the fetal heart rate pattern.
  - Discuss with the woman any changes identified since the last review, and the implications of these changes. Include birthing companion(s) in these discussions if appropriate and if that is what the woman wants.
- Obtain an in-person review of every hourly assessment by another clinician ("fresh eyes") for women on CTG, to be completed before the next assessment takes place.
- Perform and document a systematic assessment of the condition of the woman and unborn baby every hour, or more frequently if there are concerns.
- Ensure one-to-one support is maintained by having a midwife remain with the woman throughout labour. If the midwife needs to leave the room or there needs to be a change in staff, ensure the woman knows this is happening.
- Categorize the features of the cardiotocography trace
  - Contractions, baseline fetal heart rate, variability, decelerations and use alongside consideration of the presence of accelerations to classify the overall CTG trace.
  - A Category I CTG trace indicates that the baby is coping well with labour
  - If the CTG trace changes or is not Category I there will be less certainty about the condition of the baby and so maintaining continuous CTG monitoring is advised, in conjunction with a full assessment including checks for developing intrapartum risk factors such as the presence of meconium, sepsis and slow progress in labour.
  - Consider any change in the categorization of the CTG alongside other antenatal and intrapartum risk factors for hypoxia. Discuss the change and its implications with the woman, and consider her preferences when deciding how to proceed.
- **Contractions:** Use a tocodynamometer to record contraction frequency and length on the CTG trace.
- **Decelerations:** Define decelerations as transient episodes when the fetal heart rate slows to below the baseline level by more than 15 beats a minute, with each episode lasting 15 seconds or more. An exception to this is that in a trace with reduced variability, decelerations may be 'shallow'.
- **When assessing the significance of decelerations in fetal heart rate, consider:**
  - Their timing (early, variable or late) in relation to the peaks and duration of the contractions
  - The duration of the individual decelerations
  - Whether or not the fetal heart rate returns to the baseline heart rate
  - How long they have been present for
  - Whether they occur with over 50% of contractions (defined as repetitive)
  - The presence or absence of shouldering
  - The variability within the deceleration.
-

- **Regard the following as concerning characteristics of variable decelerations:**
    - Lasting more than 60 seconds
    - Reduced variability within the deceleration
    - Failure or slow return to baseline fetal heart rate
    - Loss of previously present shouldering.
    - Describe decelerations as 'early', 'variable' or 'late'.
    - Include CTG categorization as part of the full assessment of the condition of the woman and baby. Be aware categorization is a tool which quickly communicates the current state of the CTG and should be used together with antenatal and intrapartum risk factors, to assess changes over time.
- **Special considerations for cardiotocography traces in the second stage of labour**
    - Consider that interpretation of CTG traces in the second stage of labour is more challenging than in the first stage of labour. Have a lower threshold for seeking a second opinion or assistance.
    - Ensure the fetal heart rate is differentiated from the maternal heart rate at least once every 5 minutes. Consider monitoring the baby with a fetal scalp electrode if there is concern about confusing the heart rates, but if this cannot be achieved expedite birth.
    - In the second stage of labour:
        - If fetal heart rate accelerations are recorded, be aware that these are most likely to be maternal pulse
        - If fetal heart rate decelerations are recorded, look for other signs of hypoxia (for example, a rise in the baseline fetal heart rate or a reduction in variability).
- Consider that onset of hypoxia is both more common and more rapid in the active second stage of labour. Take an increase in the baseline fetal heart rate of 20 beats a minute or more from the start of labour or since the last review an hour ago as a red feature in active second stage labour.
- If CTG concerns arise in the active second stage of labour:
    - Obtain an obstetric review
    - Consider discouraging pushing and stopping any oxytocin infusion to allow the baby to recover, unless birth is imminent, agree and document a clear plan with time limits for the next review.
- **Differentiate between the maternal and fetal heartbeats hourly, or more often if there are any concerns.**
    - If there are concerns about whether the maternal heart rate is being heard rather than the fetal heart rate, discuss with the woman the methods available to differentiate and support her decision on which method to use. Options include:
    - Fetal heart rate auscultation with a Pinard stethoscope
    - Bedside ultrasound scanning
    - Continuous maternal heart rate monitoring (using a pulse oximeter or the facility on the CTG equipment)

- Fetal heart rate detection using a fetal scalp electrode which is attached to the baby's head (but be aware this may detect maternal heart rate if there is no fetal heartbeat, so should always be used in conjunction with maternal heart rate monitoring)
- Simultaneous palpation of the woman's pulse while listening to the fetal heart rate.
- Be aware that it is particularly important to confirm the fetal heart rate in the second stage of labour, when it is easier to mistakenly auscultate maternal rather than fetal heart rate.
- If concerns about differentiation between the maternal and fetal heart rate remain, or if a fetal heart cannot be heard, obtain an urgent review by an obstetrician or senior midwife. Ensure that the CTG trace is of high quality and, if not, act to improve the trace (for example, by repositioning the tocodynamometer, the transducer or by using a fetal scalp electrode).

- **Category of fetal monitoring - action**
  - When reviewing CTG traces:
    - Evaluate changes on traces over time to ascertain changes in the baby's condition
    - Document any changes in the CTG trace from the previous review
    - Review the changes alongside any existing and new intrapartum risk factors
    - Think about the possible reasons for any changes, and take these and the whole clinical picture into account when planning ongoing care.
    - Making care decisions based on the cardiotocography trace
  - Assess fetal well being every hour, considering antenatal and intrapartum risk factors, in conjunction with interpretation of the CTG trace. Take the whole clinical picture into account when making decisions on how to manage the labour, including maternal observations, contraction frequency and labour progress.
  - Discuss with the woman and her birth companion(s) what is happening, considering her individual circumstances and preferences, and support her decisions.

Table 3.5: Category and action

Category	Action
Category I Electronic Fetal Monitoring (EFM) tracings are deemed normal and do not indicate fetal acidemia. The solutions include:	• Using the same monitoring approach, whether it's Scalp Stimulation Assessment (SIA) or EFM, • Evaluating the tracing frequently, • Assessing the case clinically and any underlying causes, • Modifying the management if the tracing shifts to Category II or III.

Category II EFM tracings may indicate distress in the fetus; it is advised to:	• Assess the tracing, • Implement necessary corrective actions as needed, and subsequently reassess. • If not addressed quickly, these tracings can quickly develop into Category III tracings. • When dealing with Category II tracings, clinical Aattention should take into account gestational age, fetal growth conditions (such as IUGR), maternal history, co-existing health issues, the progress of labor, and the resources and skilled professionals available for response.
Category III EFM tracings Category III Electronic Fetal Monitoring (EFM) tracings are deemed abnormal and indicative of an imbalance acid-base status at the time they are evaluated. Such tracings necessitate immediate assessment and intervention to rectify fetal acidemia and mitigate the risks of neonatal encephalopathy, cerebral palsy, and neonatal acidosis. managements may include, when appropriate:	- Providing oxygen, - Providing an Intravenous fluid, - Change the woman position, - Halting uterine stimulants, - Managing the decrease in blood pressure. • If the above measures didn't correct the tracing, immediate delivery should be considered. The decision-to-incision • Interval should be the one that best integrates maternal and fetal risks and benefits. The standard rule of 30 minutes from decision-to-incision, although used frequently, has not been shown to reduce adverse neonatal outcomes. • Getting ready for delivery, creating a timeline for delivery, and carrying out intrauterine resuscitation techniques are crucial. • If tracings do not improve with appropriate corrective maneuvers, prompt delivery of the fetus is indicated. • Considerations in preparing for an operative delivery in the presence of a Category III tracing should be made judiciously and expeditiously. • Furthermore, delivering a fetus immediately with an undetermined duration of a Category III tracing might not enhance outcomes if the fetus suffered from hypoxic injury.

- **If the CTG trace is categorized as Category I:**
  - Continue CTG (unless it was started because of concerns arising from intermittent auscultation and there are no ongoing antenatal or intrapartum risk factors) and usual care continue to perform a full risk assessment at least hourly and document the findings.
- **If the CTG trace is categorized as Category II and there are no other concerning risk factors:**
  - Perform a full risk assessment, including a full set of maternal observations, considering the whole clinical picture, and document the findings note that if accelerations are present then fetal acidosis is unlikely if the CTG trace was previously normal, consider possible underlying reasons for the change and undertake conservative measures as indicated.
- **If the CTG trace is categorized as Category II and there are additional intrapartum risk factors such as slow progress, sepsis or meconium:**
  - Perform a full risk assessment, including a full set of maternal observations, considering the whole clinical picture, and document the findings consider possible underlying causes, and undertake conservative measures as indicated obtain an urgent review by an obstetrician or a senior midwife consider:
  - Fetal scalp stimulation, or expediting birth.
- **If the CTG trace is categorized as Category III:**
  - Obtain an urgent review by an obstetrician and a senior midwife
  - Exclude acute events (for example, cord prolapse, suspected placental abruption or suspected uterine rupture) that need immediate intervention perform a full risk assessment, including a full set of maternal observations, considering the whole clinical picture, and document the findings consider possible underlying causes and undertake conservative measures as indicated.
- **If the CTG trace is still pathological after implementing conservative measures:**
  - Obtain a further urgent review by an obstetrician and a senior midwife
  - Evaluate the whole clinical picture and consider expediting birth if there are evolving intrapartum risk factors for fetal compromise, have a very low threshold for expediting birth.
- **If there is an acute bradycardia, or a single prolonged deceleration for 3 minutes or more:**
  - Urgently seek obstetric review
- **If there has been an acute event (for example, cord prolapse, suspected placental abruption or suspected uterine rupture),**
  - expedite the birth
- **Consider possible underlying causes and undertake conservative measures as indicated to prepare for an urgent birth, including a request for pediatric or neonatal support.**
  - Expedite the birth if the acute bradycardia persists for 9 minutes, or less if there are significant antenatal or intrapartum risk factors for fetal compromise. If the fetal heart rate recovers at any time up to 9 minutes, reassess any decision to expedite the birth, but consider other antenatal and intrapartum risk factors and discuss this with the

woman.

- If a decision is made to expedite birth, ensure the time at which urgent review was sought, and the time the decision was made, are documented.

- **Underlying causes and conservative measures for category II**
  - If there are any concerns about the baby's wellbeing, be aware of the possible underlying causes and start 1 or more of the following conservative measures based on an assessment of the most likely cause(s):
  - Maternal position (as this can affect uterine blood flow and cord compression), encourage the woman to mobilize, or adopt an alternative position, and to avoid being supine
  - **Hypotension:**
    - Do not offer intravenous fluids to treat fetal heart rate abnormalities unless the woman is hypotensive or has signs of sepsis if the woman is hypotensive secondary to an epidural top-up, start intravenous fluids, move her to a left lateral position and call an anesthetist to review
  - **Excessive contraction frequency:**
    - Reduce contraction frequency by reducing or stopping oxytocin if it is being used
    - Offer a tocolytic drug (a suggested regimen is subcutaneous terbutaline 0.25 mg).
  - Do not offer maternal facial oxygen therapy as part of conservative measures because it may harm the baby. However, it can be used if it is given for maternal issues such as hypoxia, or as part of preoxygenation before a potential anaesthetic.

Fetal Scalp Stimulation (FSS)

- If the CTG trace is suspicious with antenatal or intrapartum risk factors for fetal compromise, then consider digital fetal scalp stimulation. If this leads to an acceleration in fetal heart rate and a sustained improvement in the CTG trace, continue to monitor the fetal heart rate and clinical picture.
- Be aware that the absence of an acceleration in response to fetal scalp stimulation is a worrying sign that fetal compromise may be present, and that expedited birth may be necessary.

Fetal Blood Sampling (FBS)

- There has been no high quality RCT to show the impact CTG with or without FBS has on fetal outcomes and intervention rates.
- FBS should be performed in the left lateral position.
- The FBS results and any actions taken should be written in the labour record and the blood gas analyzer print-out should also be secured in the labour record.
- FBS should be considered:
  - In the presence of a persistent pathological CTG trace despite conservative measures above, unless there is clear evidence of acute compromise or vaginal delivery can be expedited safely.
  - When prioritizing multiple cases on labour ward.

- FBS should NOT be undertaken:
  - Where there is clear evidence of acute fetal compromise (e.g. prolonged deceleration greater than 3 minutes).
  - All scalp pH estimations should be interpreted considering the previous pH measurement, the rate of progress in labour and the clinical features of the mother and baby.

Table 3.6: Fetal scalp blood sampling

pH	Interpretation	Action
≥7.25	**Normal**	• Repeat sample no more than 60 minutes later if this is still indicated by the CTG trace, or sooner if there are further abnormalities (e.g. meconium appears)
7.21-7.24	**Borderline**	• Repeat sample no more than 30 minutes later if this is still indicated by the CTG trace, or sooner if there are further abnormalities (e.g. meconium appears)
≤7.20	**Abnormal**	• Consultant obstetric advice should be sought. • Delivery within 30 minutes is indicated

- If the CTG trace remains unchanged and the FBS result is stable after the second test, a third sample may be deferred unless additional abnormalities develop on the trace.
- Where a third FBS is considered necessary, a consultant obstetric opinion should be sought.
- If it is technically impossible to obtain a satisfactory sample, but there is an accelerative trace associated with scalp stimulation, then the likelihood of significant fetal acidosis is low.
- The time taken to take an FBS needs to be considered when planning repeat samples.
- Contraindications to fetal blood sampling include:
  - Maternal infection (e.g. HIV, hepatitis viruses and herpes simplex virus).
  - Fetal bleeding disorders (e.g. haemophilia).
  - Prematurity (less than 34 weeks).

Documentation of the FHR tracing

- The following should be included in the recording of the FHR tracing and classification during labor:
  - FHR information, such as baseline rate, variability, periodic variations, and classification
  - Features of uterine activity (regularity, time frame, extent, and resting tone) as determined by palpation or a pressure transducer
  - Particular steps performed in response to variations in uterine activity or FHR
- Other maternal observations and assessments
- Maternal and fetal responses to interventions

- Subsequent return to normal findings
- Pertinent communication with other care providers.

Record keeping for CEFM (fetal monitoring)

- Make sure that date and time clocks on the cardiotocography monitor are set correctly
- Ensure the recording or paper speed is set at 1 cm a minute and that adequate paper is available
- Label traces with the woman's name, date of birth, hospital number or NHS number and pulse at the start of monitoring, and the date of the CTG.
- Individual units should develop a system for recording relevant intrapartum events (for example, vaginal examination and siting of an epidural) in standard notes and/or on the cardiotocography trace.
- Keep cardiotocography traces for 25 years and, if possible, store them electronically.
- In cases where there is concern that the baby may have sustained a possible brain injury, photocopy cardiotocography traces (if they are not available electronically) and store them indefinitely in case of possible adverse outcomes.
- Ensure that tracer systems are available for all cardiotocography traces if stored separately from the woman's records.
- Develop tracer systems to ensure that cardiotocography traces removed for any purpose (such as risk management or for teaching purposes) can always be located.

Table 3.7: Category of the Fetal Heart Rate Tracings

Category	Features
Category I Fetal Heart Rate Tracings	All of the following must be present in category I tracings, which are typical tracings that are highly indicative of normal fetal acid-base status at the time of observation: • A point of reference of 110–160 beats per minute • Baseline variability is moderate. • Lack of varied or late decelerations • Early decelerations are either absent or present. • The existence or lack of accelerations (provoked or unintentional)

Category II Fetal Heart Rate Tracings	Category II FHR tracings consist of all FHR tracings that are not classified as Category I or Category III. These Category II tracings can make up a important portion of those observed in clinical practice. Instances of Category II FHR tracings include any of the following:
	• Baseline rate
	  • Decreased HR without absent baseline variability
	  • Increased HR
	• Baseline FHR variability
	  • Minimal baseline variability
	  • Lack of baseline variability not associated with recurrent decelerations
	  • Marked baseline variability
	• Accelerations
	  • Lack of induced accelerations following fetal stimulation
	• Periodic or episodic decelerations
	  • frequent decelerations with low or average baseline variability
	  • progressive deceleration for more than 2 minutes but less than 10 minutes.
	  • frequent late decelerations with average baseline variability
	  • Variable decelerations may also display characteristics like a gradual return to the baseline, 'overshoots,' or 'shoulders.'

Category III Fetal Heart Rate Tracings	• Category III tracings are predictive of abnormal fetal acid-base status at the time they are observed. These require prompt evaluation and expedient interventions to address the pattern. Category III FHR tracings include either:
	  • Absent baseline FHR variability and any of the following:
	  • Recurrent late decelerations
	  • Recurrent variable decelerations
	  • Bradycardia
	  • Sinusoidal pattern

Table 3.8: Category and action

Category	Features
Category I Electronic Fetal Monitoring (EFM) tracings are deemed normal and do not indicate fetal acidemia. Recommendations include:	• Maintain the ongoing monitoring, whether it's SIA or EFM, • Periodically assess the tracings, • Evaluate the clinical status and any underlying risk factors, • Adjust the management approach if the tracings shift to a Category II or III.
Category II Electronic Fetal Monitoring (EFM) tracings may indicate fetal compromise. The recommendations include:	• Evaluating the tracing, • performing necessary modified measures when indicated, and then reassessing. • Without prompt intervention, these tracings can quickly progress to Category III. • Clinical management of Category II tracings should consider gestational age, fetal growth status (e.g., Intrauterine Growth Restriction), maternal medical and obstetric conditions, comorbidities, the progress of labor, and the existence of responders and resources.

Table 3.9: Management of Category II Fetal Heart Rate Tracings: Clarifications for Use of Algorithm 3.I

• Variability refers to the predominant baseline FHR pattern (marked, moderate, minimal, absent) during a 30-minute evaluation period, as defined by NICHD.
• Marked variability is considered the same as moderate variability for purposes of this algorithm.

• Significant decelerations are defined as any of the following:
  • Variable decelerations lasting longer than 60 seconds and reaching a nadir more than 60 bpm below baseline.
  • Variable decelerations lasting longer than 60 seconds and reaching a nadir less than 60 bpm regardless of the baseline.
  • Any late decelerations of any depth.
  • Any prolonged deceleration, as defined by the NICHD. Due to the broad heterogeneity inherent in this definition, identification of a prolonged deceleration should prompt discontinuation of the algorithm until the deceleration is resolved.

- Application of algorithm may be initially delayed for up to 30 minutes while attempts are made to alleviate category II pattern with conservative therapeutic interventions (eg, correction of hypotension, position change, amnioinfusion, tocolysis, reduction or discontinuation of oxytocin).
- Once a category II FHR pattern is identified, FHR is evaluated, and an algorithm is applied every 30 minutes.
- Any significant change in FHR parameters should result in reapplication of the algorithm.
- For category II FHR patterns in which the algorithm suggests delivery is indicated, such delivery should ideally be initiated within 30 minutes of decision for cesarean.
- If at any time tracing reverts to category I status, or deteriorates for even a short time to category III status, the algorithm no longer applies. However, the algorithm should be reinstituted if category I pattern again reverts to category II.
- In fetus with extreme prematurity, neither significance of certain FHR patterns of concern in more mature fetus (eg, minimal variability) or ability of such fetuses to tolerate intrapartum events leading to certain types of category II patterns are well defined. This algorithm is not intended as a guide to management of fetus with extreme prematurity.
- Algorithm may be overridden at any time if, after evaluation of the patient, the physician believes it is in the best interest of the fetus to intervene sooner.

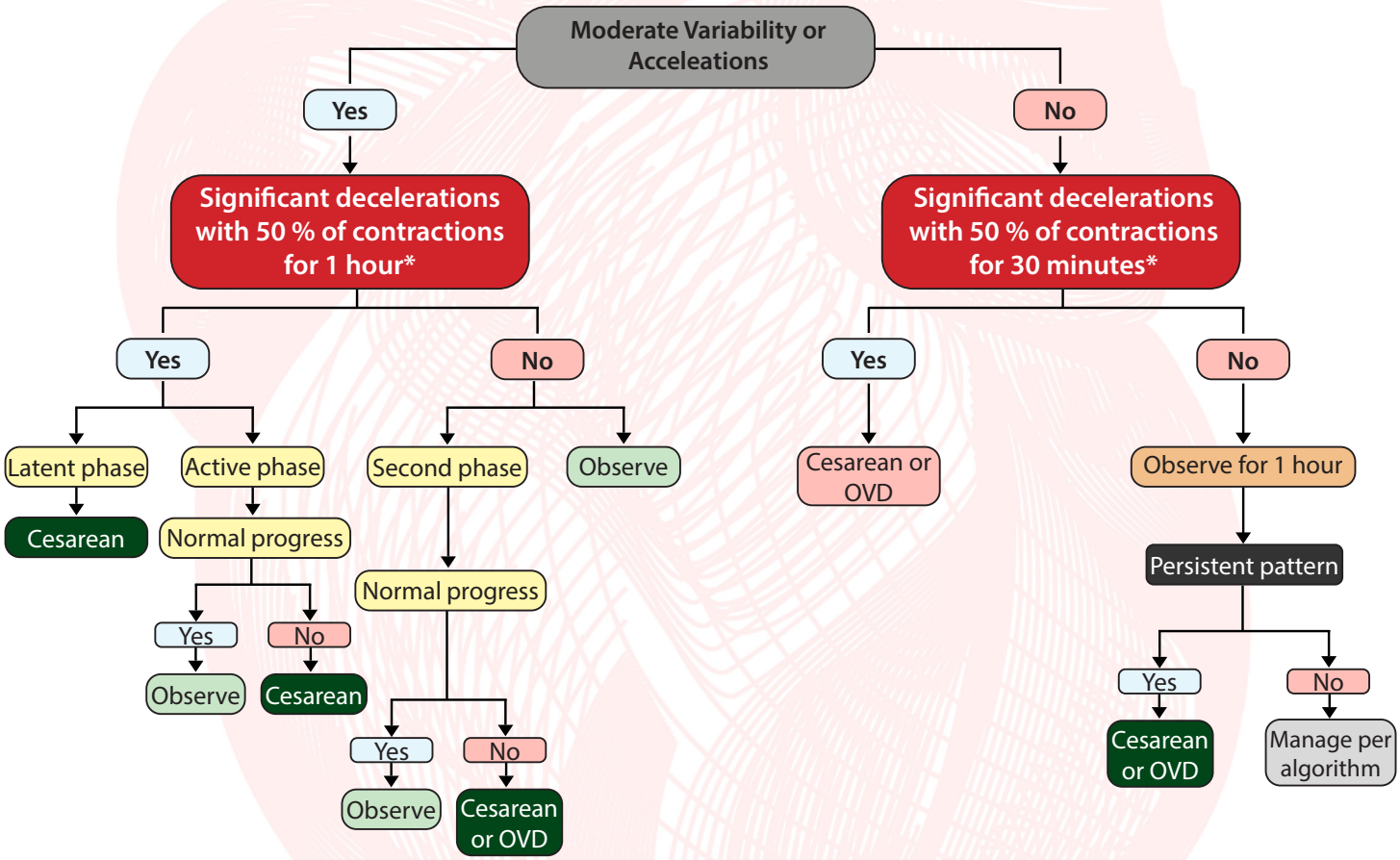
Table 3.10: Resuscitative interventions for Category II / III Tracings

Outcime	Related FHR Changes	Expected Interventions

Increased blood flow to uteroplacenta	Frequent late decelerations
	Progressive decelerations
	Reduce or lack FHR variability
		• Side lying position
		• Deliver O2
		• Giving fluid bolus
		• Decrease or stop the uterine stimulants
		  • D/C oxytocin or cervical ripening drugs
		  • Provide tocolytic medications
		  • Improve the maternal BP
		  • Be ready to give Epi If the recent epidural analgesia and decreased BP with new late decelerations are exist
		• Modify maternal pushing efforts

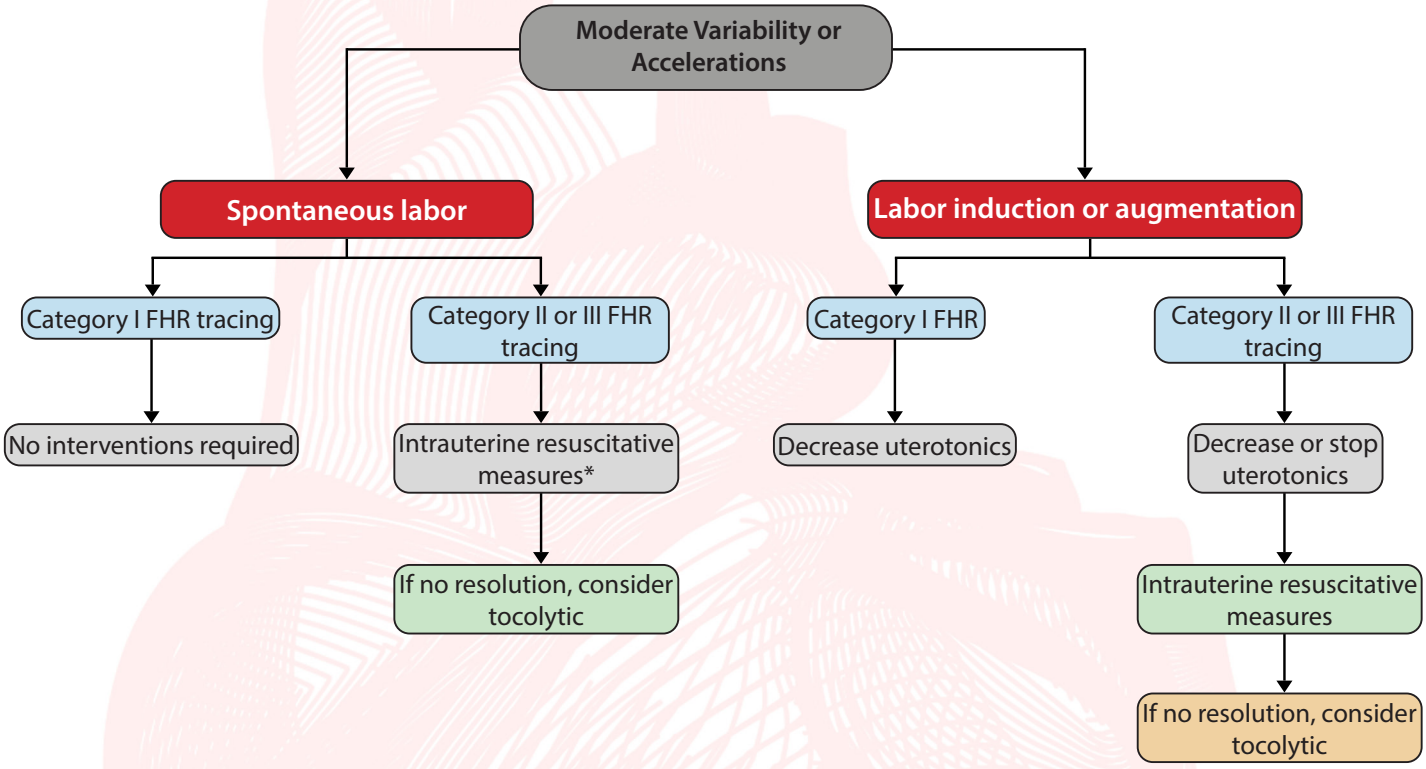
Decrease uterine activity	Tachysystole with Category II or Category III tracing	• Side lying position • Deliver O2 • Giving fluid bolus • Decrease or stop the uterine stimulants • Provide tocolytic medications
Umblical cord compression reduction	Recurrent variable decel-erations Prolonged de-celerations Bradycardia	• Ghang the position until FHR improved • Stop uterine stimulants • Start amnioinfusion if variable decelerations reoccurred • Modify maternal expulsive (pushing) efforts • Assess the compression of the cord and elevate present-ing part until operative delivery occurs.

Algorithm 3.1: Management of Category II Fetal Heart Rate Tracings



*That have not resolved with additional measures, which may include provide O2, position changes, deliver bolus, Improving BP, decrease or stop of uterine stimulation, uterine relaxant, amnioinfusion, and/or changes in second stage breathing and pushing techniques.

Algorithm 3.2: Uterine Tachysyatole



*** Intrauterine resuscitative measures**
Change position ,IVF bolus , Improve BP, D/C or decrease the uterine stimulation, uterine relaxant, amnioinfusion, and/or changes in second stage breathing and pushing techniques.

Chapter Four

Medical complications during Pregnancy

Learning Objectives:

Upon completing this chapter, participants will be able to:

1. Identify and describe common medical complications during pregnancy, such as, gestational diabetes, hypertension disorders (e.g., preeclampsia, eclampsia) and hyperemesis gravidarum.
2. Understand the pathophysiology, early signs and symptoms and risk factors of common medical emergencies (e.g., obesity, advanced maternal age, multiple gestations).
3. Diagnosis and Screening by learning appropriate screening methods for complications, including lab tests, imaging, and routine prenatal assessments.
4. Develop knowledge of management protocols for complications.
5. Understand the potential impact of complications on maternal and fetal outcomes, including preterm birth, fetal growth restriction, or maternal morbidity.

Introduction

Medical complications during pregnancy can affect both the mother and the developing fetus, sometimes requiring specialized care. Below are some common and serious complications that can arise during pregnancy:

1. Gestational Diabetes Mellitus:

Gestational Diabetes Mellitus (GDM) is defined as Impaired Glucose Tolerance (IGT) with onset or first recognition during pregnancy.Worldwide, one in 10 pregnancies is associated with diabetes, 90% of which are GDM. Moreover, women with GDM and their offspring are at increased risk of developing type 2 diabetes later in life.

Carbohydrate Metabolism in Pregnancy:

- **Insulin Resistance**
  - Production of human placental lactogen, cortisol, estriol and progesterone have an anti insulin effect.
  - Increased destruction of insulin by kidney and placenta (insulinase)
- **Increased Lipolysis.**
  - Mother utilizes fatty acids for her caloric needs sparing glucose for the fetus.
- **Changes in Gluconeogenesis**
  - Alanine and other amino acids are the major gluconeogenic source in the mother used by the fetus.

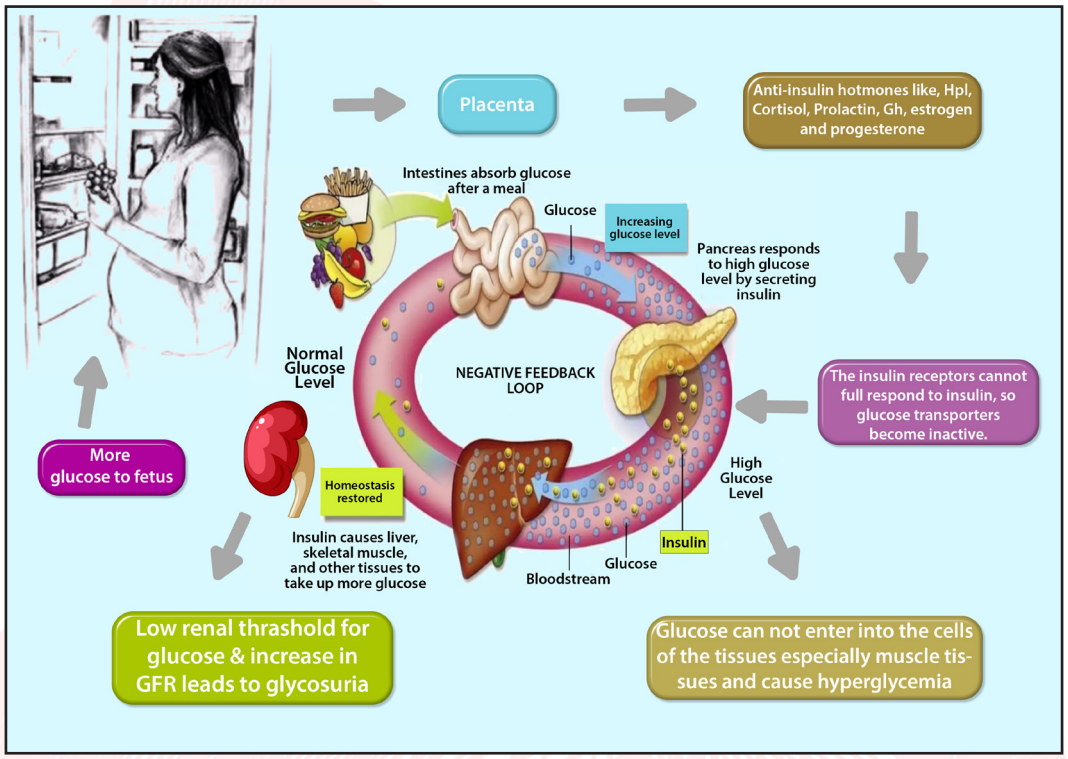


Figure 4.1: Carbohydrate Metabolism in Pregnancy

Screening Priority

Patient is overweight with BMI of 25, and one of the following:

- Physical inactivity
- Known impaired glucose metabolism
- Previous pregnancy history of:
    - GDM
    - Macrosomia (≥ 4000 g)
    - Stillbirth
- Hypertension (140/90) mm Hg or being treated for hypertension.
- HDL cholesterol ≤ 35 mg/dl (0.90 mmol/L)
- Fasting triglyceride ≥ 250 mg/dL (2.82 mmol/L)
- Polycystic Ovary Syndrome (PCOS), acanthosis nigricans, nonalcoholic steatohepatitis, morbid obesity and other conditions associated with insulin resistance.
- Hb A1C ≥ 5.7%, impaired glucose tolerance or impaired fasting glucose
- Cardiovascular disease
- Family history of diabetes – 1st degree relative (parent or sibling)
- Ethnicity of African, Southeast Asian, Hispanic, Latina, or Pacific Islander.

Guidelines for diagnosis and management of gestational diabetes

Single step test recommended by WHO for diagnosis of GDM using a 75 gm glucose, through Oral Glucose Tolerance Test (OGTT) irrespective of the last meal with a threshold value of 2-hour BS >140 mg/dL, the Guidelines advocate for universal screening of all pregnant women at first antenatal contact. If the first test is negative, the second test should be done at 24-28 weeks of gestation, and should be repeated at 6 weeks after delivery with at least a 4 week gap between the two tests.

If she presents beyond 28 weeks of pregnancy, only one test is to be done at the first point of contact.

Maternal effects

- Polyhydramnios
- Pre-eclampsia
- Prolonged Labour
- Obstructed Labour
- Cesarean Section
- Uterine Atony
- Postpartum Hemorrhage

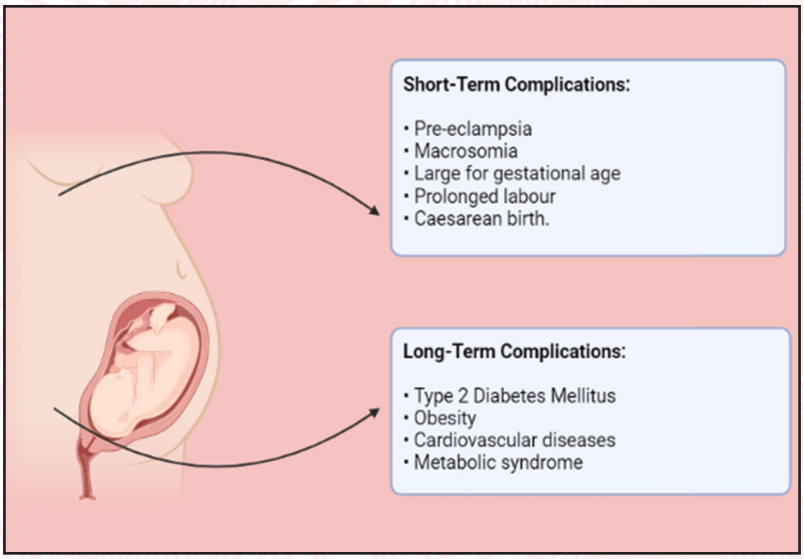


Figure 4.2: Complications of GDM

Fetal effects

- Spontaneous Abortion
- Intrauterine Death
- Stillbirth
- Congenital Malformation
- Shoulder Dystocia
- Birth Injuries
- Neonatal Hypoglycemia
- Infant Respiratory Distress Syndrome
- Hypocalcemia

- Hypomagnesemia
- Neonatal Hyperbilirubinemia

Long term sequelae

Babies born to diabetic mothers have a risk of developing, Obesity, Type 2 Diabetes, Cardiovascular disease and Impaired cognitive and motor function and Stillbirth

Risks associated with GDM:

- High birth weight
- Preeclampsia
- Increased risk of type 2 diabetes later in life.

Management:

- Blood sugar monitoring
- Diet Plan
- Anti-Diabetic medicines (insulin, oral medication)
- Pregnant women with GDM in whom blood sugar level is well controlled & there are no complications, should continue with antenatal visits as per high-risk pregnancy protocol or as recommended by the physician (at least once monthly).
- Monitor for abnormal fetal growth (macrosomia /growth restriction) and polyhydramnios at each ANC visit.
- Pregnant women with GDM to be diligently monitored for hypertension in pregnancy, proteinuria, and other obstetric complications.

Labour and delivery:

- **Timing of delivery:**

  GDM pregnancies are associated with delay in lung maturity of the fetus, so routine delivery prior to 39 weeks is not recommended.

  If a pregnant woman with GDM with well controlled blood sugar has not already delivered spontaneously, induction of Labour should be scheduled at or after 39 weeks pregnancy.

  In pregnant women with GDM with poor blood sugar control, those with risk factors like hypertensive disorder of pregnancy, previous stillbirth & other complications should be delivered earlier.

  The timing of delivery should be individualized by the obstetrician accordingly and the vaginal delivery should be preferred and Lower Segment Cesarian Section (LSCS) should be done for obstetric indications only.

  In case of fetal macrosomia (estimated fetal weight >4 kg) consideration should be given for a primary caesarean section at 39 weeks to avoid shoulder dystocia.

Table 4.1: DKA management protocol

A high index of suspicion is needed to recognise diabetic ketoacidosis (DKA) in pregnancy, DKA can occur with only very modest elevation of blood glucose levels in women with pre-existing or gestational diabetes. Always check blood ketone range in pregnancy is not established, outside pregnancy<1mmol/L is normal

START

1. **call for help** (obstetrician, anaesthetist, dibetic team / medical on-call if out of hours)
2. **Take blood and send for blood glucose, pH and blood hetone level**
   - Diagnose diabetic ketoacidosis if -->
     - Venous pH <7.3-and / or-HCO_3-<15 mmol/L -and-
     - Blood glucose > 11 mmol/L or known diabetic -and-
     - Blood ketones > 3mmol/L or urinary ketones> 2+
3. **Start IV fluid hydration (Box A)**
4. **Start fixed rate IV insulin infusion** at 0.1 units/kg of actual body weight/hr
   - Increasr fixed rate by 1 unit / hour if -->
     - <0.5 mmol/L fall in blood ketones per hour -or-
     - <3 mmol/L fall in blood glucose per hour -or-
     - <3mmol/L rise in venous bicarbonate per hour

   Maximum rate no more than 14 units/hour unless under diabetic team instruction if woman on own insulin pump --> discontinue woman's pump
5. **Inform wonam to continue long-acting insulin as per usual regime**
6. **Plan frequency of monitoring (maternal and fetal)**
7. **Plan frequency of blood tests (Box B)**
8. **Agree appropriate location for care (e.g., HDU)**
9. **Check for underlying cause for DKA**
   - Infection
   - Protracted vomiting
   - History of missed insulin doses
   - Insulin pump failure
   - Steroid therapy

Box A: Fluid and potassium replacement

First bag of fluid
If systolic BP <90 mmHg--> give 500 ml 0.9% sodium chloride over 15 minutes. Monitor BP and repeat if required.

If systolic BP <90 mmHg--> give 1L 0.9% sodium chloride over 1 hour.

Second bag of fluid
Replace potassium from second bag onwards, guided by venous potassium (aim K+4-5.5 mmol/L)
if K^+>5.5 mmol/L --> give 1 L 0.9% sodium chloride over 2 hours
if K^+<5.5 mmol/L --> give 1 L 0.9% sodium chloride with 40 mmol/L KCl over 2 hours. Discuss central venous assess with ICU if K^+< 3.5 mmol/L to allow more concentrated KCL administation.

When blood glucose< 14mmol/L --> give 10% glucose at 50 ml/hr to run alongside 0.9% normal saline

Subsequent fluids to be guided by blood results, observations and input/ output. MDT input is needed to guide all fluid management in women with pre-eclampsia

Box B: Fluid and potassium replacement

Blood glucose and capillary ketones - hourly
Venous bicarbonate, potassium at 1,2 and 4 hours
Electrolytes 4 hourly

2. Preeclampsia:

A serious condition marked by high blood pressure (more than or equal to 140/90 mHg) and signs of organ damage after 20 weeks of pregnancy. It can also cause other symptoms, such as severe headaches, vision changes, and upper abdominal pain. It can lead to severe consequences for both mother and baby if not managed effectively.

Not all women with preeclampsia experience all of these symptoms, Some women may only have mild symptoms, while others may experience severe complications.

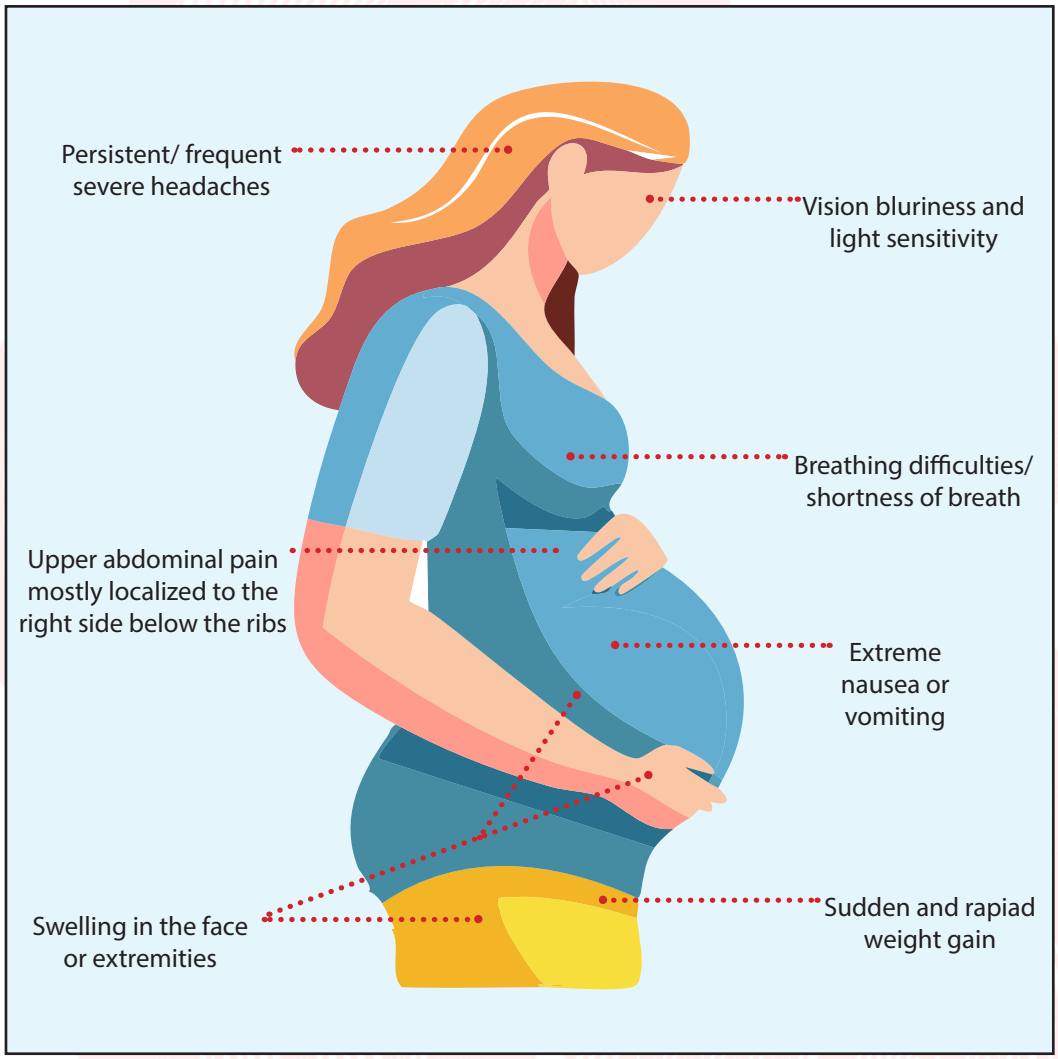


Figure 4.3: Signs and Symptoms of preeclampsia

Causes:

The exact cause of preeclampsia is unknown, but it's believed to be related to problems with the placenta, the organ that nourishes the developing baby.

Risks to the mother:

- Preeclampsia
- Eclampsia (life-threatening seizures)

- (Hemolysis, Elevated Liver enzymes and Low Platelets) syndrome (liver and blood disorders)
- Increased risk of stroke
- Organ damage

Risks to the baby:

- Premature birth
- Low birth weight
- Placental abruption (placenta detaches from the uterus)

Management:

Hypertension in pregnancy is a serious condition but can often be managed effectively with the early detection and proper treatment can significantly reduce risks for both mother and baby, the management includes the following:

- Monitoring (monitoring of blood pressure, protein levels in urine, and other tests)
- Lifestyle changes:
  - Healthy diet
  - Regular exercise
  - Stress management
- Medications to control blood pressure
- Early delivery.

Table 4.2: Eclampsia management protocol

Tonic clonic sezure in a pregnant or recently pregnant woman with known / suspected or undiagnosed pre-eclampsia. The seizures typically self-terminate after 1-2 minutes, however the woman may remain drowsy afterwards.

START

1. **Call for help** (obstetrician, midwife, anaesthetist,+/- neonatal team)
   - **Ask:** "who will be the team leader?"
   - **Team leader assigns** checklist reader and scribe
   - **Request eclapsia drug box**
2. **Airway & breathing**
   - Position woman in left lateral (recovery) position
   - If airway obstruted --> preform head titl/chin lift or jaw thrust
   - Start oxygen at 15 L/min via reservoit mask (t it rate to SpO_2 95-98%)
3. **Circulation**
   - Start continuous monitoring : SpO2 respiratory rate, 3-lead ECG and blood pressure
   - Insert wide bore IV access
   - Take bloods: FBC, U&E, clothing, LFTs,blood glucose, venous blood gas
   - If IV fluids are runnung--> stop fluids
   - Insert urinary catheter, document fluid balance
4. **Check for and treat seizures**
   - Give IV magnesium sulfate bolus and infusion **(Box A)**
   - Protect woman from trauma. Do not restrain
   - If recurrent or prolonged seizures, consider other diagnoses **(Box B)**
   - Check blood glucose
   - check neurology
5. **Check for and treat hypertension (Box C)**
6. **Plan for bith (stabilise woman's condition prior to birth)**
7. **Plan ongoing care in a suitable lacation**

Box A: Magnesium sulfate emergency regimen

Loading dose:
4g Magnesium sulfate

Maintenance infusion:

- 1g/hr magnesium sulfate IV infusion (20 mL (10 g) 50% MgS04 diluted to 50 mL with 0.9% saline, infused at 5ml/hr)
- If creatinine >90umol/L start at 0.5g/hr and re-check Mg levels in 4 hurs

Recurrent sezures:

- 2 g magnesium sulfate over 5 minutes (4 ml (2g) 50% $MgSO_4$ diluted to 10 ml with 0.9% saline)

Treatment for magnesum toxicity

- 1g calcium gluconate

Box B: Alternative diagnosis for seizure

Hypo/hyper glycaemia, hyponatraemia, epilepsy, hypoxia, hypercarbia, hypotension, intracranial bleed, cerebral vein thrombosis, space-occupyinglesion, drugs.

Urgent CT/MRI head if diagnosis remain uncertain

Box C: Treatment of severe hypertension

PO Labetalol (AVOID in women with asthma)

- 200 mg orally . Can repeat after 15-30 minutes
- Maintain with 200 mg orally TDS if good response

PO Nifedipine (if asthmatic, or labetalol is ineffective)

- 10 mg modified release orally
- Maintain with 10 mg BD if good response

IV Labetalol (5 mg/ml)(AVOID in women with asthma)

- Loading dose: 50 mg (10 mL) over 2 minutes. Can repeat every 5 minutes to a maximum of 4 doses (200 mg) if needed
- Maintenance: Start at 4 ml/hr; double rate every 20 minutes until BP controlled (max rate 32 ml/hr)

3. Hyperemesis Gravidarum

Severe nausea and vomiting leading to dehydration and weight loss, Nausea and vomiting in pregnancy is common and at best an unpleasant experience for the patient, and at worst can be life threatening. It normal starts at 4-7/40, peaks at 9/40, and finishes at 20/40. conduct a thorough history and examination looking for causes other than a high βHCG. these include:

- Abdominal pathology
- Urinary pathology
- Infections
- Drug History
- Chronic H.Pylori

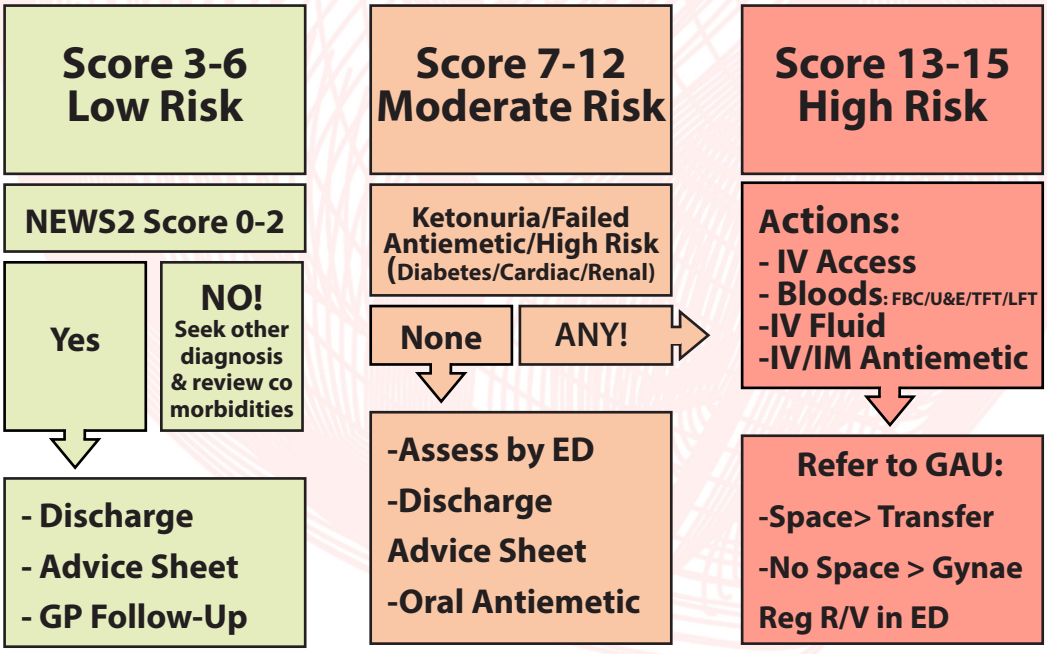
Risks:

In the short term, hyperemesis gravidarum can lead to significant weight loss due to inadequate calorie intake, as well as dehydration and electrolyte imbalance. In rare cases, vitamin deficiencies, including thiamine deficiency, can result in severe maternal morbidity or even death. Additionally, hyperemesis gravidarum heightens the risk of venous thromboembolism both before and after birth.

An objective and validated measure like the Pregnancy-Unique Quantification of Emesis (PUQE) score can be utilized to determine the severity of the condition.

Table 4.3: Pregnancy-Unique Quantification of Emesis (PUQE) score

Motherisk PUQE-24 scoring system	1	2	3	4	5
In the last 24 hours, for how long have you felt nauseated or sick to your stomach?	None	≤1 hr	2-3 hr	4-6 hr	>6 hr
In the last 24 hours have you comited or thrown up?	None	1-2	3-4	5-6	7+
In the last 24 hours how many times have you had retching or dry heaves without bringing anything up?	None	1-2	3-4	5-6	7+



GAU: Gynaecology Assessment Unit

Management:

The management of nausea and vomiting in various conditions can guide the treatment of hyperemesis gravidarum, but it's crucial to consider the safety of medications during pregnancy.

The treatment for hyperemesis gravidarum typically begins with one antiemetic medication. If this does not alleviate the nausea, it is recommended to add another antiemetic from a different class.

Clinicians should assess patients for signs of dehydration and electrolyte imbalances. If present, intravenous fluids should be administered, including 100 mg of thiamine intravenously.

Hospitalization is often required for those with significant dehydration and electrolyte issues. It may also be necessary if oral or sublingual medications are not well-tolerated or effective, or to enable parenteral or intravenous treatments. Thrombosis prophylaxis should be considered for hospitalized patients, although not all agents are safe during pregnancy. Corticosteroids are reserved for instances where conventional treatments are ineffective.

For women with severe Nausea and Vomiting of Pregnancy (NVP) or hyperemesis gravidarum (HG), a multidisciplinary approach may be needed, involving midwives, nurses, dietitians, pharmacists, endocrinologists, nutritionists, gastroenterologists, and mental health professionals, including psychiatrists.

Algorithm 4.1: Hyperemesis Gravidarum (HG) protocol

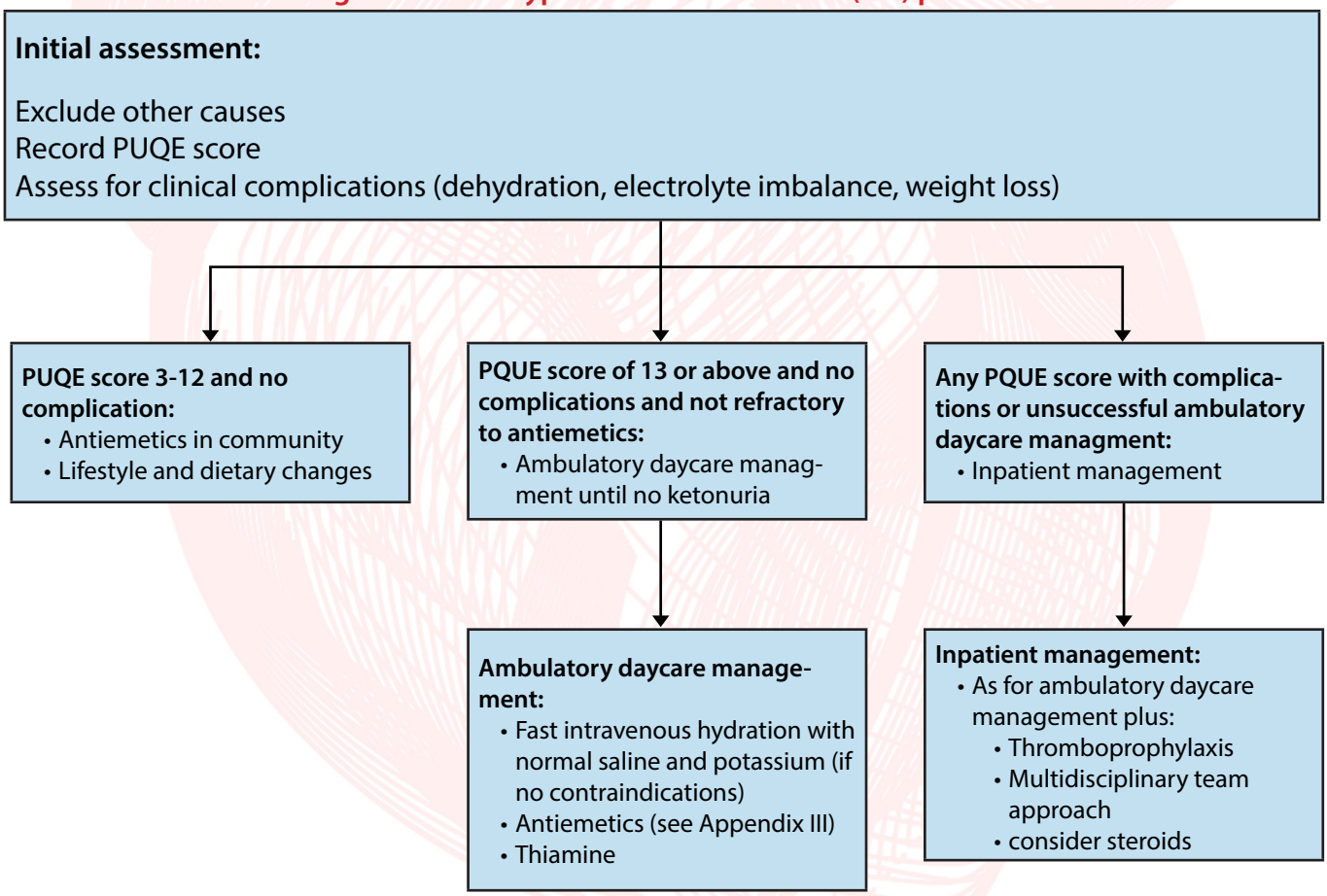


Table 4.4: Antiemetic therapies

Frist Line	• Cyclizine 50 mg PO, IM or IV 8 hourly • Prochlorperazine 5-10 mg 6-8 hourly PO; 12.5 mg 8 hourly IM/IV; 25 mg PR daily • Promethazine 12.5 - 25 mg 4-8 hourly PO, IM, IV or PR • Chlorpromazine 10-25 mg 4-6 hourly PO, IV or IM; or 20-100 mg 6-8 hourly PR
Secound Line	• Metoclopramide 5-10 mg 8 hourly PO, IV or IM (maximum 5 days' duration) • Domperidone 10 mg 8 hourly PO; 30-60 mg 8 hourly PR • Ondansetron 4-8 mg 6-8 hourly PO; 8mg over 15 minutes 12 hourly IV
Third Line	• Corticosteroids: hydrocortisone 100 mg twice daily IV and once clinical improvement occurs, convert to prednisolone 40-50 mg daily PO, with the dose gradually trpered unit the lowest maintrenance dose that controls the sympotoms is reached
IM intramuscular; **IV** intravenous; **PO** by mouth; **PR** by rectum.	

4. Placenta Previa

Introduction

- Determining the placental location is a primary goal of routine mid-pregnancy (18+6 to 21+6 weeks of gestation) transabdominal obstetric ultrasound examinations. Placenta previa is initially identified using a Transabdominal Scan (TAS) as a placenta within the lower uterine segment, graded by its proximity or distance to the internal os of the uterine cervix.
- Grade I, or minor previa, is when the lower edge is inside the lower uterine segment; grade II, or marginal previa, is when the lower edge reaches the internal os; grade III, or partial previa, occurs when the placenta partially covers the cervix; and grade IV, or complete previa, is when the placenta fully covers the cervix.
- Grades I and II are often termed 'minor' placenta previa, while grades III and IV are 'major' placenta previa. The advent of Transvaginal Scanning (TVS) in the 1980s enabled more precise measurement of the distance between the placental edge and the internal os.
- A recent American Institute of Ultrasound in Medicine (AIUM) workshop recommended ceasing the use of 'partial' and 'marginal' terms, advising 'placenta previa' be used when the placenta is directly over the internal os.
- For pregnancies beyond 16 weeks of gestation, the placenta is reported as 'low lying' if the edge is less than 20 mm from the internal os, and 'normal' if it is 20 mm or more from the internal os on TAS or TVS. This classification aims to better define the risks of perinatal complications, such as antepartum hemorrhage and major postpartum hemorrhage (PPH), and could improve the management of placenta previa. Recent guidelines refer to the AIUM classification, with the incidence of placenta previa at term estimated at 1 in 200 pregnancies.
- The placenta covers the cervix, potentially causing bleeding during pregnancy.

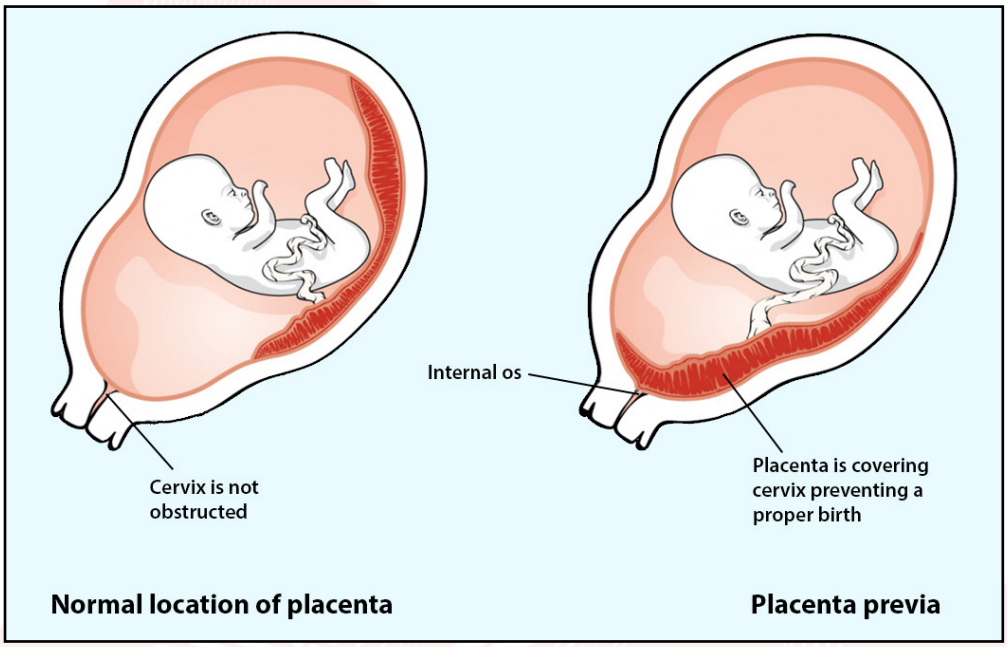


Figure 4.4: Placenta Previa

Risks

Neonatal Prognosis

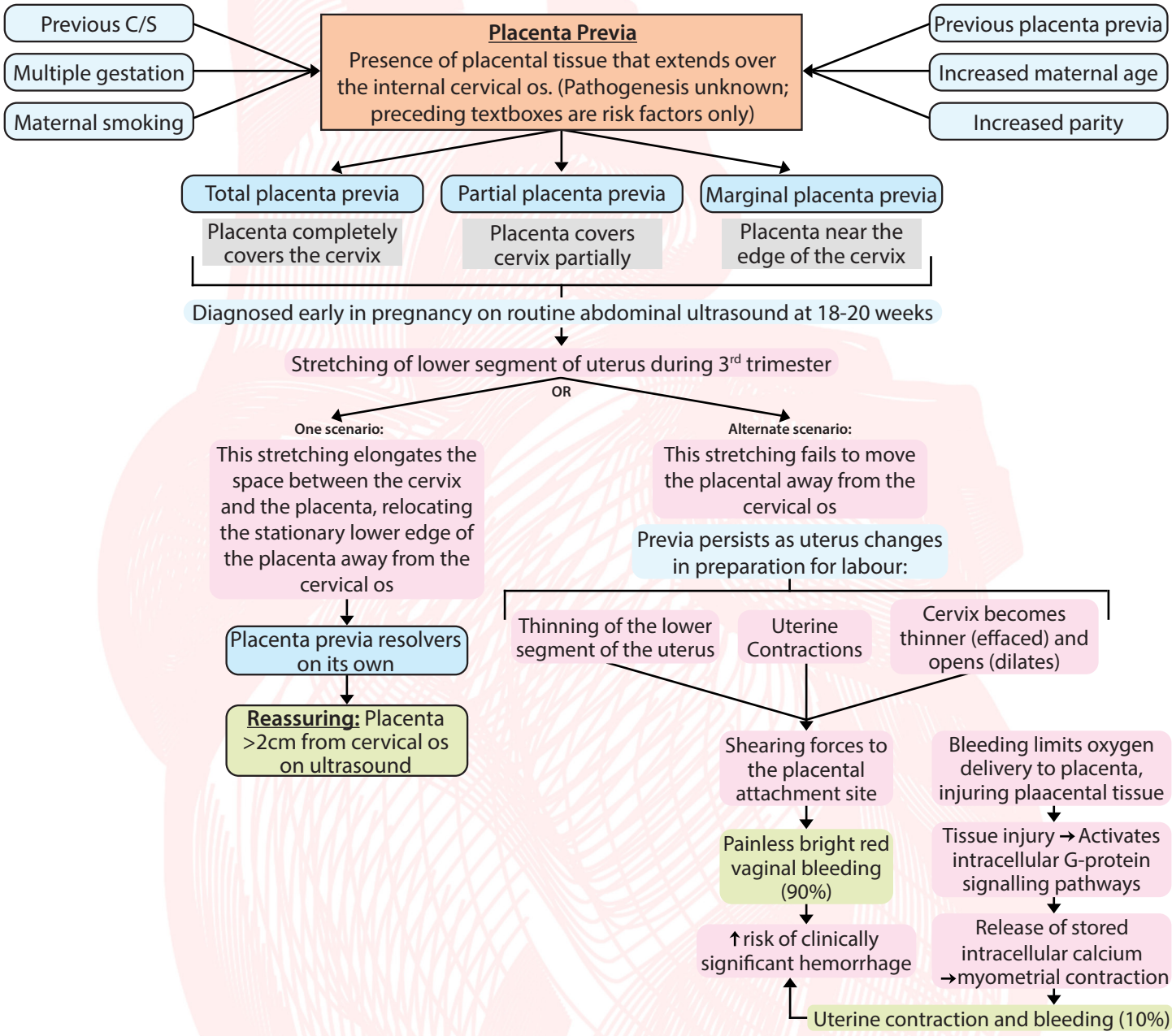
Neonatal mortality and morbidity rates are three to four times higher with placenta previa, primarily due to preterm delivery. Neonates face a higher risk of preterm birth, reduced birth weight, lower APGAR scores, and a greater likelihood of respiratory distress syndrome.

Maternal Prognosis

Approximately 90% of placenta previa cases are resolved through delivery. Jing et al. reported that women with anterior placentas experience worse prognostic outcomes and are more prone to significant blood loss and increased rates of hysterectomy compared to other placental locations. These complications are often due to the placenta attaching to a previous uterine incision, leading to PAS, and incisions made through the placenta.

Patients with confirmed placenta previa have a risk of requiring blood transfusions, sustaining injuries to adjacent organs, undergoing cesarean hysterectomy (0.2%), needing intensive care admission, and facing mortality. The risk increases with subsequent pregnancies.

Placenta Previa: Pathogesis and Clinical Findings



Note on Physical Exam:

- Do not perform bimanual exam during vaginal bleed until placenta previa is ruled out (2nd trimester onwards)
- If patient presents with blwwding, a pelvic exam = risk of damaging placenta more bleeding
- Use transvaginal ultrasound to confirm location of placenta

Management:

Pelvic rest and cesarean delivery if necessary.
Women with bleeding should have sonographic examination prior to digital examination to confirm/negate the presence of a placenta previa. Digital vaginal examination may provoke catastrophic hemorrhage and should not be performed.

Consider serial growth scans in patients with a placenta previa who have had hemorrhagic episodes.
It is recommended to conduct a follow-up ultrasound (if a low lying placenta or previa is detected during the midtrimestrer) between 28-30 weeks to evaluate whether the lower uterine segment has cleared. When a previa or low-lying placenta is found in the midtrimester, follow-up ultrasound at 28-30 weeks should be performed to assess for clearing of the lower uterine segment. If it is found there is continued presence of a previa/ L-L placenta, final ultrasound should be performed at 36-37 weeks to aid in delivery planning.

Management of acute hemorrhagic episode:

Initial assessment of maternal stability via vital signs, physical examination, complete blood count and coagulation studies, a fall in the fibrinogen is a concerning initial marker for the development of a coagulopathy and in the presence of active bleeding should increase consideration for delivery.

Placement of one to two peripheral IV catheters or a central line, depending upon maternal stability, ease of IV access and probable need for surgical management and/or massive transfusion.

Preparation of blood products as deemed medically necessary, TXA crosses the placenta and safety prior to fetal delivery is unknown. Can be considered in patients with active hemorrhage following delivery.

Gestational age is 20-24 weeks:

- Initial assessment of fetal status with fetal heart tones.
- Ultrasound for confirmation of dates, fetal size and placental location as clinically indicated, and dependent upon maternal stability.
- Continued admission for concerns for maternal stability.

Gestational age is > 24 weeks:

- Initial assessment and ultrasound as above.
  - Continuous fetal monitoring.
  - Administration of betamethasone course, if not previously given or if a candidate for rescue dose.
  - Consider immediate cesarean delivery for maternal instability, nonreassuring fetal status.
  - Consider tocolytics if the patient is contracting, hemodynamically stable, and is a candidate for Antenatal Corticosteroids (ANCS) <34 weeks, In general, prolonged tocolytic therapy is not recommended. Tocolytics may be considered in certain circumstances in the setting of maternal stability at early gestational ages.
  - For patients experiencing their first or second bleed, patients should remain under inpatient observation for at least 48 hours after their bleeding episode, Duration of hospitalization may be individualized based upon severity of the hemorrhagic episode.
  - Upon discharge patients should be advised regarding pelvic rest precautions. Pelvic rest/ bedrest

are not known to decrease recurrent hemorrhagic episodes or prolong pregnancy but may be considered on an individualized basis.

- Patients who have experienced three bleeding episodes should remain hospitalized until delivery.

Delivery Indications:

- Maternal instability, regardless of gestational age.
- Acute hemorrhagic episode at greater than 34 weeks.
- ACOG recommends delivery for placenta previa at 36 0/7- 37 6/7 weeks.

Mode of Delivery:

- Patients with a placenta previa should be delivered via cesarean section. Care should be taken at the time of delivery to avoid transaction of the umbilical cord at the cord insertion to prevent massive fetal hemorrhage. Ultrasound prior to delivery may assist in mapping of the placenta and cord insertion to avoid this complication.

5. Placental Abruption

Placental abruption is a significant complication during pregnancy, characterized by the complete or partial separation of the placenta before delivery, leading to bleeding within the decidua basalis. Typically, a classical abruption happens when a spiral artery's vascular rupture causes a hematoma that detaches the placenta from the decidua.

Although not included in the strict definition, it's noteworthy that more than half of placental abruptions occur preterm. Placental abruption affects 0.4-1% of all pregnancies, a rate substantial enough to make it the primary cause of vaginal bleeding in the latter half of pregnancy.

The incidence of placental abruption appears to be rising, potentially due to heightened blood pressure, a rise in stimulant drug abuse, and more frequent errors in ultrasound detection.

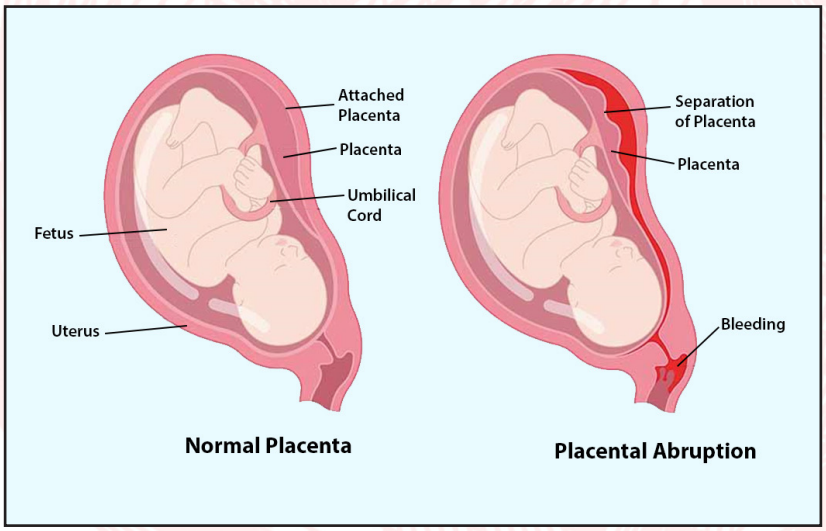


Figure 4.4: Placenta Abruption

Risk factors for placental abruption include abdominal trauma, use of stimulants such as cocaine, amphetamines, or smoking, increased BP, thrombophilia, chorioamnionitis, oligohydramnios, iron deficiency anemia, premature rupture of membranes, uterine fibroids, and a history of abruption in a previous pregnancy.

Management: Hospitalization, monitoring, and possibly early delivery.

Table 4.5: Antepartum Haemorrhage

Blood loss from or into genital tract from 24+0 weeks pregnant. Minor APH <50ml. Major APH 50-1000ml with no shock. Massive APH> 1000ml and / or signs of clinical shock. Causes of APH include placenta praevia, abruption, uterine rupture, vasa praevia

START

1. **Call for help** (obstetrician, midwife, anaesthetist,+/- neonatal team)
   - **Ask:** "who will be the team leader?"
   - **Team leader assigns** checklist reader and scribe
   - **If massive haemorrhage --> activate major haemorrhage protocol**
2. **Assess clinical status using ABCDE approach**
   - Give oxygen at 15 L/min via reservoir mask, titrate to spO2 95-98%
   - Start continuous monitoring : SpO2, respiratory rate, 3-lead ECG and blood pressure
   - Insert 2x wide-bore IV access (take FBC, clothing, fibrinogen, cross match)
   - Give tranexamic acid 1g IV **(Box A)**
   - Give IV crytalloid fluid bolus(es) **(Box A)**
   - Give blood and blood products early in ongoing haemorrhage
3. **Check abdomen and assess pain**
   - If pain continuous--> consider abruption as cause for pain
   - If pain with contractions--> consider labour as cause for pain
4. **Obstetric assessment**
   - Check fetal heart
   - Start continuous CTG
   - Check placental site with USS
   - If no placenta praevia--> vaginal + cervical assessment
5. **Obstetrician to decide plan for birth**
6. **Weih swabs and announce total blood lss every 10 minutes**
7. **Assess need for continued management suggestions (Box B)**
8. **Preform Kleihauer if mother RHD-ve**

Box A: Drug doses and treatments

Tranexamic acid:
Initial bolus 1g IV over 10 minutes
If bleeding continues--> repeat 1g tranexamic acid after 30 minutes

IV crystalliod bolus(es)
250-500 ml, up to 2 Litres, until blood available

Calcium replacement:
10 ml IV 10% calcium choride -or- 30 ml IV 10% calcium gluconate

Box B: During resuscitation

Use point of care testing to guide blood product and fluid resuscitation
- Thromboelastography (TEG*)-or- rotational throboelastometry (ROTEM*)-and-
- Blood gases

Do not be reassured by normal Hb before adequate fluid resuscitation

Use cell salvage where possible

Keep woman warm

Prepare for **postpartum haemorrhage**

Table 4.6: Postpartum Haemorrhage

Postpartum haemorrhage

START

1. **Call for help** (obstetrician, midwife, anaesthetist)
   - **Ask:** "who will be the team leader?"
   - **Team leader assigns** checklist reader and scribe
   - Request **postpartum haemorrhage drugs**
   - If major or massive PPH --> **activate major haemoorrhage protocol**
2. **Check clinical status using ABCDE approach**
   - Start oxygen at 15 L/min via reservoir mask, titrate to Spo_2 95-98%
   - Start continuous monitoring: SpO_2, respiratory rate, 3-lead ECG and blood pressure
   - Insert 2x wide-bore IV access (take FBC, clotting, fibrinogen, cross match)
   - Give tranexamic acid 1g IV
   - Start IV crystalloid fluid bolus(warm)
   - Give blood and blood products early in ongoing haemorrhage
3. **Check for-and- treat source of bleeding (Box A)**
4. **Check for atony--> treat if identified**
   - Manual--> rub contraction or bimanual uterine compression
   - Give utertonics (Box B)
   - Isert urinary catheter
   - If still atony--> transfer to theatre for EUA and haemorrhage control (Box C)
5. **Weigh all swabs and announce total blood loss every 10 minutes**
6. **Use point of care testing to guide blood and blood product replacement (Box C)**
   - Check for hypocalcaemia **(Box B)**
7. **Keep woman warm**
   - Warm fluids -and- warm woman
8. **Use cell salvage where possible**

Box A: Source of bleeding. 4 Ts of obstetric haemorrhage

- Tone - uterine atony
- Tissue - retained placental tissue
- Trauma - lacerations of birth tract
- Thrombin - clotting abnormalities

Box B: Drug doses and treatments

Uterotonics:

- **Syntometrine or Ergometrine IM** one only and avoid if hypertensive -or-
- **Oxytocin IV** 5 iu diluted in ml normal saline given over at least 2 min, up to 2 doses
- **Oxytocin** infusion (40 iu in 50 ml normal saline at 12.5 ml /hr) or as per local protocol
- **Carboprost** (Hemabate) 250 mcg IM repeated every 15 min maximum 8 doses (avid if asthmatic)
- **Misoprostol** 1000 mcg (5x200 mcg tablets) PR / or 800 mcg sublingual

Calcium replacement
10 ml IV 10% calcium chloride-or- 30 ml IV 10% calcium gluconate

Box C: During resuscitation

Haemorrhage control strategies

- Aortic compression
- Intrauterine tamponade device (e.g., Bakri ballon*)
- Uterine brace sutures
- Interventional radiology
- Hysterectomy

Point of care testing to guide blood product and fluid resuscitation

- Thromboelastography (TEG*) -or- rotational thromboelastometry (ROTEM*) -and- blood gas

Do not be reassured by normal Hb before adequate fluid resuscitation

6. Maternal Sepsis

Maternal sepsis is a leading cause of preventable maternal mortality that requires early recognition, expedient evaluation, and appropriate management. The WHO defines maternal sepsis as "a life-threatening condition characterized by organ dysfunction resulting from infection during pregnancy, childbirth, post-abortion, or the postpartum period."

Table 4.7: The differences between Sepsis -2 and Sepsis- 3 definitions

Criteria definition	Sepsis-2 (1991 and 2001 consensus terminology)	Sepsis-3 (2016 Definition)
SIRS	2 or more of the following: Temperature>38°C or <36°C Heart rate >90/minutes Respiratory rate >20/minutes or $PaCO_2$ <32 mm Hg (4.3 kPa) White blood cell count >12,000/mm^3 or <4,000/mm^3 or >10% immature bands	Category not used
Sepsis	Defined as 2 or more SIRS criteria in a suspected infection	Present. Suspected or documented infection and an acute increase of≥2 SOFA points
Severe sepsis and sepsis induced hypotension	Present. Sepsis related organ dysfunction or hypoperfusion	Category not used
Septic shock	Present. Sepsis with persisting hypotension requiring vasopressors to maintain MAP 65 mm Hg and having a serum lactate level >36 mg/dL (4 mmol/L) despite adequate volume resuscitation	Present. Sepsis with persisting hypotension requiring vasopressors to maintain MAP 65 mm Hg and having a serum lactate level > 18 mg/dL (2 mmol/L) despite adequatevolume resuscitation

***MAP**- mean arterial pressure; SIRS- systemic inflammatory response syndrome; SOFA- Sequential Organ Failure Assessment. Information from Seymour CW, Liu VX, Iwashyna TJ, et al. Assessment of clinical criteria for sepsis: for the Third International Consensus Definitions for Sepsis and Septic Shock (Sepsis-3). JAMA. 2016;315(8):762-774; Poutsiaka D, Porto M, Perry W, et al. Prospective observational study comparing Sepsis-2 and Sepsis-3 definitions in predicting mortality in critically ill patients. Open Forum Infect Dis. 2019;6(7):ofz271.*

Risk Factors Associated With Maternal Sepsis

The recognized risk factors for sepsis and its escalation to septic shock are divided into obstetric-related and patient-related categories. Surgical interventions, particularly caesarean sections (CS), are significant independent obstetric risk factors for postpartum maternal sepsis, contributing to a 20% increase in morbidity compared to vaginal births.

Other obstetric-related risk factors include cervical cerclage, extended rupture of membranes, histories of pelvic and streptococcal infections, vaginal discharges, multiple pregnancies, preterm prelabor rupture of membranes (PPROM), and amniocentesis among other invasive procedures.

Major patient-related risk factors encompass primiparity, pre-existing medical conditions, and instances of febrile infection or antibiotic use in the two weeks prior to admission.

Additionally, independent comorbidities associated with sepsis include congestive heart failure, chronic liver or renal failure, HIV infection, systemic lupus erythematosus, and diabetes mellitus.

Patient factors

Obesity	Group A streptococcal infection in close contacts
Impaired Immunity or Immunosuppressive therapy	Age older than 35 y
Anemia	Disadvantaged socioeconomic background
Impaired Glucose tolerance	Congestive heart failure
Vaginal infection	Chronic renal failure
Pelvic Inflammatory disease	Chronic liver failure
History of group B streptococcal infection	Systemic lupus erythematosus

Obstetric factors

Cesarean delivery	Cervical cerclage
Retained products of conception	Amniocentesis or other invasive procedure
Prolonged rupture of membranes	Complex perineal lacerations
Multiple gestation	Wound hematoma

Investigations

The diagnosis and management of sepsis are particularly challenging during gestation and the postpartum period due to the physiological changes induced by pregnancy. Changes in coagulation, fibrinolysis, and blood cell counts also play a significant role in delaying the diagnosis of sepsis. Recently, various societies have attempted to provide early scoring systems to facilitate the timely recognition of septic disease, such as the Modified Early Warning System (Table 4.8).

Table 4.8: The differences between Sepsis -2 and Sepsis- 3 definitions

	Yellow Trigger	Red Trigger
Respiratory rate (Breaths/minute)	21 -30	<10 or >30
Oxygen saturation (%)		<90
Heart rate (BPM)	100 -120 or 30 - 40	<30 or >120
Systolic blood pressure (mm Hg)	80 - 90 or 150 - 160	<80 or >160
Diastolic blood pressure (mm Hg)	80 - 90	>90
Lochia		Heavy / foul smell
Proteinuria		>+2
Colour of liquor		Green
Nonresponse	Voice	Unresponsive, pain
General condition	Looks unwell	

BPM- Beats per minute.
Information from Singh S, McGlennan A, England A, Simons R. A validation study of the CEMACH recommended modified early obstetric warning system (MEOWS). Anaesthesia. 2016;67(1):12-18

In patients with suspected sepsis, the following complementary tests are recommended: a complete blood count, liver and renal function tests (including bilirubin), coagulation studies, and plasma C-reactive protein levels.

Venous blood gases and serum lactate should also be analyzed. Although serum lactate does not increase predictive validity, it can help identify intermediate risk and is useful for guiding resuscitation by normalizing lactate levels in cases of hypoperfusion.

Serial monitoring of serum lactate is valuable for tracking therapeutic response and serves as a prognostic tool in patients with sepsis and septic shock, regardless of the presence of hypotension and/or hypoperfusion.

Procalcitonin is another important biomarker; while it should not be the sole criterion, it aids in decisions regarding the initiation, de-escalation, or cessation of antibiotic therapy and may indicate a poorer prognosis in terms of mortality.

Blood cultures should be taken even if the patient is afebrile, prior to the start of antimicrobial therapy.

Ideally, two blood cultures should be drawn in both aerobic and anaerobic media before antibiotic administration, with separate extractions from the catheter and/or peripheral blood. The collection of blood cultures should not postpone antibiotic treatment, and it is crucial to note on the request whether samples

are from peripheral blood or a catheter, including catheter identification, to aid result interpretation.

For urine cultures, spontaneous urination is preferable to samples obtained via a urinary catheter. Different requests for microbiology should be made, and it is important to indicate if the sample is postpartum to assist in result interpretation.

For suspected sources, microbiological cultures are essential. In pregnant women, if an intrauterine origin is suspected, cultures of amniotic fluid (via amniocentesis), vaginal, rectal, and endocervical swabs should be evaluated.

Stool cultures should be considered if there is significant diarrhea (Salmonella, Campylobacter, other parasites). In cases of puerperal fever, an endometrial culture is necessary.

For chest pain, an ECG and Troponin test should be requested. Fetal assessment can be done through CTG and/or fetal ultrasound.

Imaging tests should be performed based on the suspected infection site and clinical-analytical progression. For example, a renal ultrasound for suspected urinary issues, a gynecological ultrasound for suspected endometritis with retained placenta, chest radiography for suspected pneumonia or acute pulmonary edema, abdominal and pelvic CT for suspected abdominal collections, intestinal or urological lesions, or septic pelvic thrombosis, and head CT or MRI for altered consciousness.

In any patient with shock and no apparent focus, imaging tests (abdominal ultrasound, CT, etc.) should be conducted to exclude renal and biliary issues and to check for pathway obstructions.

Table 4.9: Diagnostics test

Laboratory Evaluation	Common Results	Pearls to Remember
Immediate		
Complete blood count with differential WBC count	Elevated	Can be elevated, normal, or decreased
Immature granulocyte count	Elevated	"Left shift" or immature granulocytes may be a normal finding in pregnancy
Hemoglobin	Normal Decreased in septic shock	Can be elevated, normal, or decreased
Platelets	Increased in early sepsis	Can be elevated, normal, or decreased
Serum lactate	Normal in early sepsis Elevated in septic shock	Positively correlated with ICU or telemetry unit admission; false-positives may occur from 2nd stage labor, anaerobic metabolism, tourniquet left on too long during blood draw, administration of beta-agonists, and liver failure
Blood cultures	Blood cultures positive in approximately 50% if collected before antibiotic administration	Blood cultures collected from 2 separate sites; do not draw from indwelling catheters or a central intravascular
Additional		
Urinalysis and urine culture	Presence of bacteria, nitrates, WBCs or leukocyte esterase	Collect by urinary catheterization; positive results may indicate a genitourinary source
Comprehensive metabolic panel that includes hepatic and renal function	Elevations in liver enzymes, total serum bilirubin, and serum creatinine; hyperglycemia	Used to assess for presence of end-organ dysfunction
Coagulation studies with INR	Prolonged INR, low fibrinogen	DIC: thrombocytopenia, elevated levels of fibrin-related markers, decreased coagulation factors
Arterial blood gas	High anion gap metabolic acidosis	Used to assess acid-base status and tissue hypoperfusion
Peripheral blood smear	Toxic granulation, Dohle bodies, cytoplasmic vacuoles, intracellular bacteria, neutropenia	Useful when diagnosis is unclear; results may be delayed becouse it requires interpretation by a qualified physician; schistocytes may be seen with DIC
Other cultures (eg, sputum) with additional cultures as clinically appropriate (eg, woun, surgical site, body fluids such as amniotic fluid or cerebrospinal fluid)	Most positive cultures will result in 2-3 d; amniotic fluid and cerebrospinal fluid cultures may take more than 1-2 wk	Do not delay antibiotic administration sputum cultures; they may be collected after antibiotic administration sputum cultures will not derect Mycoplasma pneumoniae, Chlamydia pneumoniae, legionella species, Mycobacterium tuberculosis, Pneumocysis jiroveci or other fungi, or viruses

Algorithm 4.2: Risk Assessment Tool for Sepsis

1. **Has MOEWS been triggered?**
2. **Dose the woman look sick?**
3. **Is the fetal heart rate ≥ 160 bpm?**
4. **Could this woman have an infection?**
   common infections include:
   - Chorioamniontis/endometritis
   - Urinary tract infection
   - Wound infection
   - Influenza/pneumonia
   - Mastitis/breast abscess

Affix Patient ID

If YES to any of the above, complete risk assessment

High Risk criteria
(tick all those that are appropriate)

- Respiratory rate ≥25 ☐
- SpO2 < 92% without O2 ☐
- Heart rate > 130 ☐
- Systolic BP ≤ 90 ☐
- Altered mental status/ Responds only to voice, pain or unresponsive ☐
- Blood lactate ≥ 2.0* ☐
- Non-blanching rash/mottled/cyanotic ☐
- Urine < 0.5 ml/kg/hr ☐
- No urine for 18 hrs ☐

If ONE criteria is present:

Commence 'Sepsis Six' NOW

- **Immediate obstetric review or higher** (transfer to Obstetric Unit if in the community)
- **Inform Consultant Obstetriac & Consultant Anaesthetist**
- **Commence Maternal Critical Care Chart**
- **Commence 'High Risk of Maternal Sepsis' Pro forma**

Moderate Risk criteria
(tick all those that are appropriate)

- Respiratory rate 21-24 ☐
- Heart rate 100-130 ☐
- Systolic BP 91-100 ☐
- Temperature< 36°c ☐
- No urine output for 12-18 hours ☐
- Fetal heart> 160bpm/Pathological CTG ☐
- Prolonged SRM ☐
- Recent invasive procedure ☐
- Bleeding/wound infection/vaginal discharge/abdominal pain ☐
- Close contact with Group A strep ☐
- Relatives concerned about mental/ funtional status ☐
- Diabetes/ gestational diabetes/ immunosuppressed ☐

If TWO criteria are present
(also consider if only ONE criteria):

Send bloods:
FBC, lactate, CPR, U+Es, LFTs, clotting
OBSTETRIC REVIEW
within one hour
Consider 'Table 4.11'

Review Bloods: If lactate ≥ 2 or Acute Kindney injury present, follow HIGH Risk Pathway

Low Risk criteria
(tick all those that are appropriate)

- Respiratory rate ≤ 20 ☐
- Heart rate < 100 ☐
- Systolic BP > 100 ☐
- Normal mental status ☐
- Temperature: 36 - 37.3°c ☐
- Looks well ☐
- Normal CTG ☐
- Normal urine output ☐

If ALL criteria are present:

LOW RISK OF SEPSIS

Review & monitor for improvement or deterioration

Consider obstetric needs & full clinical picture

***NB: Lactate measurement may be transiently elevated during and immediately after normal labour and birth. If unsure, repeat sample.**

Completed by:

Name: Designaton: Time:

Signature: Date:

adopted from UK Sepsis Trust In Patient Maternal Sepsis Tool

Antibiotics Spectra for Sepsis

The administration of intravenous broad-spectrum antibiotics is recommended within one hour of suspecting severe sepsis in a woman, with or without septic shock, as part of the Surviving Sepsis Campaign Resuscitation Bundle.

Empirical use of broad-spectrum antimicrobials, active against Gram-negative bacteria and capable of inhibiting exotoxin production from Gram-positive bacteria, should align with local microbiology policies. Therapy should be refined once the causative organism(s) are identified. The 2003–2005 The confidential enquiry into maternal death (CEMACH) report mentioned cefuroxime and metronidazole for genital tract sepsis; however, cefuroxime has been removed from many hospital formularies due to its association with C. difficile. Neither agent offers coverage against MRSA, Pseudomonas, or extended-spectrum beta-lactamases (ESBL).

Table 4.10: Antibiotic spectra for obstetrics and gynaecology

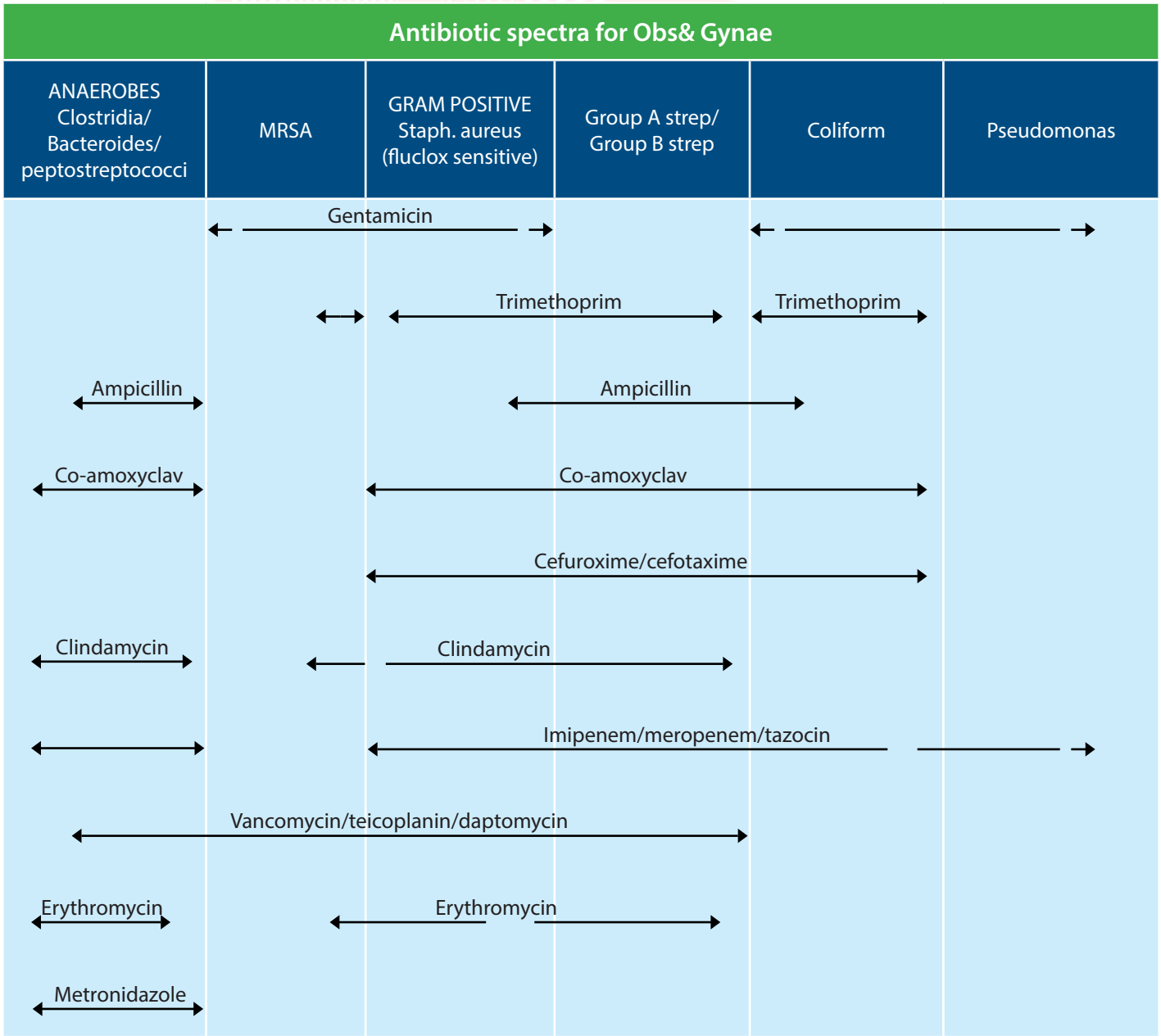


Table 4.11: The Sepsis 6 Care Pathway in Community settings

THE SEPSIS 6

COMMUNITY SETTINGS

Start immediately and complete within the hour if your patient requires active treatment and has been identified as Red Flag Sepsis on your screening tool

1 Discuss with GP or on-call clinician
Sepsis is complex-clinicians will help guide your actions

2 Give oxygen if available
Especially if their oxygen saturations are less than 92%

3 Help clinician obtain blood tests
This may be omitted if urgent hospital transfer is arranged

4 Give antibiotics
IV, or consider oral antibiotics if patient is to remain in the community

5 Ensure hydration
Give IV fluids if available, or encourage oral intake

6 Monitor
Including vital signs if possible, and urine output estimates

Remember: the Sepsis 6 for Community Sttings is appropriate for most patients who require active treatment, even if it is not hospital-based.

Table 4.12: Top 10 Pearls for Managing Maternal Sepsis

Recognition is key
Pearl 1. Always maintain a high index of suspicion for sepsis
Pearl 2. Implement a rapid bedside tool for detection of maternal deterioration
Move fast during the golden hour to save lives
Pearl 3. Implement sepsis bundles to facilitate rapid escalation of care.
Pearl 4. Laboratory and radiologic studies are keys to search for etiology and source control.
Pearl 5. Know your "bugs," their likely origin, and that group A streptococcus can kill quickly.
Pearl 6. Choose antimicrobials tailored to the most likely diagnosis.
Pearl 7. Fluid resuscitation should be initiated rapidly for patients with a blood lactate greater than 4 mmol/L or mean arterial pressure less than 65 mm Hg.
Beyond the golden hour
Pearl 8. Escalation of care is critical to survival.
Pearl 9. Once the patient is stabilized, get to the source of the problem.
Pearl 10. Anticipate and prevent adverse pregnancy outcomes.

Chapter Five

Pre-labour Preterm Rupture of Membrane

Learning Objectives:

Upon completing this chapter, participants will be able to:

1. Define prelabour rupture of membranes and discuss its potential causes.
2. Explain the diagnostic process for pre-labour rupture of membranes.
3. Outline the management strategies for pre-labour rupture of membranes based on gestational age, Post delivery care, and in subsequent pregnancy.

Introduction

Pre-labour preterm rupture of membranes (PPROM) is defined as rupture of membranes from 24+ 0 to 36+ 6 weeks of gestation.

Pre-labour preterm rupture of membrane (PPROM) complicates up to 3% of pregnancies and is associated with 30 - 40% of preterm births.

Risk Factors

- History of pre-labour preterm rupture of membrane in a previous pregnancy
- Ascending genital infections, most are subclinical and give few signs and symptoms until fluid loss has occurred
- Antepartum haemorrhage, particularly when is recurrent
- Cervical incompetence
- Maternal smoking

Complications

1. Pre-labour preterm rupture of membrane can result in significant neonatal morbidity and mortality, primarily from
   - Prematurity
   - Sepsis
   - Cord prolapse
   - Pulmonary hypoplasia
   - Fetal death
2. Risks associated; chorioamnionitis and placental abruption

Diagnosis

The diagnosis is made by maternal history followed by a sterile speculum examination.

- Pooling of fluid on speculum examination is a gold standard.
- If aon speculum examination, no pooling/ amniotic fluid is observed. Clinicians should consider performing an insulin-like growth factor-binding protein 1 (IGFBP 1) or placental alpha microglobulin 1 (PAMG 1) test of vaginal fluid to guide further management.
- The role of ultrasound assessment of amniotic fluid is unclear.

Assessment

A combination of clinical assessment and maternal blood tests should be used to diagnose chorioamnionitis in women with pre-labour preterm rupture of membrane. The parameters should not be used in isolation.

Diagnosis of clinical infection is done by:

1. Clinical: maternal pulse, blood pressure, temperature and symptoms. Symptoms include; Lower abdominal pain, abnormal foul smelling vaginal discharge, fever, malaise and reduced fetal movements.
2. Investigations:
   - Maternal blood tests; C-reactive protein and white cell count
   - Genital cultures
3. Fetal heart rate using cardiotocography.
4. Digital pelvic examination should be avoided.

Management

1. **Antibiotics**
   Erythromycin should be given for 10 days or until the woman is in established labour (whichever is sooner). Penicillin may be used in women who cannot tolerate erythromycin.

2. **Antenatal corticosteroids**
   In women who have pre-labour preterm rupture of membrane from 24+0 weeks antenatal corticosteroids should be:
   - offered between 24^{+0} to 33^{+6} weeks of gestation
   - considered between 34^{+0} to 35^{+6} weeks

3. **Magnesium Sulfate**
   In women who have pre-labour preterm rupture of membrane and are in established labour or having a planned preterm birth within 24 hours, intravenous magnesium sulfate should be offered between 24th and 29th weeks. Magnesium sulfate should be considered when preterm birth is anticipated between 30+0 and 33+6 weeks and the neuroprotective benefit is greatest before 30 weeks of gestation.

4. **Tocolysis**
   Tocolysis in patients with pre-labour preterm rupture of membrane is not recommended.

5. **Neonatologist**
   - Neonatologist should be informed when the diagnosis of pre-labour preterm rupture of membrane is confirmed and delivery is anticipated to ensure that neonatal until has appropriate staff and facilities to care for the neonate should delivery occur.
   - Women with PPROM and their partners should have the opportunity to meet with a neonatologist antenatally to discuss their baby's care.

6. **Monitoring of women at home**
   - If delivery seems imminent, then in-patient care is indicated to prepare the woman for birth (including administration of steroids and intravenous magnesium sulfate).
   - The decision to offer out-patient care to women with PPROM, following a period of in-patient care, should be made on an individual basis. Multiple factors should be considered;
     - Past obstetric history
     - Support at home

- Distance from the hospital
- Women's preference

7. Fetal monitoring

- Fetal growth on ultrasound fortnightly.
- Assessment of amniotic fluid volume and umbilical artery doppler weekly.

8. Amnioinfusion

In PPROM, amnioinfusion is not recommended as part of routine clinical practice.

A cochrane systematic review of five trials found that amnioinfusion is associated with:

- Improved fetal umbilical artery pH at delivery
- Reduced variable decelerations in labour
- Neonatal death
- Neonatal sepsis
- Pulmonary hypoplasia
- Puerperal sepsis

Further evidence is required before amnioinfusion is recommended for routine clinical practice.

Timing of Birth - Early delivery versus Expectant Management

1. Women with PPROM with no contraindications to continuing the pregnancy, expectant management with careful monitoring is associated with better outcomes for the mother and baby.
2. Timing of birth should be discussed with each woman on an individual basis with careful consideration of patient preference and ongoing clinical assessment.
3. There is no difference between early birth and expectant management in neonatal sepsis or infection.
4. Early delivery increased the incidence of respiratory distress syndrome and an increased rate of caesarean section.
5. Early birth was associated with a higher rate of neonatal death and need for ventilation.
6. There were no differences in overall perinatal mortality or intrauterine deaths when comparing early delivery with planned treatment..

Late pre-labour preterm rupture of membranes

Expectant management benefits are less clear in women with PPROM at 34^{+0} to 36^{+6} weeks.

Debriefing

1. Patients and family should be made aware of all potential benefits and risks associated with PPROM, to allow them to make an informed decision.
2. Women with PPROM and their partners should be offered additional emotional support during pregnancy and postnatally.

Chapter Six

Vaginal Bleeding in Late Pregnancy

Learning Objectives:

Upon completing this chapter, participants will be able to:

1. Outline the major causes of third trimester hemorrhage.
2. Identify the steps needed to evaluate a patient with an antepartum hemorrhage.
3. Discuss the management of a patient with a third-trimester bleeding.

Introduction

In the later stages of pregnancy, after 20 weeks, vaginal bleeding occurs in 3 to 4% of women. This bleeding could indicate a risk of miscarriage or severe hemorrhaging. In exceptional cases, the blood loss may be so substantial that it leads to dangerously low blood pressure (shock) or the formation of small blood clots throughout the bloodstream, a condition known as disseminated intravascular coagulation.

It is crucial for women experiencing vaginal bleeding in the latter part of pregnancy to seek immediate medical evaluation, as the bleeding could be related to complications that pose a danger to both the woman and the fetus.

Pathophysiology

The most frequent cause of vaginal bleeding in late pregnancy is the onset of labor. During this time, some women may expel the mucus plug—a collection of mucus in the cervix—through the vagina. Typically, the mucus plug is a small, sticky mass that may contain streaks of blood. While passing the mucus plug does not indicate the immediate start of labor, it often suggests that labor could commence within the following week.

Labor usually begins with a slight discharge of blood mixed with mucus from the vagina, known as the bloody show. This discharge results from the tearing of small veins as the cervix starts to dilate, allowing the fetus to pass through the vagina. The blood present in the discharge is usually minimal.

Other serious reasons for vaginal bleeding during late pregnancy include placenta previa, vasa previa (which is rare), placental abruption, and a rare occurrence of uterine rupture.

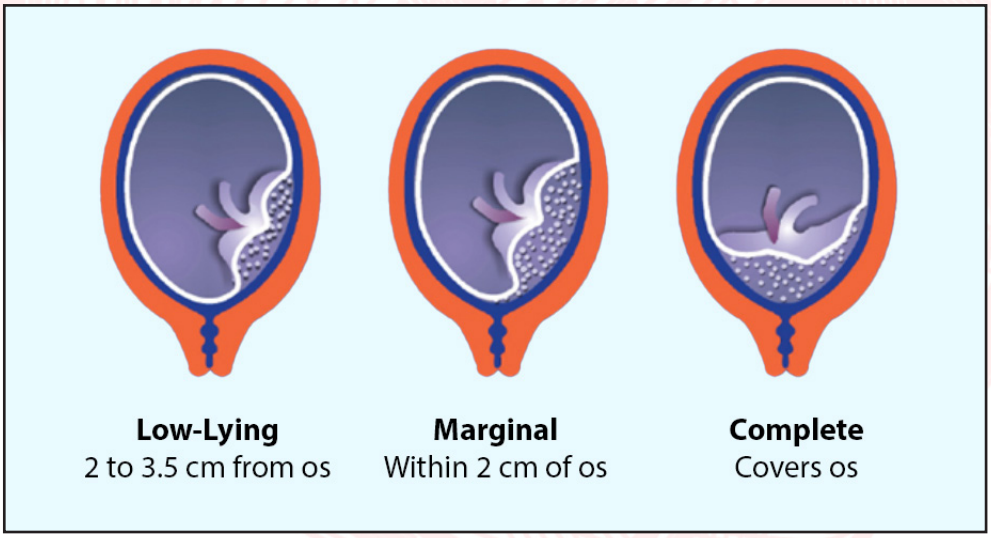


Figure 6.1: Abnormal placental implantation

In placenta previa,
the placenta attaches to the lower part of the uterus instead of the upper part. This positioning can partially or fully obstruct the cervix, which the fetus must pass through. Bleeding can occur unexpectedly or be induced during a cervical exam to check for dilation or the onset of labor.

Placenta previa causes about 20% of late pregnancy bleeding and is most prevalent in the third trimester. Although the placenta may be low-lying earlier in pregnancy, it typically moves away before the third trimester.

Table 6.1: Causes of bleeding during late pregnancy

Cause	Suggestive Findings	Diagnostic Approach*
Labor	Passage of blood-tinged mucus plug, not active bleeding Painful, regular uterine contractions with cervical dilation and effacement	Maternal vital signs and serial pelvic examinations Fetal heat rate monitoring
Placental abruption	Dark, clotted, or bright red blood, bleeding may be profuse; in some women, slight or absent bleeding before delivery (concealed abruption) Painful, tender uterus, often tense with contractions Some times, maternal hypotension Signs of fetal distress (eg, bradycardia or prolonged deceleration, repetitive late decelerations, sinusoidal pattern)	Maternal vital signs and pelvic examination Fetal heart rate monitoring Complete blood count, coagulation tests Often, ultrasonography, although it is not very sensitive
Placenta previa	Sudden onset of painless vaginal bleeding with bright red blood and minimal or no uterine tenderness Often, a low-lying placenta detected earlier in pregnancy on routine screening ultrasonography	NOTE: DIGITAL CERVICAL EXAMINATION SHOULD NOT BE PERFORMED. Complete blood count Ultrasonography
Vasa previa	Painless vaginal bleeding with fetal instability but normal maternal signs Often, symptoms of labor Sometimes, suspected based on findings during routine screening ultrasonography	Transvaginal ultrasonography with color Droppler studies
Uterine rupture	Severe abdominal pain, tenderness, cessation of contractions, often loss of uterine tone	clinical suspicion, based on characteristic signs and symptoms

Vasa previa
is an uncommon condition where the blood vessels supplying the fetus via the umbilical cord stretch across the cervix, blocking the fetal passage. These vessels can rupture during labor, leading to significant blood loss for the fetus, which can be critical or fatal due to the fetus's limited blood volume.

Placental abruption

involves the premature detachment of the placenta from the uterus. The exact cause of this detachment is unknown, but it may relate to insufficient blood flow to the placenta. It can also follow an injury, such as from a car accident. The bleeding may appear less severe than it is, as the blood can be concealed behind the placenta. Placental abruption is the leading life-threatening cause of late pregnancy bleeding, responsible for about 30% of such cases, and it can happen at any time but is most frequent in the third trimester.

Uterine rupture may occur during labor, typically in women with a damaged uterus that has scar tissue. This damage often results from a cesarean delivery or other uterine surgeries, such as a myomectomy to remove fibroids.

Bleeding can also stem from non-pregnancy related disorders.

Risk Factors

Certain conditions increase the risk of complications that may cause bleeding in late pregnancy.

Risk factors for placenta previa include:

- Previous cesarean delivery
- Multiple past pregnancies
- Multiple fetuses in the current pregnancy
- History of placenta previa
- Being over the age of 35
- Smoking cigarettes

Undergoing in vitro fertilization, involving laboratory fertilization of an egg and subsequent placement of the embryo into the uterus.

Risk factors for vasa previa include:

- A low-lying placenta in the uterus
- A segmented placenta
- Multiple fetuses in a pregnancy
- In vitro fertilization

Risk factors for placental abruption include:

- Elevated blood pressure
- Being older than 35
- Having had one or more previous pregnancies
- Smoking cigarettes
- Cocaine use
- A history of placental abruption
- A recent abdominal injury, such as from a car accident

Risk factors for uterine rupture include:

- A previous cesarean delivery
- Any past uterine surgery
- Being over the age of 30
- Prior uterine infections
- Induced labor
- Trauma, such as from a vehicle collision
- Having given birth to more than five children

- Closely spaced pregnancies
- Placenta accreta, where the placenta invades too deeply into the uterine wall.

Table 6.2: Risk factors of bleeding during late pregnancy

Cause	Risk Factors
Placental abruption	Hypertension Age > 35 Multiparity Cigarette smoking Cocaine Previous placental abruption Physucal trauma
Placenta previa	Previous cesarean delivery Multiparity Multifetal pregnancy Previous placenta previa Age > 35 Cigarette smoking In vitro fertilization
Vasa previa	Low-lying placenta Bilobed or succenturiate-lobed placenta Multifetal pregnancy In vitro fertilization
Uterine rupture	Previous cesarean delivery Any prior uterine surgery Age > 35 History of uterine infection Induction of labor Trauma (eg, gunshot wound) Grand multparity (delivery of > 5 viable fetuses) Uterine abnormalities Multifetal pregnancy

Diagnosis and Evaluation

In late pregnancy, the evaluation of vaginal bleeding is critical. Doctors prioritize excluding serious causes such as placental abruption, placenta previa, vasa previa, and uterine rupture. If these are ruled out, the most likely diagnosis is the onset of labor, signaled by the bloody show.

Warning Signs:

Vaginal bleeding in the later stages of pregnancy is always a warning sign, with the exception of the mucus plug or bloody show, which involves minimal blood and is short-lived.

Healthcare providers are especially concerned about women who experience fainting, lightheadedness, or a

rapid heartbeat—indicative of very low blood pressure.

Other alarming symptoms include:

- A tense, tender uterus
- Absence of fetal heartbeat or a slow fetal heart rate
- Cessation of labor and a loss of uterine muscle tone

A woman experiencing vaginal bleeding in late pregnancy should be evaluated about the following:

- Its duration
- Its severity
- The color of the blood
- The presence of other symptoms, such as abdominal pain, light-headedness, or fainting.

Women are questioned about their pregnancy history, including the number of pregnancies, live births, and any miscarriages or abortions, as well as complications in previous pregnancies. They are also asked if the amniotic sac has ruptured, which often indicates the onset of labor.

Health care providers assess risk factors for the most common and serious causes of bleeding, especially previous cesarean deliveries.

During the physical exam, look for signs of significant blood loss, like a rapid heart rate and low blood pressure. They monitor the fetal heart rate and may use electronic fetal heart monitoring for constant observation. The abdomen is palpated to gauge the uterus's size, tenderness, and muscle tone. A pelvic exam is conducted, and the cervix is examined with a speculum.

If bleeding occurs late in pregnancy, ultrasonography is performed to check for placenta previa and vasa previa before a digital cervical examination. If these conditions are diagnosed, the digital examination is avoided to prevent exacerbating the bleeding. Women with known placenta previa or vasa previa are encouraged to inform their clinicians of their condition and decline a digital cervical examination, although a careful speculum examination may be performed.

Testing

The following tests are conducted:

- Fetal heart rate monitoring
- Ultrasonography
- A complete blood cell count
- Occasionally, blood tests to check for normal blood clotting
- Blood type and Rh status (positive or negative)

In the event of bleeding during pregnancy, the doctor evaluates the mother's vital signs, performs a physical examination, and assesses the fetus using a fetal heart rate monitor or ultrasonography.

Ultrasonography is also utilized to identify the source of the bleeding. Transvaginal ultrasonography, which involves placing an ultrasound device inside the vagina, can determine the location of the placenta, umbilical cord, and blood vessels.

This helps health care providers confirm or exclude the presence of placenta previa and vasa previa. However, ultrasonography may not always reveal a placental abruption. The diagnosis of placental abruption and uterine rupture is based on the physical examination results, including known risk factors.

A complete blood cell count is performed. Blood type and Rh status are established to find a compatible blood donor if the woman requires a transfusion. If there is significant bleeding or suspicion of placental

abruption, tests for disseminated intravascular coagulation are conducted.

Management

If possible, the disorder causing the bleeding is treated.

In cases of placental abruption or placenta previa, hospital admission is usually recommended unless delivery is not required and both the pregnant woman and fetus are healthy. In the hospital, both can be monitored closely, and treatment is readily available.

The woman may return home if the bleeding stops. However, if the bleeding persists, worsens, or if the pregnancy is near term, delivery of the baby is initiated. Cesarean delivery is necessary for women with placenta previa, while those with placental abruption may undergo either vaginal or cesarean delivery.

Cesarean delivery is scheduled before labor begins, typically between 34 to 37 weeks of pregnancy, if vasa previa is diagnosed. If there is bleeding in a case of vasa previa, an immediate cesarean delivery may be necessary.

Immediate delivery of the baby is required if the uterus has ruptured, followed by surgical repair of the uterus. A woman who has lost a significant amount of blood receives intravenous fluids. Blood transfusions are administered if fluid treatment alone is insufficient.

Chapter Seven

Shoulder Dystocia

Learning Objectives:

Upon completing this chapter, participants will be able to:

1. List risk factors for shoulder dystocia
2. Identify the critical tasks that should be performed when this complication occurs
3. Know how to demonstrate proper technique for basic manoeuvres to relieve shoulder dystocia
4. Understand importance of clear and accurate documentation
5. Describe the potential complications of shoulder dystocia

Introduction

Shoulder dystocia is most commonly diagnosed as failure to deliver the fetal shoulder(s) with gentle downward traction on the fetal head, requiring additional obstetric manoeuvres to effect delivery.

Shoulder dystocia occurs when the descent of anterior shoulder is obstructed by the symphysis pubis, but it also can result from impaction of the posterior shoulder on maternal sacral promontory.

Shoulder dystocia is an unpredictable and unpreventable obstetric emergency that places the pregnant woman and fetus at risk of injury, occurs in 0.2 - 3% of all vertex vaginal delivery. There is evidence that a systematic approach and simulation training can improve outcomes and documentation.

Identification

- Head delivered
- Shoulder stuck at level of pelvic brim, pubic bone or sacral promontory
- Delivery of head with retraction against maternal perineum (turtle sign)
- Difficulty with or arrest of delivery of fetal head and chin

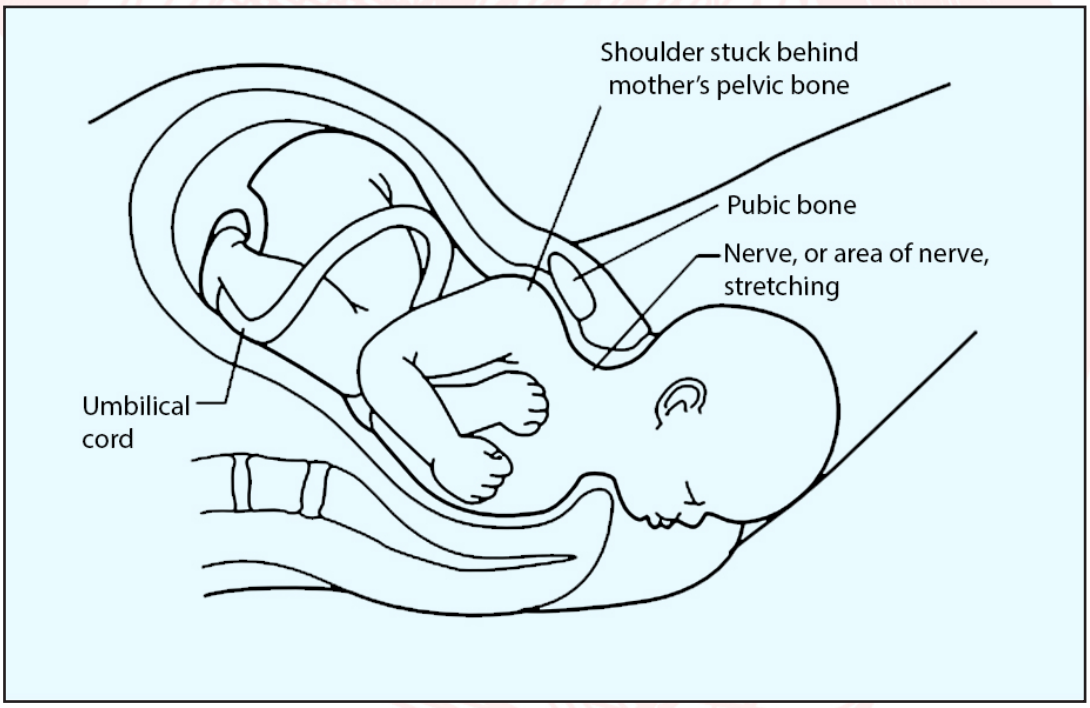


Figure 7.1: Shoulder Dystocia

Risk factors

The following antenatal and intrapartum characteristics have been reported to be associated with shoulder dystocia:

Antepartum:

- Increasing birth weight
- Obesity (>30 BMI)
- Diabetes
- Prior shoulder dystocia
- Prior macrosomic infant
- Induction of labour

Intrapartum:

- Prolonged second stage
- Operative vaginal delivery
- Precipitous delivery
- Oxytocin Augmentation

Prevention

Elective induction to prevent shoulder dystocia is not recommended and the prevention of shoulder dystocia with caesarean section should only be considered in unusual circumstances.

1. Estimated foetal weight in diabetic ≥4500 gm
2. Estimated Fetal Weight (EFW) in non diabetic ≥5000 gm
3. Prior shoulder dystocia with injury to infant (brachial plexus, limb fracture or asphyxia)

Potential complications

Shoulder dystocia can cause several maternal and neonatal complications.The most common maternal complications are postpartum hemorrhage and obstetric anal sphincter injuries. The most common neonatal injuries are brachial plexus injuries and clavicular or humeral fractures.

Maternal

- Haemorrhage
- Higher degree perineal laceration
- Uterine rupture
- Post traumatic stress disorder (PTSD)

Neonatal

- Hypoxemia
- Still birth
- Brachial plexus injury, fracture (clavicle, humerus)

Shoulder dystocia Training

Practical sessions or simulated drills allow staff to gain experience in the preparation, guidance and communication required to support a woman and her partner.

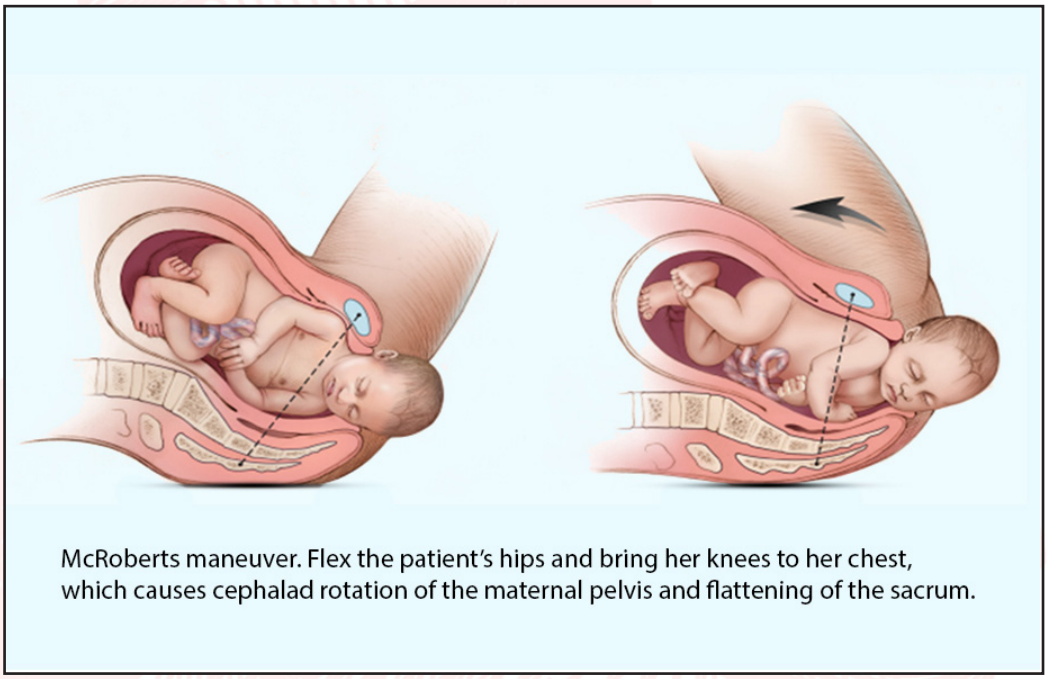
Emphasis is on teaching staff to use a specific algorithm of evaluated and effected manoeuvre that will assist

the release of maneuver shoulder.

Initial Maneuvers

60% will be resolved from following:

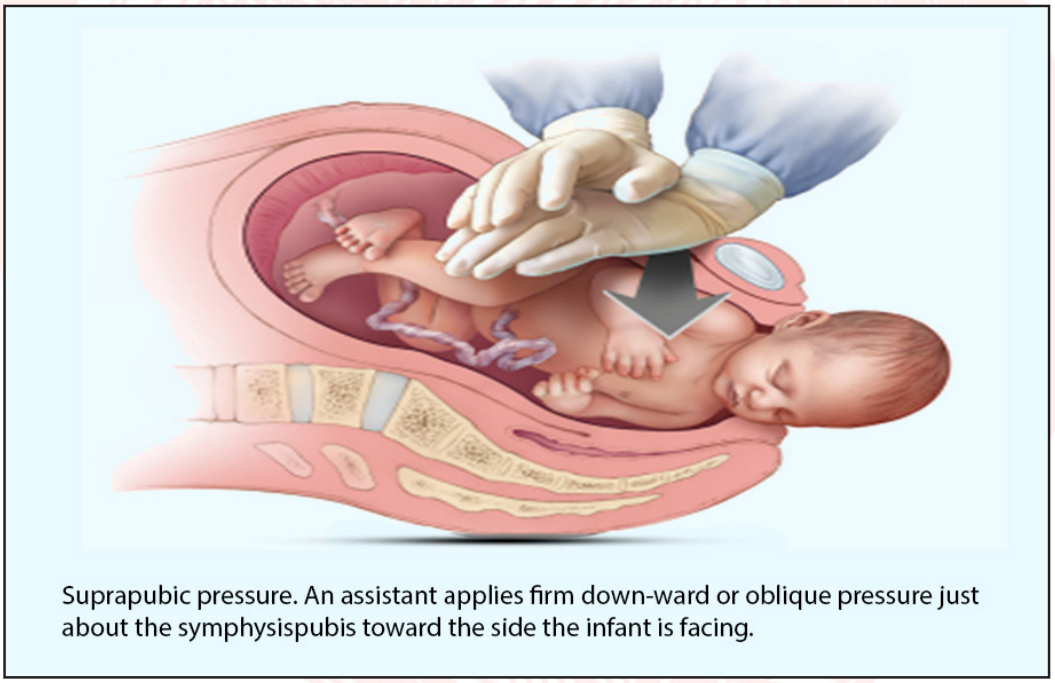
- Announce the complication and call for assistance
- Perform the McRoberts Maneuver



McRoberts maneuver. Flex the patient's hips and bring her knees to her chest, which causes cephalad rotation of the maternal pelvis and flattening of the sacrum.

Figure 7.2: McRoberts Maneuver

- Apply supra-pubic pressure



Suprapubic pressure. An assistant applies firm down-ward or oblique pressure just about the symphysispubis toward the side the infant is facing.

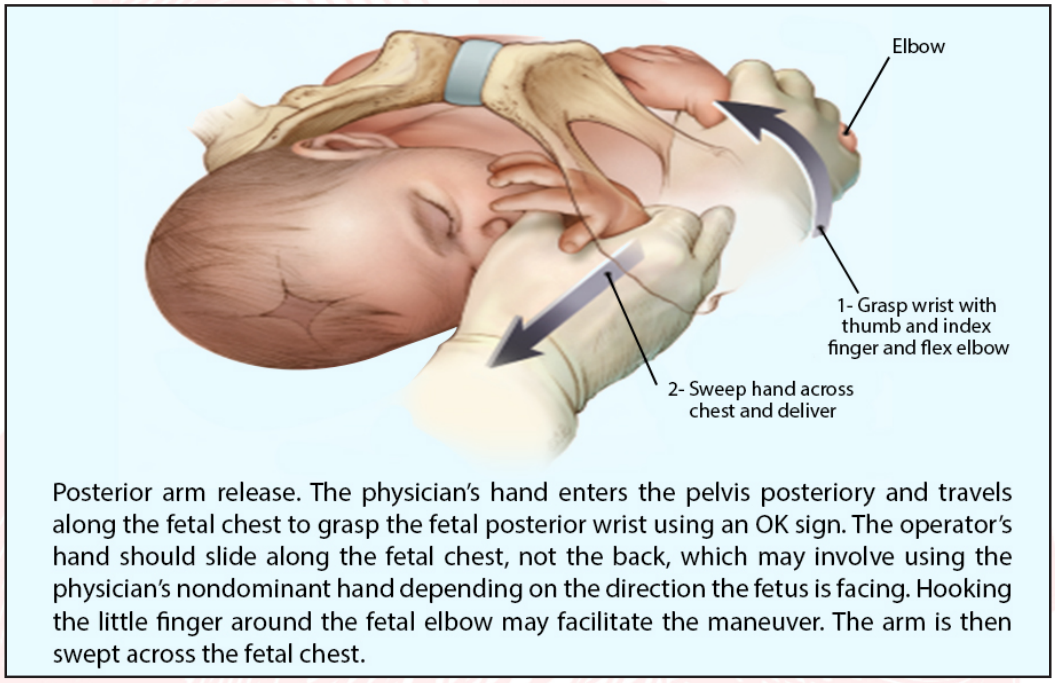
Figure 7.3: Supra-pubic pressure

- Avoid fundal pressure

Secondary maneuver

1. Posterior Arm delivery

   Up to 95% of cases of shoulder dystocia will resolve with combination of McRoberts maneuver, supra-pubic pressure and posterior arm delivery.



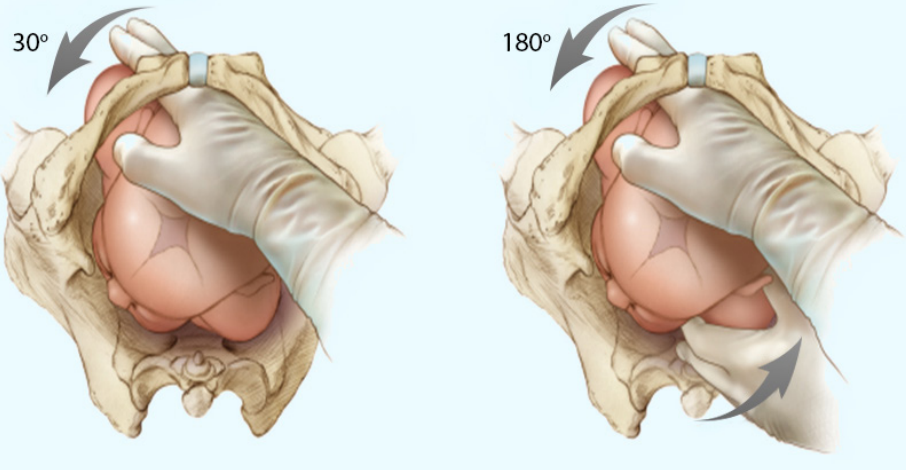
Posterior arm release. The physician's hand enters the pelvis posteriory and travels along the fetal chest to grasp the fetal posterior wrist using an OK sign. The operator's hand should slide along the fetal chest, not the back, which may involve using the physician's nondominant hand depending on the direction the fetus is facing. Hooking the little finger around the fetal elbow may facilitate the maneuver. The arm is then swept across the fetal chest.

Figure 7.4: Posterior Arm delivery maneuver

2. Rotational maneuver:
   - Rubin

     Place hand behind most easily accessible shoulder and push towards the fetal chest to free the impacted anterior shoulder
   - Woods Corkscrew

     One hand attempts to move the anterior shoulder (as in Rubin). Place the other hand behind the posterior shoulder and attempt to rotate 180 degrees.



Rubin II maneuver*(left)*: Place two fingers on the back (posterior) side of the anterior shoulder and rotate 30 degrees toward the fetal face. Woods maneuver *(right)*: Continue the finger placement for the Rubin II maneuver and add two fingers to the front (anterior) of the posterior sholder and rotate the fetus 180 degrees

Figure 7.5: Robin II maneuver

3. Episiotomy
    - Evaluate and determine if additional room is needed posteriorly
    - Consider Medio-lateral Episiotomy
    - Should not be performed with every shoulder dystocia
4. All fours manoeuvre; Patient is positioned in all four hands and knees to deliver the shoulders.
5. If unsuccessful all the manoeuvres can be repeated starting from McRoberts.

Destructive maneuvers

1. Cleidotomy --> Intentional fracture of clavicle.
2. Symphysiotomy-->Should only be performed by an experienced person, This involves making an incision over the pubic cartilage until the pubic bones are separated. The urethra must first be rejected laterally with the index, and middle fingers and requires local anaesthesia.
3. Zavanelli manoeuvre -->Replacement of head back into uterus and proceed with caesarean delivery.

Documentation

It is very important that this difficult and traumatic birth is clearly documented. It should include:

- Time of birth of baby's head and body
- Head to body time interval
- Specify which shoulder was anterior shoulder
- Timing and sequence of maneuver performed
- Baby condition at birth (APGAR score and cord blood gases)
- Staff present/ paediatrician called present at delivery

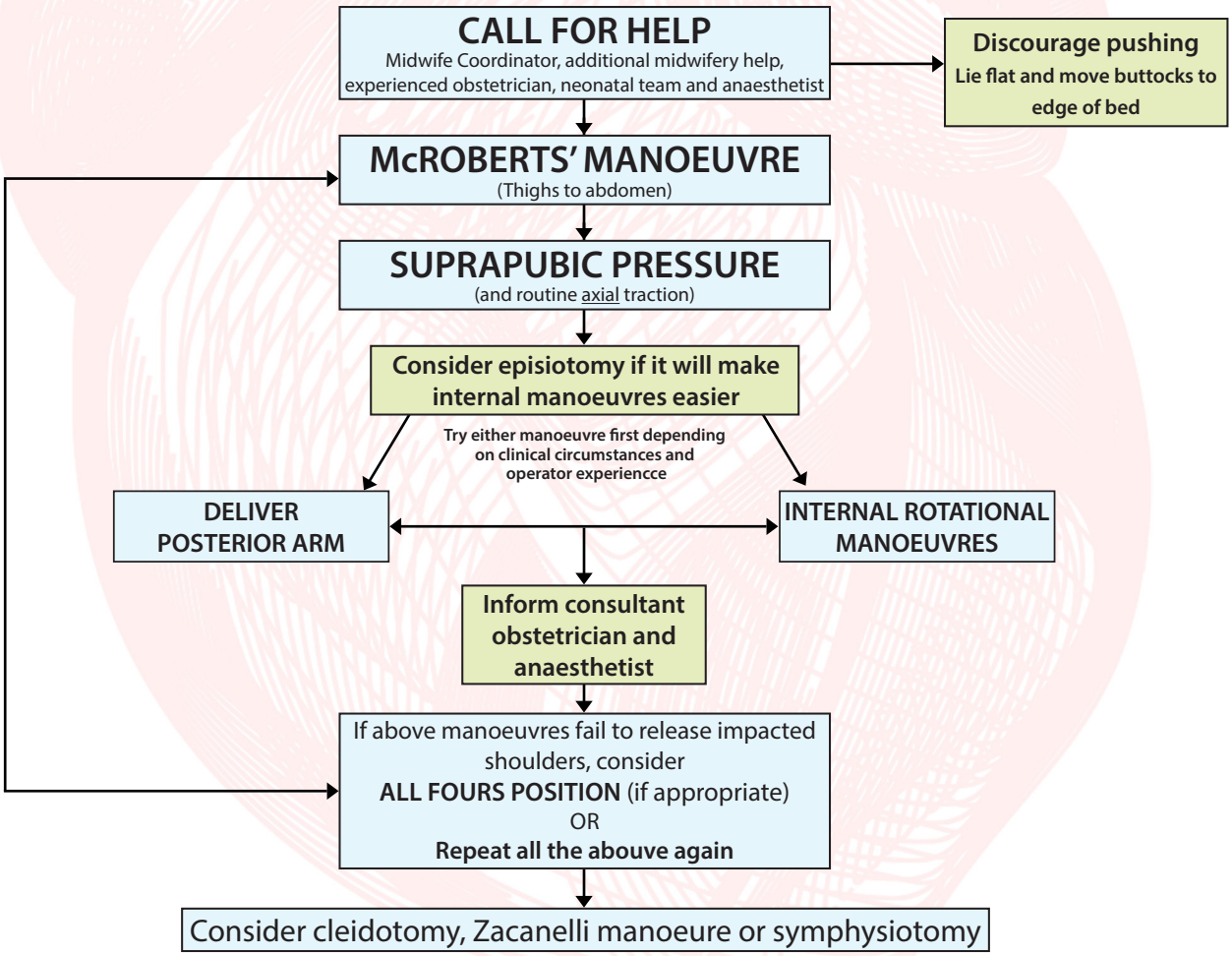
Debriefing

- Communication with patient
- Staff debriefing using the checklist provided

Table 7.1: Management of shoulder dystocia HELPERR

H	elp: call for help
E	valuate for episiotomy
L	egs (McRoberts' position)
P	resure (suprapubic)
E	nter manoeuvres (rotational)
R	emove the posterior arm
R	oll over onto all fours

Algorithm 7.1: Management protocol for shoulder dystocia



Baby to be reviewed by neonatologist after birth and referred for Consultant Neonatal review if any concerns

Chapter Eight

Malpresentations, Malpositions, and Multiple Gestation

Learning Objectives:

Upon completing this chapter, participants will be able to:

1. Identify complications linked to different malpresentations.
2. Examine the management of deliveries involving multiple gestations.
3. Enumerate the steps to conduct a breech delivery safely.

Definitions:

Lie:

It is the relationship between the baby's long axis and the woman's long axis. It is specified as longitudinal, transverse, or oblique.

Presentation:

It is the portion of the baby that is foremost, or presenting in the mother's birth canal. The baby may present by vertex, breech, face, brow, or shoulder.

Position:

It is a reference point on the presenting part and its relationship to the mother's pelvis. For example, the reference point on the vertex is the occiput. When the fetal occiput is directed anteriorly, the baby is in the occiput-anterior (OA) position, when is directed toward the mother's spine, it is in the occiput-posterior (OP) position. Other positions might be left or right occiput-anterior (LOA and ROA), left or right occiput-transverse (LOT and ROT), and left or right occiput-posterior (LOP and ROP).

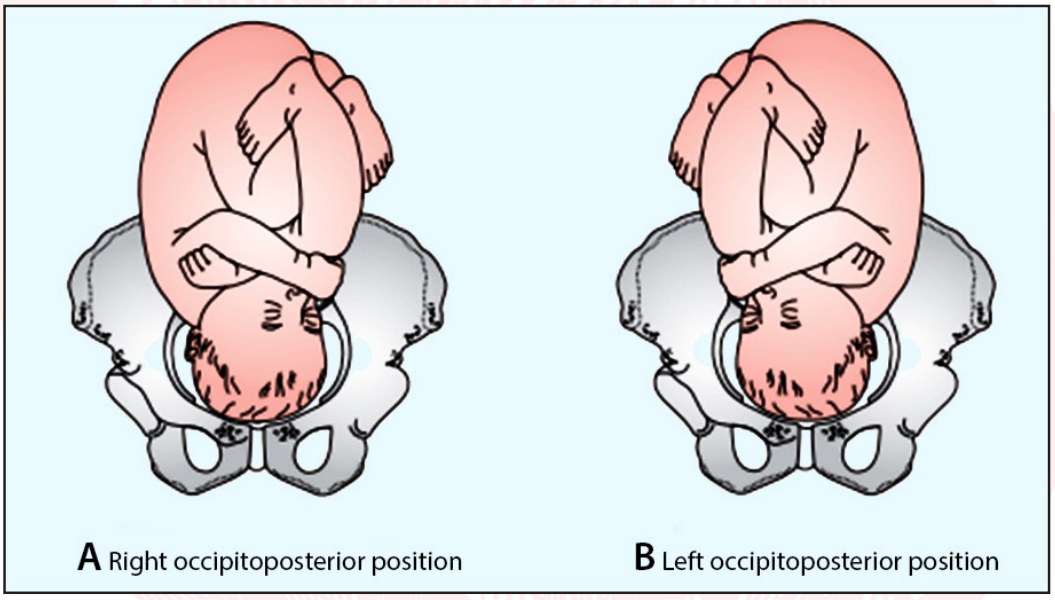


Figure 8.1: ROP & LOP fetal positions

How to diagnose:

There are three Ways To diagnose:

1. Leopold maneuvers, or abdominal palpation .
2. vaginal examination.

3. imaging with ultrasound.

Vaginal Examination:

Vertex presentation:
The scalp with hair, the sagittal suture, the Y-shaped posterior fontanel, and the diamond-shaped anterior fontanel can be palpated.

Breech presentation:
The buttocks with smooth skin, and no hair can be felt. An orifice i.e. anus and/or the ischial tuberosities may also be felt.

Face presentation:
The smooth face and no hair can be felt. An orifice i.e. mouth may be felt, and/or the malar prominences, forming a triangle with the mouth can be felt.

Brow presentation:
The anterior fontanel, orbital ridges, eyes, and the base of the nose can be felt.
Transverse lie: In cases of transverse lie, the vaginal examination reveals an empty pelvis, and the diagnosis is typically made through palpation or ultrasound.

Cord prolapse or other malpresentations are typically diagnosed either visually or by palpation during a vaginal examination.

Causes of malpresentation:

1. Asynclitism:

The baby's head lateral flexion keeps the sagittal suture from being in the center of the birth canal. While a certain amount of asynclitism is normal, severe cases could stop labor from moving forward.

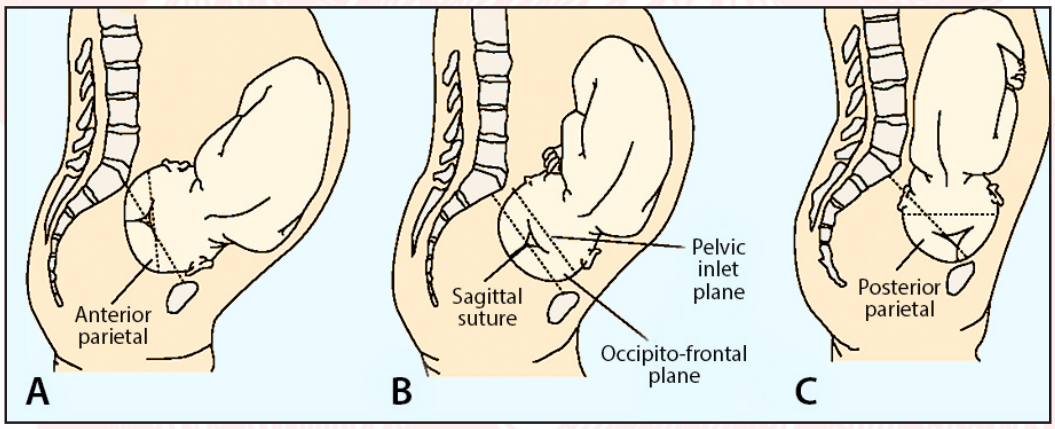


Figure 8.2: Synclitism and Asynclitism

2. Maternal pelvis type:

Pelvis type also affects various malpresentations. There are four pure types of pelvises: 1) Gynecoid (round), 2) Anthropoid (oval pelvis with the long axis in the anteroposterior plane), 3) Platypelloid (oval pelvis with the long axis in the transverse plane), 4) Android (triangular or heart-shaped pelvis with anteriorly placed apex). Most women have a gynaecoid pelvis. The anthropoid pelvis can cause a persistent OP position, the platypelloid pelvis can cause a transverse arrest, and the android pelvis can cause all malpresentations.

3. Fetal head diameter:

The fetal head's smallest diameter is known as the suboccipitobregmatic diameter. This diameter lines

up with the pelvis during full flexion, making delivery simpler. However, larger head diameters are presented due to fetal head extension, which can occur in occiput posterior (OP), face, brow, and some breech presentations. This makes delivery more difficult.

Occiput Posterior Position :

In the OP position, the back of the baby's head faces the mother's spine, with the face towards the abdomen. Although most babies turn to the OA position before birth, in 5-12% of cases the baby stays in this OP position. When this happens, the baby's head is slightly tilted back and moves into the curve of the lower spine.

Diagnosis of OP position:

Observation and examination of the patient are necessary for diagnosis. The occiput posterior (OP) position is clinically indicated by prolonged labor and excruciating back pain. Since the anterior fontanelle is easiest to palpate during a vaginal examination when the baby's head is partially deflexed, it serves a diagnostic purpose. Finding the sagittal suture when palpating the anterior fontanelle is crucial. Ultrasound imaging could be useful as well..

There is no discernible difference between occiput anterior (OA) and persistent occiput posterior (OP) delivery positions. Cervical dilation and the vertex's descent through the birth canal can be used to gauge how far along labor is. Anal sphincter lacerations, cesarean sections, and assisted vaginal delivery are more common during labor in the OP position, which also tends to be longer. There is no discernible difference between perinatal mortality and Apgar scores in the OP and OA positions.
Spontaneous delivery, manual rotation, vacuum delivery, forceps delivery, and forceps rotation are the five options for vaginal delivery in the OP position.

1. **Spontaneous delivery:**

   45% of deliveries occur spontaneously. The baby's head cannot move upward until the face has passed the symphysis pubis; hence the vertex must pass through the posterior pelvis. It places strain on the perineum. The delivery, however, is mostly easy.

2. **Manual rotation:**

   The manual rotation enhances the natural and normal forces of rotation. Rotation occurs when the flexed head strikes the muscles of the pelvic floor (levator sling). Hence, the clinician must flex the head. This is accomplished by placing a hand in the posterior pelvis behind the occiput and applying rotatory force.

   When the woman is pushing her head down on the levator sling, she should try to rotate it by using her natural ability to bend and turn. Manual rotation can be attempted with the patient in the lithotomy, the Sims, or the hands-and-knee positions.

   If the baby is in a straight position, the dominant hand rotates it. If the baby is in a ROP or LOP position, the rotation should be as short as possible. So, turn the baby in the ROP position clockwise and turn it in the LOP position counterclockwise. The hand that pronates during the rotation should be used for the ROP position and the LOP position.

   The manual rotation is safe and requires no instrumentation.

3. **Vacuum Delivery:**

   An assisted vaginal delivery is not always indicated by the OP position. To make flexion easier, the vacuum cup should be placed on the flexion point anterior to the posterior fontanel.

Ultrasound should be taken into consideration to confirm the head's precise position because the doctor may not be certain about it. By bending the head and pulling it down on the levator sling, the vacuum can either encourage rotation or pull the head out in the OP position. Delivery will therefore take place in the OA position. When traction is applied, the head frequently rotates 180 degrees.

However, the cup should not be subjected to direct rotational force as this could cause the cup to split from the baby's head and produce a cookie-cutter injury.

To reach the flexion point for a baby in the OP position, the vacuum cup must be positioned as posteriorly on the head as feasible. When using a vacuum, the delivery process for the OP position is the same as that of forceps or spontaneous delivery. The extractor's shaft needs to be maintained at a straight angle to the cup's plane, just like with any vacuum delivery. Third- and fourth-degree tears are more common in the OP position.

4. **Forceps Delivery:**

In cases of occiput posterior (OP) presentation, the standard indications for forceps delivery remain applicable. The delivery mechanism mirrors that of a spontaneous OP delivery, wherein the fetal head descends through flexion. Forceps can accommodate the OP vertex as effectively as they do the occiput anterior (OA) vertex.

It is essential for the fetal face to pass beneath the symphysis pubis prior to the head flexing upward; therefore, traction applied to the forceps must be directed more posteriorly for an extended duration compared to OA deliveries. Additionally, applying pressure to the perineum may lead to third- and fourth-degree lacerations.

In the context of an OP delivery accompanied by a prolonged second stage of labor, significant molding and edema of the fetal head may occur. Initially, the vertex may appear to be at a +2 station or even visible at the perineum; however, a thorough examination may reveal that the fetal head is elongated and the biparietal diameter is not fully engaged. In such scenarios, a Cesarean delivery becomes necessary.

5. **Forceps Rotation:**

Only skilled clinicians trained in the Scanzoni maneuver should use forceps for rotating a baby in the OP position.

Breech presentation:

Breech presentation is when the baby's bottom is first in the birth canal and the head comes last.

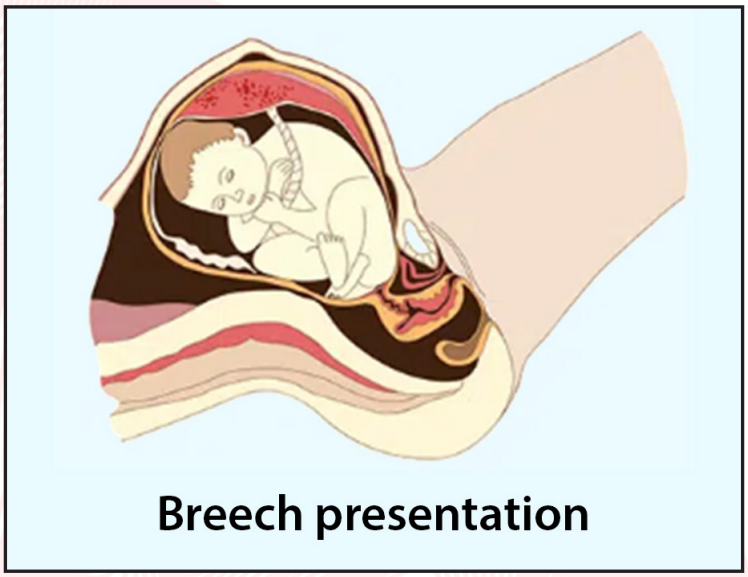


Figure 8.3: Breech presentations

Breech presentations may be classified as:

1. Frank breech: In this type of breech the hips are flexed, and the legs are extended over the anterior surface of the body
2. Complete breech: In this type of breech the hips and legs are flexed (tailor-sitting or squatting)
3. Footling breech: In this type, one or both hips are extended, with one or both feet presenting. One or both feet may commonly be palpable on vaginal examination.

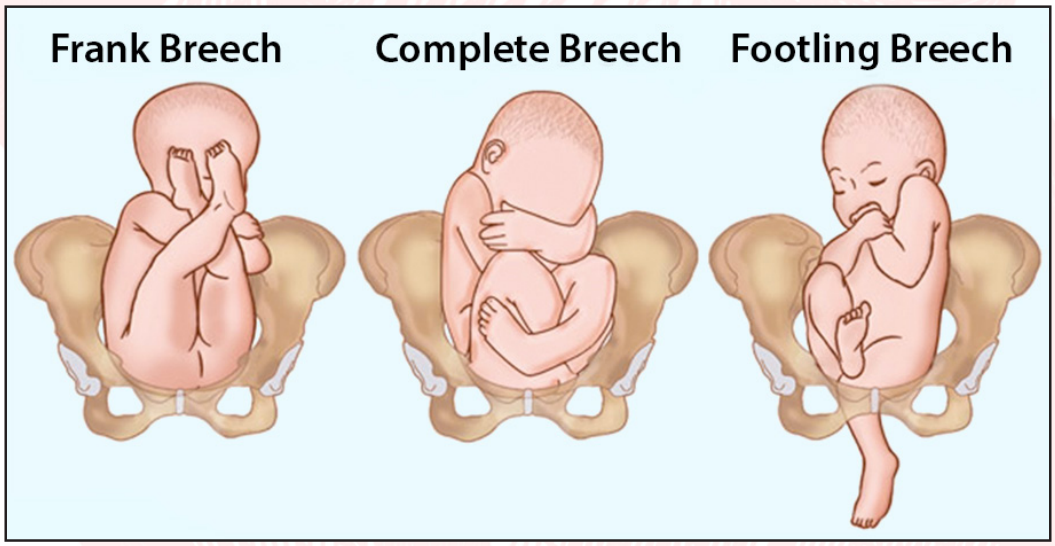


Figure 8.4: Classifications of breech presentation

4. The prevalence of breech presentation drops to 3-4% as the fetus gets closer to term. High parity, relaxation of the abdominal and uterine walls, uterine anomalies, pelvic tumors, poly- or oligohydramnios, hydrocephalus in the fetus, anencephaly, Down syndrome, macrosomia, multiple pregnancies, placenta previa, cephalopelvic disproportion, and prior breech delivery are among the risk factors for breech presentation.

Diagnosis of breech:

Abdominal palpation and vaginal examination can be used to make the diagnosis. The firm, round, bal-

lotable head is felt in the uterine fundus during Leopold's maneuver. When breech presentation is diagnosed in the final trimester, an ultrasound is recommended. Until the patient presents with ruptured membranes at full term or in labor, the diagnosis should not be made.

Vaginal examination:

This method may reveal tiny pieces of the breech. Making the distinction between a hand and a foot is crucial. It's possible that the breech feels a lot like a vertex.

Finding fontanels and sutures to indicate a vertex is crucial. The mouth and malar prominences create a triangle in breech, whereas the anus and ischial tuberosities make a straight line. If the examiner inserts their finger gently into the opening, the fetus will suck on it if it is the mouth, and it will be covered in meconium if it is the anus.

1. **Prenatal Breech Presentation Management:**

   Breech presentation management consists of four components:

2. **Finding the cause:**

   The breech presentation must have a reason, which is typically found by ultrasonography.

3. **Breech-turning exercises:**

   The woman may try specific breech-turning exercises. These workouts are safe, but their efficacy cannot be established.

4. **External cephalic version (ECV):**

   ECV is a recognized part of the prenatal care of breech presentation. It involves manipulating the baby through the woman's uterus and abdominal wall to transform the infant from breech presentation to vertex. ECV is not advised before about 37 weeks of pregnancy, but postponing it past that point increases the risk of labor or membrane rupture. ECV should be attempted in early labor when membranes are intact.

   This method is characterized by its simplicity and affordability, and it has the potential to reduce the rates of cesarean deliveries. The likelihood of experiencing adverse events as a result of external cephalic version (ECV) is minimal.

   While clinical guidelines enumerate several contraindications for ECV, there is a scarcity of robust evidence concerning many of these restrictions. In cases where vaginal delivery is deemed inadvisable due to conditions such as placenta previa or a history of classical cesarean delivery, ECV should be avoided.

   A systematic review has indicated that there is substantial evidence supporting three specific contraindications: a history of placental abruption, severe preeclampsia (or HELLP syndrome), and issues related to fetal monitoring, particularly concerning abnormal Doppler ultrasound findings.

   Procedure for External Cephalic Version:

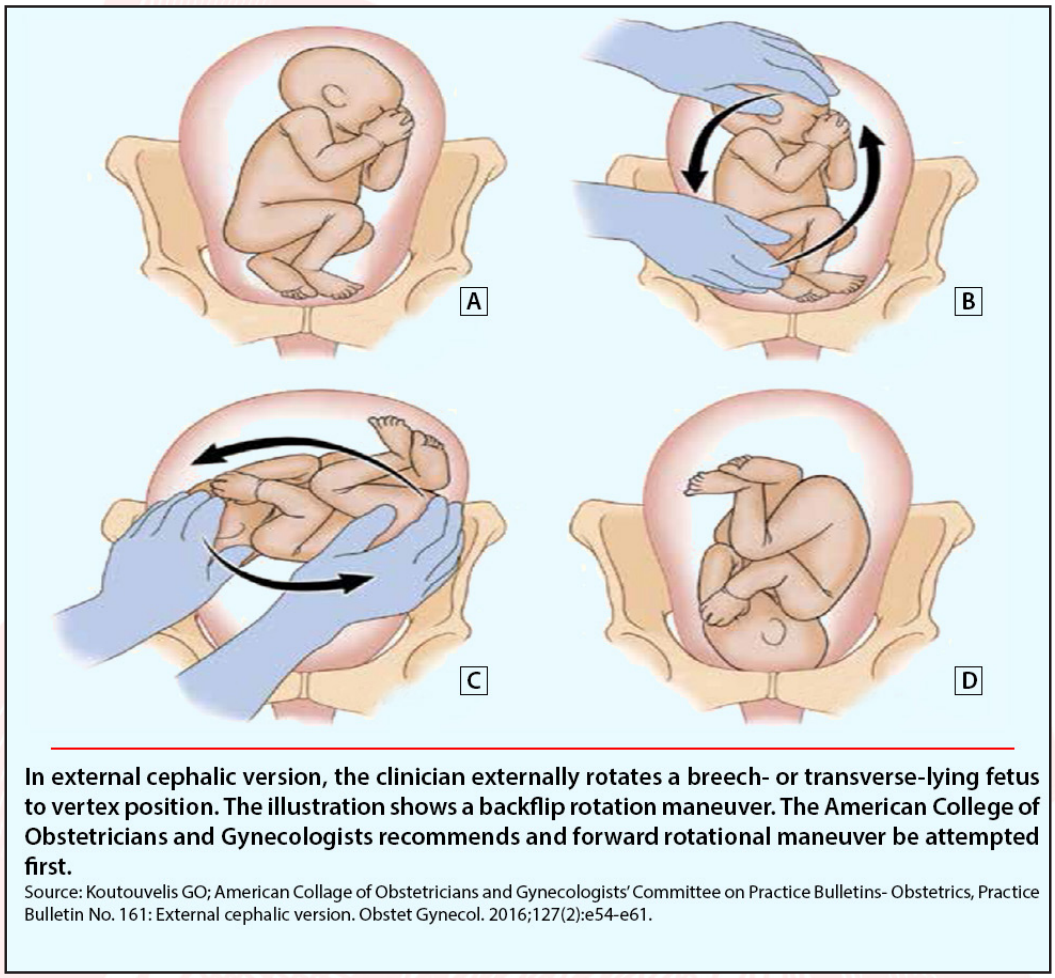
   Preparation of the patient:

   1. The patient should fast (NPO) for 6-8 hours prior to the procedure.
   2. The patient should be gowned and have an emptied bladder.
   3. Confirm breech presentation with ultrasound and check for fetal anomalies.
   4. Perform a nonstress test.
   5. Obtain informed consent.

6. Ensure cesarean delivery facilities are available.
7. Establish intravenous (IV) access.
8. For tocolysis, administer 0.25 mg of terbutaline subcutaneously 15 minutes before starting the ECV, or intravenously immediately before the procedure.
9. Position the patient supine with a slight left lateral tilt and Trendelenburg position, with knees slightly bent.

Procedure done by two physicians:

1. Physician 1 elevates the fetus in breech presentation from the pelvis by placing a hand supra-pubically beneath the fetal buttocks.
2. Physician 1 applies pressure to the fetus, directing it into the iliac fossa. Concurrently, Physician 2 flexes the head and rotates the fetus into an oblique position. The application of force should be distributed such that two-thirds is directed towards the breech and one-third towards the head.
3. Both physicians are to rotate the fetus gradually, employing just sufficient force to facilitate movement. Progress will manifest in stages, with the fetus rotating slightly, encountering resistance, and then rotating further. It is advisable to allow brief intervals of rest when resistance is detected.
4. Periodic monitoring should be conducted during and after the external cephalic version (ECV) using ultrasound, an external fetal monitor, or a Doppler stethoscope.
5. Once the fetus has moved past the transverse position, it may continue to rotate into the optimal position with minimal effort as it adapts to the contours of the uterus.
6. Gentle fundal pressure may be applied to guide the vertex over and into the pelvic inlet. An ultrasound should be performed to verify the fetal position.
7. Following a successful version, continuous monitoring should be maintained for a minimum of 20 to 40 minutes, or until a reactive non-stress test (NST) result is achieved.
8. In cases involving Rh-negative mothers, it is essential to administer Rho(D) immune globulin. Should the forward roll technique prove ineffective, consider attempting a backward flip, particularly if both the vertex and breech are positioned on the same side of the maternal midline.
9. If the procedure remains unsuccessful after a duration of 15 to 20 minutes, it is advisable to cease the attempt. Should the patient experience sharp pain or find the procedure intolerable, it should be halted until she regains comfort.
10. A reassessment of the patient's condition is necessary to determine whether to continue or discontinue the procedure. In the event of bradycardia, the procedure must be stopped.
11. If bradycardia continues, the fetus should be returned to its original breech position. Should bradycardia persist, preparations for cesarean delivery should be initiated.
12. When regional anesthesia is employed, it is crucial to wait for blood pressure levels to stabilize, as it can be challenging to differentiate between fetal bradycardia caused by hypotension and that resulting from the external cephalic version procedure itself.



In external cephalic version, the clinician externally rotates a breech- or transverse-lying fetus to vertex position. The illustration shows a backflip rotation maneuver. The American College of Obstetricians and Gynecologists recommends and forward rotational maneuver be attempted first.

Source: Koutouvelis GO; American Collage of Obstetricians and Gynecologists' Committee on Practice Bulletins- Obstetrics, Practice Bulletin No. 161: External cephalic version. Obstet Gynecol. 2016;127(2):e54-e61.

Figure 8.5: ECV technique

5. Favorable mode of delivery:

The majority of breech presentations in the US are delivered via cesarean section. Cesarean delivery does not, however, eliminate all newborn morbidity, which in certain cases may result from the same issues that led to the breech presentation, such as oligohydramniosis and neuromuscular illness. According to current ACOG standards, if a skilled doctor is available and the patient chooses to have a vaginal breech delivery after receiving thorough risk counseling, then it is permissible to offer this option.

Elective Vaginal Breech Delivery Contraindications:

- Inconsistent definition of macrosomia based on 3,800 g
- Absence of a doctor with vaginal breech birth experience
- Breech footling
- Prolapsed concealed cord
- Growth restriction within the womb
- Absence of resources to quickly switch to caesarean delivery
- abnormalities of the fetus that prevent vaginal delivery
- Indications of a weak pelvis
- Head extended (stargazing) on ultrasonography

Vaginal delivery of breech presentation:

1. Check presentation, dilation, and cord:

Have patience and allow the breech to descend on its own.To prevent head entrapment at the cervix, the cervix must be fully dilated. Because the doctor must feel for the soft cervix against the soft buttocks rather than the firm skull, determining full dilation might be challenging.

Feeling for an occult cord is crucial due to the higher prevalence of cord prolapse. Cord compression during the second stage of childbirth might induce recurrent varied decelerations in babies.

After an hour of vigorous pushing or 90 minutes of passive second stage, the Society of Obstetricians and Gynecologists of Canada (SOGC) guidelines advise a cesarean delivery if delivery is not imminent.

A frank breech presentation distends the perineum and dilates the introitus similar to a vertex presentation. Episiotomy was traditionally done but is selectively done now when additional room is required to perform maneuvers e.g., Piper forceps application.

2. See umbilicus , deliver the legs :

In the frank breech position, the baby is delivered with the hips aligned in the anteroposterior plane, and the sacrum positioned either left or right. The anterior hip moves down into the introitus, similar to the anterior shoulder, passing beneath the symphysis. As the baby's body laterally flexes, the posterior hip is delivered across the perineum. Following this, external rotation occurs, and the baby's back turns to the front.

The delivery should continue naturally until the baby's umbilicus is visible at the introitus. physicians should avoid pulling on the baby before the umbilicus has been delivered, as premature traction could lead to the baby's head extending or the arms being positioned around the neck.

The legs in the frank breech presentation may be delivered by inserting a finger behind the knee to flex the knee and abduct the thigh (Pinard maneuver). The legs deliver spontaneously, and the feet spring free eventually.

After the umbilicus is delivered, gentle downward traction can be used to deliver the torso. The baby is grasped on the pelvis by the physician's fingers, with thumbs on the sacroiliac regions. Traction should be directed toward the floor at a 45-degree angle. The doctor might get on his knees beneath the infant.

3. See inferior angle of scapula , deliver the arms:

The delivery of the trunk may involve varying degrees of effort. Facilitating the rotation of the baby's back from one anterior oblique position to another can aid in the extraction of the trunk and may promote the arms to adopt a flexed position across the chest. Maintaining an anterior sacrum during delivery is crucial, as it enables the baby's head to enter the pelvis in an occipito-anterior (OA) position.

The delivery of the arms is achieved by rotating the baby's body into an oblique orientation. The tip of the baby's scapula will be visible and easily identifiable due to its winged ap-

pearance. The anterior arm can then be gently swept down across the baby's chest and out through the introitus.

When delivering the humerus, it is advisable to splint it using two fingers instead of hooking the antecubital fossa with a single finger. The delivery of the opposite arm follows a similar approach, requiring rotation of the baby into the corresponding oblique position.

4. **See the nape of neck , deliver head by modified Mauriceau-Smellie-Veit (MSV) maneuver:**

The most challenging aspect of a breech delivery is the head delivery, which comes after the trunk delivery. The head quickly follows the delivery of the arms. The head might not be low enough to start assistive measures, though.

The doctor ought to make an effort to view the nape of the neck. For as long as 30 seconds, the infant can hang with its head still inside the pelvis. The sacrum ought to be in front. Flexion through the pelvis should be used to deliver the head. Due to favorable diameters presented to the pelvis, the head passes through the birth canal by further flexion when it is flexed and OA, just like in a vertex OA delivery.

The MSV maneuver has been modified to encourage flexion. With one finger on the baby's occiput and one on each shoulder, the doctor's hand should be positioned inside the vagina superior to the infant. The baby is placed under the other hand.

Because it can dislocate the jaw, the traditional MSV maneuver—which involves putting a finger in the mouth—is no longer advised. Alternatively, the maxillae can be touched with two fingers. An assistant should be ready to flex the head through the pelvis by applying suprapubic pressure.

Prior to the head being delivered, the assistant may hold the baby in a sling. The head delivery process starts once it is in the proper position. Four distinct mechanisms work together to flex the head through the pelvis: the occipital finger flexes the occiput, the assistant applies suprapubic pressure, the maxillae fingers apply pressure to the lower face, and the sling raises the baby's body upward.

Using downward pressure from the fingers on the shoulders, traction is achieved. As the fetus's body defines its arc, the assistant holding it in a sling may hold its feet and gently tug. To prevent hyperextension, the baby's body should remain in a neutral position with respect to the head.

5. **Lift Baby Onto Mother:**

The sacrum almost always rotates into an anterior position during breech delivery because the trunk delivers after the buttocks. If the baby shifts into a sacrum posterior position, the doctor must gently rotate and guide the baby into the sacrum anterior position before the arms are delivered. When the mouth and nose come out over the perineum, they could be suctioned.

The skull's vault

It is then delivered by further flexion using the Ritgen maneuver. As soon as the head appears, the baby's body flips over onto the woman's abdomen.

If the baby does not need it, a delayed cord clamping is acceptable because breech babies are more likely to require resuscitation because of increased cord compression during the second stage of labor.

Neonatal resuscitation requires the presence of additional personnel in all vaginal breech deliveries.

Cesarean Delivery of a Fetus in Breech Presentation:

Cesarean sections are used for the majority of planned breech deliveries. A significant portion will require cesarean delivery, even in cases where a vaginal breech delivery is planned. Due to cord prolapse and fetal intolerance of the second stage of labor, some of these deliveries will require an emergency cesarean section. The same techniques used in vaginal delivery must be used to extract the baby in the breech presentation during cesarean delivery.

Piper forceps:

When the MSV maneuver is unsuccessful, forceps are indicated. The purpose of Piper forceps was to deliver a breech presentation of the fetus's head. They have an axis-traction curve and are long. In a generic basket catch, the blades seize the fetal head. Although there are no strict guidelines, if the MSV maneuver is attempted and no improvement is seen after two to three minutes, Piper forceps should be taken into consideration. If the fetus is premature, piper forceps may also be used.

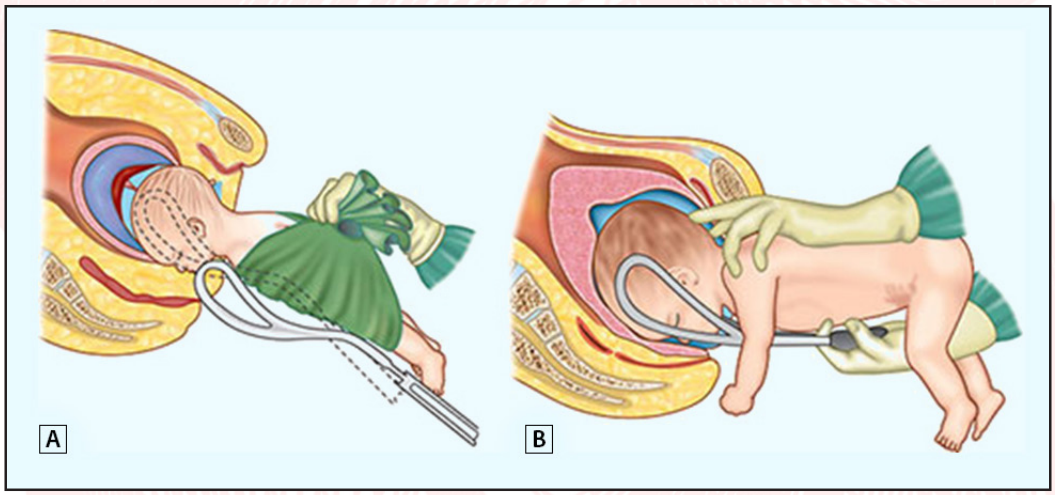


Figure 8.6: Piper forceps

Complications of Breech Delivery:

1. Nuchal arms:

The head delivery may be hampered by the nuchal arm, which is when one or both arms are wrapped around the back of the neck. The head and extended arm may be delivered together if the fetus is small or the pelvis is large. In order to remove the arm from the nuchal position, the doctor may rotate the fetus 90 to 180 degrees in the direction of the hand or attempt to flex the arm and sweep it down over the face and chest.

2. Hydrocephalus:

A breech birth and an entrapped head are two symptoms of hydrocephalus. A cesarean delivery is typically the outcome of a prenatal diagnosis of hydrocephalus. In the absence of a quick cesarean delivery, decompression of the fetal ventricles is the only method to deliver a live baby, even though it may be harmful to the fetus. Using a long needle, cephalocentesis can be performed transvaginally or transabdominally.

3. Symphysiotomy:

In order to free a trapped head, the pelvic symphysis ligaments are cut during this emergency procedure. Although it is rarely utilized in privileged environments, it can save lives when used in low-resource environments. Orthopedic and urological injuries are among the risks for mothers.

Transverse Lie, or Shoulder Presentation:

A transverse lie occurs when the fetus's long axis is perpendicular to the mother's. The incidence is 0.3% at term. Predisposing factors include multiparity, placenta previa, a contracted pelvis, and uterine myoma.

The diagnosis is suspected when the fundal height is less than expected, the fetal head is located in the iliac fossa, and the fetal heart rate is auscultated near the umbilicus. Patients with a transverse lie should not undergo labor due to the risks of uterine rupture or cord prolapse. Maternal deaths can result from hemorrhage, infection, and complicated surgery. For the fetus, there is a risk of cord prolapse, intrauterine death, and traumatic delivery. Typically, a transverse lower segment incision is performed, although a vertical lower uterine incision may be considered when there is uncertainty regarding the position of the fetal back.

Early diagnosis, skilled assessment, and planned delivery by the most suitable route by an experienced obstetrician are crucial for optimal outcomes. Operative delivery by cesarean section is mandatory in most cases. Successful management relies on timely intervention, with cesarean section being preferred over destructive procedures.

Face Presentation:

Face presentation is a fetal presentation where the face, extending from the forehead to the chin, leads as the fetal part descending into the birth canal. In this presentation, the neck is hyperextended, and the face is foremost, with the submento-bregmatic diameter being the largest leading diameter.

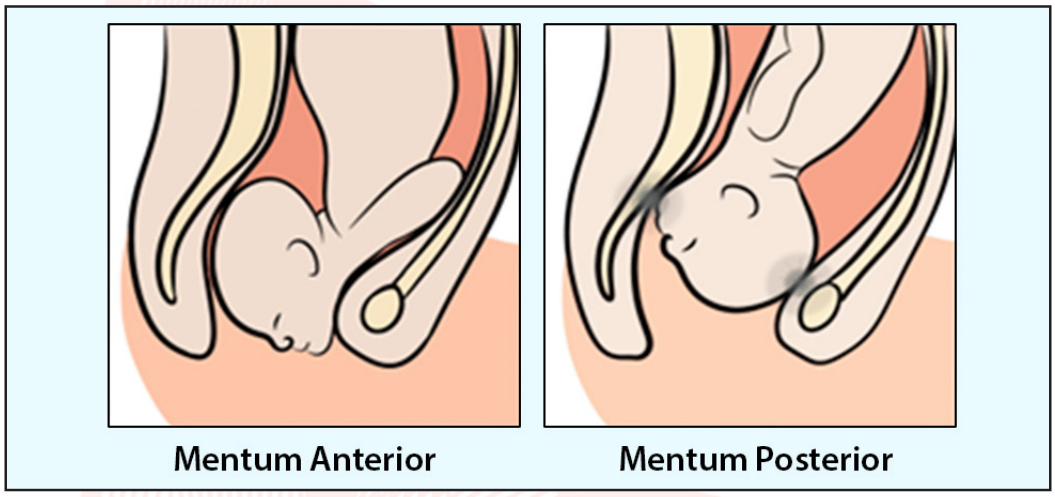


Figure 8.7: Face presentation

Brow Presentation:

Brow presentation is characterized by the extension of the fetal neck, with the orbital ridge and anterior fontanelle presenting at the pelvic inlet, meaning the presenting diameter is mento-vertical. In cases where the diagnosis is confirmed, an emergency caesarean section should be performed.

Compound Presentation:

A compound presentation occurs when one or more limbs prolapse alongside the head or the breech, with both entering the pelvis simultaneously. This category does not include footling breech or shoulder presentations. An associated prolapse of the umbilical cord is seen in 15 to 20 percent of these cases.

Multiple gestation:

A multiple pregnancy occurs when two or more babies are expected simultaneously, such as twins, triplets, or more. This happens in approximately one out of every 60 pregnancies. The likelihood of a multiple pregnancy increases with age or fertility treatments.

Twins or triplets can be identical (monozygotic) or fraternal (di/tri-zygotic). Identical twins or triplets originate from a single egg fertilized by one sperm that splits into two or three post-fertilization. They share the same genes, appearance, and sex. Fraternal twins or triplets come from separate eggs fertilized by different sperm, resulting in different genes and no more resemblance than any other siblings.

Chorionicity determines whether each baby has a separate placenta or if they share one. Babies with a shared placenta (monochorionic) are always identical, while those with separate placentas (dichorionic/trichorionic) are usually fraternal but can also be identical.

Maternal complications are common in multiple gestations which include anemia, hyperemesis, gestational hypertension, gestational diabetes, preeclampsia, placental abruption, placenta previa, and postpartum hemorrhage.

Diagnosis:

Multiple gestation is routinely diagnosed by ultrasound during prenatal care in privileged settings. The intrapartum diagnosis of the second twin occurs uncommonly but is most common when there is a lack of prenatal care. Findings suggestive of multiple gestation are hyperemesis gravidarum, uterine size larger than date, raised maternal serum alpha-fetoprotein levels, polyhydram-

nios, history of ovulation induction, and family history of multiple gestations.

A. Prenatal Management of Multiple Gestation:

A multiple pregnancy may heighten the likelihood of experiencing common pregnancy symptoms such as nausea, heartburn, varicose veins, back pain, fatigue, and swollen ankles.

It also raises the risk of pregnancy-related conditions, including: Anaemia, which is due to a lack of iron in your blood, necessitating an additional blood test and possibly iron supplements if your iron levels are low; Pre-eclampsia, characterized by high blood pressure and protein in your urine, requiring regular monitoring and possibly aspirin if you are at increased risk; and Gestational diabetes, which may lead to a glucose test during pregnancy.

Additionally, a multiple pregnancy can elevate the risk of needing a caesarean or assisted vaginal birth for delivery and post-partum haemorrhage, which involves heavier bleeding than usual after giving birth.

babies may be at a higher risk for certain conditions: Prematurity is more likely with twins, with about 60% of twin pregnancies resulting in birth before 37 weeks, often between 34 and 37 weeks. This increases the risk of respiratory, feeding, and infection issues, possibly requiring care in a neonatal unit. Steroids may be administered to aid lung development if early birth is anticipated. Growth problems affect about 20-30% of twins, necessitating more frequent scans.

The possibility of IUGR is higher in multiple pregnancies and surveillance with ultrasound is required for interval growth. An ultrasound examination every four weeks, starting at approximately 24 weeks gestation is recommended.

Twin to Twin Transfusion Syndrome (TTTS) is a risk for monochorionic twins sharing a placenta, where the 'donor' twin may have too little blood and low blood pressure, and the 'recipient' twin too much blood and high blood pressure.

Fetal mortality rates are significantly higher in twin pregnancies compared to singleton pregnancies. Fetal heart rate (FHR) should be monitored at every prenatal appointment using ultrasound. Due to the increased risk of intrauterine fetal demise, it is advised to routinely induce labor for diamniotic/dichorionic twin pregnancies at 38 weeks and for monoamniotic/dichorionic twin pregnancies at 36-37 weeks gestation.

B. Intrapartum Management of Multiple Gestation:

Malpresentations, cord prolapse, locked twins, placental abruption, and postpartum hemorrhage are examples of intrapartum complications. The twins' presentation is the primary cause of the majority of these issues.

The infant may be in a transverse lie, breech, or vertex position. The most prevalent presentations are vertex-vertex. Labor can be permitted to progress to vaginal delivery with the right monitoring and emergency cesarean arrangements in place.

If the second twin is doing well, the time between deliveries is not crucial, but oxytocin augmentation is frequently used if there is a delay. Because the second twin may present breech or transversely after the first twin is delivered, a doctor with experience in vaginal breech deliveries should be available for all twin vaginal deliveries. One must choose between performing a cesarean delivery or attempting an ECV to vertex if the second twin is in a transverse lie or breech presentation.

Because placental abruption and umbilical cord prolapse can happen in between the twins' deliveries, the second twin needs to be closely watched. It is best to deliver twins in the operating room so

that plans can be made promptly in the event of a cesarean delivery.

There should be an anesthetist on call. For the second breech twin, some doctors recommend a cesarean delivery; however, if the doctor is skilled in vaginal breech delivery and internal podalic version, a cesarean delivery is not required. If the baby weighs more than 1,500 grams or is more than 32 weeks along in the gestation, the second twin can be delivered vaginally breech. A breech extraction can be performed when the second twin presents obliquely, transversely, or as a footling breech.

Without rupturing the second gestational sac, the physician can lower the feet. The feet can be found with an abdominal ultrasound. To push the baby's head into the uterine fundus, the doctor's second hand or an assistant can gently press on the abdomen. The membranes are then ruptured while maintaining a constant downward traction on the feet for the breech presentation. The arms and head are delivered similarly to other vaginal breech deliveries following the delivery of the umbilicus. Birth attendants should always be aware of the possibility that an ultrasound has not been performed.

Cord prolapse, placental abruption, incapacity to reach the feet for internal podalic version, and breech extraction of a baby in a transverse lie are among the circumstances that necessitate cesarean delivery for twin gestations.

There should be an option for an immediate cesarean delivery because the cervix may close after the first twin is delivered. In most cases, a cesarean delivery is advised when the first twin is in a non-vertex. When the first twin is in breech presentation and the second twin is a vertex or in a transverse lie, a rare and catastrophic event known as locking or collision of the twins may occur.

It has been decided that ECV of a breech first twin is contraindicated. Due to the uterus's overdistension, postpartum hemorrhage is rather common in multiple pregnancies. Complete preparations should be made, including blood products, oxytocic medications, and IV access. Prematurity frequently necessitates neonatal resuscitation.

Chapter Nine

Assisted Vaginal Birth

Learning Objectives:

Upon completing this chapter, participants will be able to:

1. Define the assisted vaginal birth and discuss its potential causes.
2. Differentiate between different types of assisted vaginal birth.
3. Outline the indications and contraindications of different types of assisted vaginal birth.
4. Discuss the appropriate preparations for the different assisted vaginal birth techniques.
5. Outline the postnatal care.

Introduction

The majority of vacuum and forceps deliveries, when conducted properly by trained professionals, lead to safe outcomes for both mother and child. Women who have an assisted vaginal delivery for their first childbirth are more likely to experience uncomplicated vaginal births in future pregnancies (Royal College for Obstetricians and Gynecologists RCOG 2020).

However, obstetricians, midwives, and neonatologists should be cognizant of the fact that serious, rare, complications such as subgaleal hemorrhage, intracranial hemorrhage, skull fractures, and spinal cord injuries can lead to perinatal morbidity or mortality. These complications are more likely with midpelvic, rotational, or unsuccessful assisted vaginal deliveries.

Opting for a caesarean delivery late in the second stage of labor presents its own challenges and can lead to significant maternal and perinatal morbidity. Therefore, it necessitates intricate decision-making when weighing the options of assisted vaginal delivery against a caesarean delivery in the second stage.

An assisted vaginal birth occurs when healthcare professionals use specialized instruments to aid in the delivery of your baby. This information is intended for those who want to learn more about assisted vaginal birth, also referred to as operative vaginal birth.

The prevalence of Assisted Vaginal Birth (AVB) differs globally, being more prevalent in high-income countries. In the United States, increasing rates of cesarean deliveries have coincided with a decline in AVB usage. This decline is even more significant in middle- and low-income countries, where AVB is used in less than 1% of births, despite its potential benefits, especially in regions where access to emergency obstetric care is limited and cesarean deliveries may pose greater risks.

Types of assisted vaginal

An assisted vaginal birth is designed to aid in delivering the baby when the cervix is fully dilated during the final stage of labor. Assisted births are necessary for various reasons, primarily if the baby is not progressing through the birth canal, is in distress during birth, or if you are unable to push or have been advised against it. The goal of an assisted birth is to emulate a normal (spontaneous) delivery while minimizing risk to both mother and child. To achieve this, an obstetrician or midwife may use specialized instruments, such as a vacuum extractor or forceps, to facilitate the baby's birth.

Prior to an assisted birth, the obstetrician will ensure that vaginal delivery is safe for the baby. This includes an abdominal palpation and an internal examination. Pain relief should be provided during an assisted birth, either through a local anaesthetic injection in the vagina (pudendal block) or a regional anaesthetic around

the back nerves (epidural or spinal).

An empty bladder is necessary for an assisted birth, and a catheter may be used to empty the bladder. If there is uncertainty about a vaginal birth, the procedure may take place in a theatre to allow for a swift transition to a caesarean section if required. A caesarean section involves making an incision in the abdomen to deliver the baby.

Vacuum (Ventouse) birth

A ventouse, also known as a vacuum extractor, is a device that employs suction to affix a soft or hard cup, made of plastic or metal, onto the baby's head. This cup is connected via tubing to a suction apparatus.

Once activated, the machine creates a vacuum that securely attaches the cup to the baby's head. During a contraction, as the woman pushes, the obstetrician or midwife carefully pulls on the device to assist in delivering the baby.

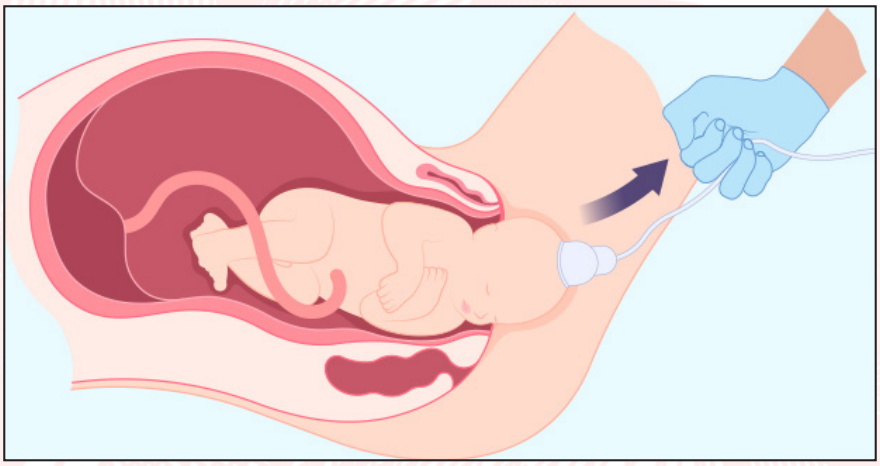


Figure 9.1: Vacuum (Ventouse) delivery

Forceps delivery

Forceps are smooth metal instruments resembling large spoons or tongs, curved to fit around a baby's head. They are meticulously positioned and joined at the handles around the baby's head. During a contraction, with the woman's effort, an obstetrician gently pulls with the forceps to assist in delivering the baby.

There are various types of forceps, with some designed to rotate the baby, such as when the baby's back is facing the mother's back. The obstetrician will select the type of forceps that best suits the individual situation.

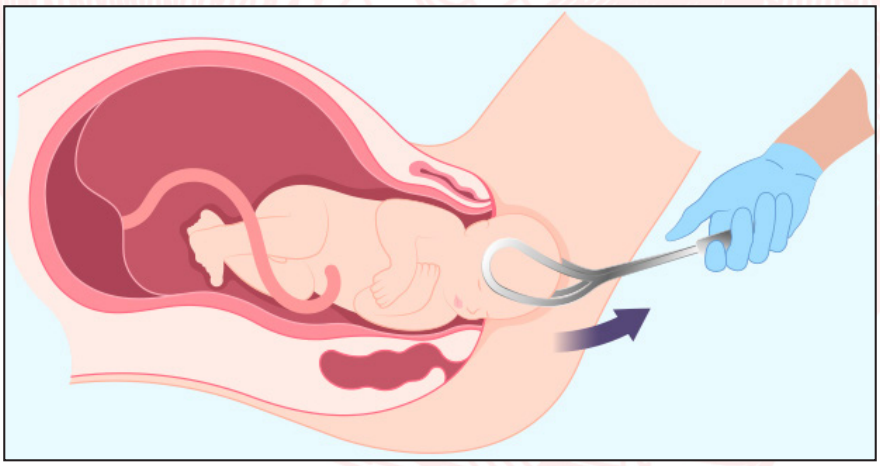


Figure 9.2: Forceps delivery

Indications for assisted birth

The indication for assisted birth should be individualized, but may include:

- Inadequate progress in the second stage of labour in the presence of adequate contractions.
- Abnormal fetal heart rate (FHR) pattern or abnormal fetal scalp sample in the second stage of labour.
- To reduce the effects of the second stage of labour on maternal medical conditions, or other condi tions resulting in the woman's inability to actively push
- Malposition of the fetal head.

Contraindications to assisted birth

- Fetal bleeding disorders (relative).
- Fetal tendency to bone fracture (relative).
- 1/5 of the fetal head palpable abdominally.

Safety criteria for operative vaginal birth (Adapted from the RCOG guideline)

Safe assisted vaginal birth requires a careful assessment of the clinical situation, clear communication with the woman and healthcare personnel, and expertise in the chosen procedure.

Table 9.1: Safety criteria for for assisted vaginal birth

Full abdominal and vaginal examination	• Head is < 1/5 palpable per abdomen (in most cases not palpable) • Cervix is fully dilated and the membranes ruptured • Station at level of ischial spines or below • Position of the fetal head has been determined • Caput and moulding is no more than moderate (or+2)[a] • Pelvis is deemed adequate
Preparation of month	Clear explanation given and informed consent taken and documented in women's case notes Trust established and full cooperation sought and agreed with woman Appropriate analgesia is in place: for midpelvic or rotational birth, this will usually be a regional block; apudendal block may be acceptable depending on urgency; and a perineal block may be sufficient for low or outlet birth Maternal bladder has been emptied Indwelling catheter has been removed or ballon deflated Aseptic technique
Preparation of staff	Operator has the knowledge, experience and skill necessary Adequate facilities are available (equipment, bed, lighting) and access to an operating theatre Backup plan: for midpelvic births, theatre facilities should be available to allow a caesarean birth to be performed without delay; a senior obstetrician

Analgesia Epidural

- May increase the need for assisted vaginal birth although this is less likely with newer analgesic techniques.
- Adopt lying down lateral positions rather than upright positions in the second stage of labour as this increases the rate of spontaneous vaginal birth.
- Consider delaying pushing for one to two hours in nulliparous women with epidural analgesia as this may reduce the need for rotational and midpelvic assisted vaginal birth.
- Do not routinely discontinue epidural analgesia during pushing as this increases the woman's pain with no evidence of a reduction in the incidence of assisted vaginal birth.

Vacuum extraction vs forceps-assisted birth

Assisted birth using vacuum or forceps can lead to significant complications, with distinct risks for each method. In choosing the instrument for assisted vaginal birth (AVB), it is crucial to opt for the one that maximizes the likelihood of a successful vaginal delivery using the primary instrument.

The use of multiple instruments sequentially increases maternal and neonatal morbidity; therefore, it is vital to reduce the necessity for a second instrument. This reduction can be accomplished by judiciously selecting the primary instrument, taking into account clinical findings and the woman's preferences. The likelihood of not completing the birth with a single instrument is higher with vacuum extraction, whereas forceps are more likely to cause maternal perineal trauma.

The use of Ventouse is preferable in the following circumstances:

- Low lift out delivery, especially if there has been no previous analgesia
- Rotational delivery if the operator has inadequate experience with Kielland forceps
- Operator or maternal preference when either Ventouse or forceps would be equally suitable
- Ventouse must not be used below 32+0 weeks and must be used with caution between 32+0 and 36+0 weeks
- Vacuum and difficult instrumental deliveries are contraindicated in women with bloodborne viruses or at risk of coagulation defects or if there is a risk of bleeding in the fetus
- There is a higher risk of subgaleal haemorrhage and scalp trauma with vacuum extraction compared with forceps at preterm gestational ages.
- Rapid negative pressure application for vacuum-assisted birth is recommended as it reduces the duration of the procedure with no difference in maternal and neonatal outcomes.
- Soft cup vacuum extractors have a higher rate of failure but a lower incidence of neonatal scalp trauma.
- Discontinue vacuum-assisted birth where there is no evidence of progressive descent with moderate traction during each pull of a correctly applied instrument by an experienced operator.
- Maximum of three pulls to bring the fetal head on to the perineum. Three additional gentle pulls can be used to ease the head out of the perineum.
- Ensure no cervix or vaginal wall is trapped beneath the rim of the cup
- When using the disposable Kiwi Ventouse cup, pump to the yellow zone, followed by a further safety check, then increase pressure to green zone.

- Discontinue vacuum-assisted birth if there have been
  1. Two 'pop-offs' of the instrument by experienced operators
  2. One 'pop-off' of the instrument by a less experienced operator and seek a second opinion to optimise chance of success.
  3. The application of suction to the fetal head is ≥12 minutes
  4. It is more than 30 minutes from the decision for instrumental delivery being made.

Forceps

The use of forceps is preferable in the following circumstances:

- Face presentation
- After coming head of the breech
- Marked active bleeding from a fetal blood sampling site
- Contra indication to ventouse delivery in the absence of contraindications for forceps delivery
- Large caput noted
- The mother is unable or unwilling to push with contractions
- Operator or maternal preference when either instrument would be equally suitable

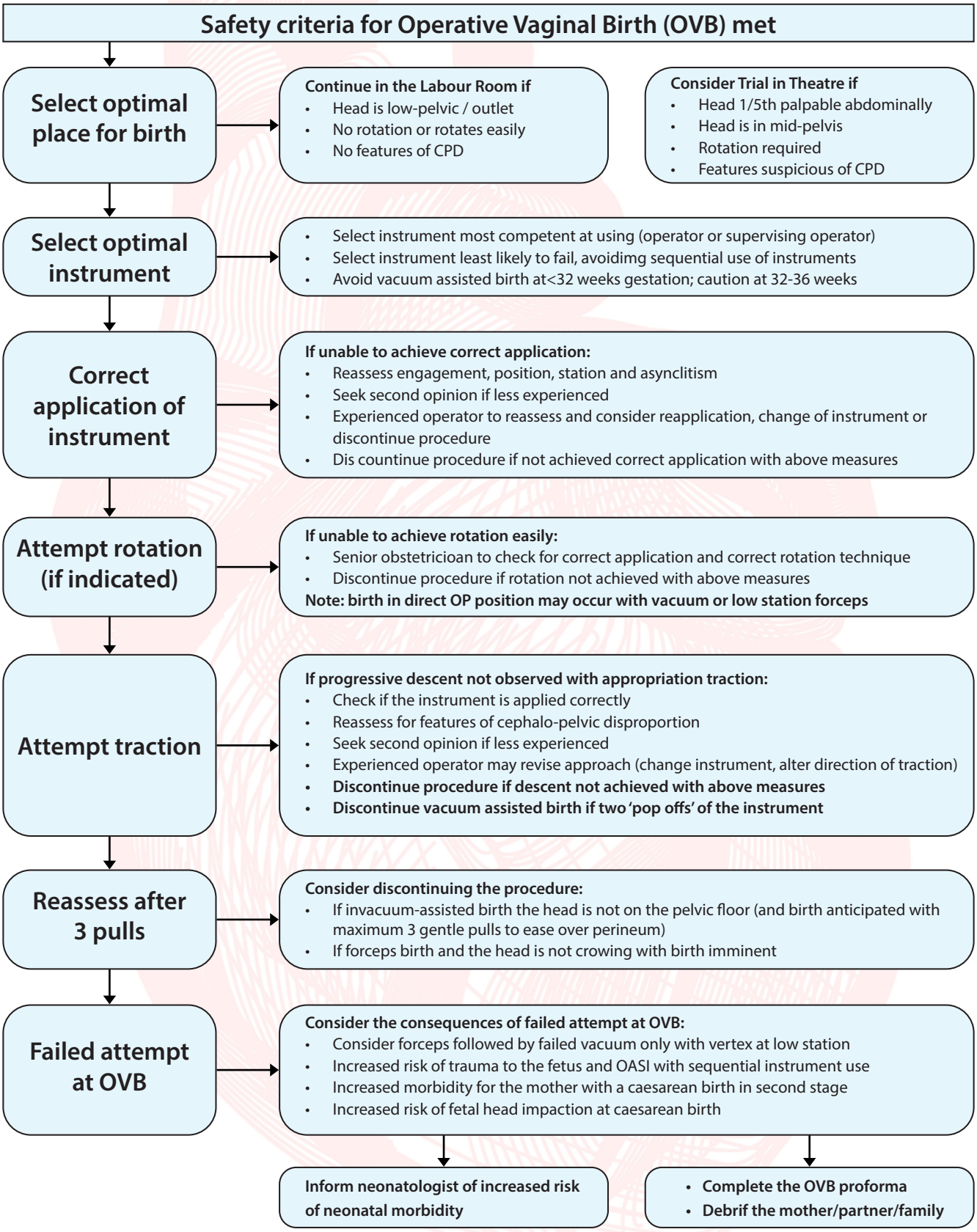
Check that the forceps are a pair before starting the procedure:

- Lock them together and make sure they are a symmetrical neat fit
- The maximum diameter between the blades must be at least 9cm

Cease the attempt at forceps delivery when:

- The forceps are not easily applied
- The handles do not come together smoothly
- There is no progressive descent despite moderate traction
- Gentle pressure does not result in easy rotation in rotational forceps
- The birth is not forthcoming after three pulls with the instrument correctly in place.

Algorithm 9.1: RCOG decision making guidelines for assisted vaginal birth



Antibiotics prescription

Prescribe antibiotics for every instrumental delivery as following:

First line treatment:

Intravenous Cefuroxime 1.5g single dose and Metronidazole 500 mg single dose (Women with a BMI > 35 will require additional antibiotic cover).

Women with allergies to penicillin:

- Non-life threatening allergy – Intravenous Cefuroxime 1.5g single dose and Metronidazole 500mg single dose.
- Life threatening allergy – Intravenous Gentamicin 120 mg single dose and Clindamycin 600 mg single dose.

Women with a history of MRSA:

Intravenous Teicoplanin 600 mg single dose, plus Gentamicin 2 mg/kg single dose and Metronidazole 500 mg single dose

Immediate care following operative vaginal delivery includes:

- Obtaining paired cord pH samples and recording the results.
- Performing a vaginal and rectal assessment to identify any trauma.
- Conducting perineal repair as necessary.
- Prescribing/administering analgesia – consider a Voltarol suppository of 100mg and a routine prescription of paracetamol and NSAIDs for pain relief, unless contraindicated.
- Allowing the woman to hold her baby as soon as possible after delivery and encouraging skin-to-skin contact.
- Offering an appropriate debrief to the woman in the postnatal period.
- Reassessing the woman for venous thromboembolism risk after an assisted vaginal birth.
- Informing the woman of the high probability of a spontaneous vaginal birth in future labours following an assisted vaginal birth.

Postnatal Care Observations:

After a ventouse or forceps delivery in the birthing room, it's essential to record clinical observations on the Modified Early Obstetric Warning System (MEOWS) chart and assess the risk of significant clinical deterioration.

Women with a high MEOWS score or those at high risk will require more frequent monitoring (at least every four hours). If a woman has undergone a forceps delivery in theatre with regional anaesthesia, she is considered high risk for deterioration, and the midwife should conduct observations according to the postnatal guidance for caesarean sections.

Table 9.2: Use MEOWS chart in detecting the serious ill and deteriorating women

Score	3	2	1	0	1	2	3
Temperature		<35°c	35-35.9°c	36-37.4°c	37.5-37.9°c	38.0-38.9°c	≥9°c
Systolic BP	≤70	71-79	80-89	90-139	140-149	150-159	≥160
Diastolic BP			≤49	50-89	90-99	100-109	≥110
Pulse		<40	40-49	50-99	100-109	110-129	≥130
Respiratory Rate	≤10			11-20	21-24	25-29	≥30
Oxygen Saturations	≤94%			≥95%			
AVPU				Alert	Responds to Voice	Responds to Pain	Unconscious
Urine output mLs/hr	<10	<30		Not Measured			

Bladder Care:

Women who have had regional analgesia for an assisted vaginal birth trial in theatre should be offered a catheter for up to twelve hours or until they can move independently.

Monitoring and documenting the timing and volume of the first voided urine is crucial. It's important to educate women on the risk of urinary retention and to measure post-void residual volume with a bladder scanner if retention is suspected, following the Postpartum Bladder Care guidelines.

Women should be offered physiotherapy-led strategies to minimize the risk of urinary incontinence at three months.

Psychological Care:

To reduce morbidity, shared decision-making, effective communication, and continuous positive support during labor and birth are vital. Women should be reviewed before hospital discharge to discuss the reasons for assisted vaginal birth, manage any complications, and provide advice for future births.

Chapter Ten

Postpartum Hemorrhage

Learning Objectives:

Upon completing this chapter, participants will be able to:

1. Define postpartum hemorrhage
2. Differentiate between primary and secondary postpartum hemorrhage.
3. Describe prevention (active management of the third stage of labour) and treatment of postpartum hemorrhage.
4. Recall the four Ts as causes of postpartum hemorrhage.
5. Identify risk factors for PPH and the implications on the health of the mother and baby.
6. Discuss the prevention and management of PPH.

Introduction

Postpartum hemorrhage (PPH) is the leading cause of maternal mortality and morbidity globally. Approximately one-quarter of all deaths occurring during pregnancy, childbirth, or the puerperium are attributed to postpartum hemorrhage. The incidence is notably higher in developing countries. Maternal mortality represents a significant event and serves as a crucial indicator of the overall health and development status of a country.

The five most common causes of maternal death in Western countries include postpartum hemorrhage, thromboembolic disease, hypertension-related conditions such as preeclampsia, sepsis, and deaths related to anesthesia.

Global estimates suggest that in 2020, there were 287,000 maternal deaths, with the majority occurring in the least developed countries of the world (WHO). Notably, 87% of these deaths took place in sub-Saharan Africa and South Asia.

Obstetric hemorrhage remains the primary cause of maternal mortality, representing 27% of maternal deaths globally each year. Postpartum hemorrhage (PPH) accounts for most of these fatalities. The World Health Organization (WHO) estimates approximately 14 million women suffer from PPH annually.

99% of all maternal deaths still occur in developing countries, with sub-Saharan Africa accounting for 66% of these. In these regions, the risk of maternal death due to postpartum hemorrhage (PPH) is 1 in 1,000 deliveries, which is approximately 100 times higher than in wealthier nations, where the rate is 1 in 100,000.

Based on a 2017 World Health Organization (WHO) report, Saudi Arabia had a Maternal Mortality Ratio (MMR) of approximately 17%, and the reduction rate between 2000 and 2017 was only 29%. In 2022, Saudi Arabia reported that 5,464 pregnant women suffered from postpartum bleeding, according to the Ministry of Health.

Table 10.1: Prevalence of postpartum hemorrhage in Saudi Arabia (MOH, 2022)

Complications	Total	Non-Saudi	Saudi
Vaginal Bleeding (Antepartum)	6.201	403	5.798
Vaginal Bleeding (Intrapartum)	905	68	837
Vaginal Bleeding (Post Partum)	5.464	579	4.885

Definition

The American College of Obstetricians and Gynecologists characterizes early postpartum hemorrhage as a total blood loss of at least 1,000 mL or bleeding that accompanies signs and symptoms of hypovolemia within 24 hours following the delivery of the fetus or during intrapartum loss.

Primary postpartum hemorrhage can occur before the placenta is delivered and up to 24 hours after the fetus is delivered. The complications associated with postpartum hemorrhage vary from the exacerbation of typical postpartum symptoms like fatigue and depressed mood to fatal cardiovascular collapse and hysterectomy. while secondary postpartum hemorrhage is defined as bleeding that occurs 24 hours to 12 weeks after delivery.

Table 10.2: Postpartum hemorrhage complications

Anemia	Death
Anterior pituitary ischemia with delay or failure of lactation (i.e., Sheehan syndrome or postpartum pituitary necrosis)	Dilutional coagulopathy
	Fatigue
	Myocardial ischemia
	Orthostatic hypotension
Blood transfusion	Postpartum depression

The Royal College of Obstetricians & Gynaecologists (RCOG) defines minor postpartum hemorrhage (PPH) as an estimated blood loss between 500 and 1,000 mL, and major PPH as an estimated blood loss exceeding 1,000 mL. Major PPH is further categorized into major control, if the blood loss is managed, and major persistent, if it compromises the mother's health to the extent of posing an imminent danger to life.

Table 10.3: Postpartum hemorrhage signs and symptoms

Table 1. Signs and Symptoms of Postpartum Hemorrhage	
Signs	**Symptoms**
Blood loss > 1,000 mL	Chest pain
Diaphoresis	Confusion
Hypotension	Dizziness
Hypoxia	Dyspnea
Oliguria	Nausea
Pallor	Palpitations
Syncope	Restlessness
Tachycardia	Weakness

Risk Factors

Although risk factors are a prompt to remain vigilant for PPH, in reality only a small proportion of women with risk factors experience PPH. Possible predisposing factors include, but are not limited to:

Antenatal Intrapartum

- History of previous PPH
- Large for gestational age newborn (> 4 kg)
- Placenta praevia/ accreta
- Hypertensive disorders
- Obesity
- High Parity
- Bleeding disorders

Intrapartum

- Induction and/or augmentation
- First stage labour > 24 hours
- Delay in progress of second stage
- Precipitate labour
- Instrumental delivery
- Caesarean section
- Retained placenta
- Lacerations

Prevention

Active management of the third stage of labor (AMTSL) is the most effective method to prevent postpartum

hemorrhage. AMTSL also lowers the risk of postpartum maternal hemoglobin levels falling below 9 g per dl (90 g per dl) and the necessity for manual placenta removal.

The components of AMTSL include:

1. Oxytocin (Pitocin) during or shortly after the anterior shoulder delivery;
2. Using controlled cord traction (Brandt-Andrews maneuver) for placental delivery.
3. Massaging the uterus after the placenta is delivered. To deliver the placenta, the Brandt-Andrews maneuver entails using one hand to apply firm traction on the umbilical cord and the other to apply suprapubic counterpressure.
4. Massaging uterus after delivery of the placenta.

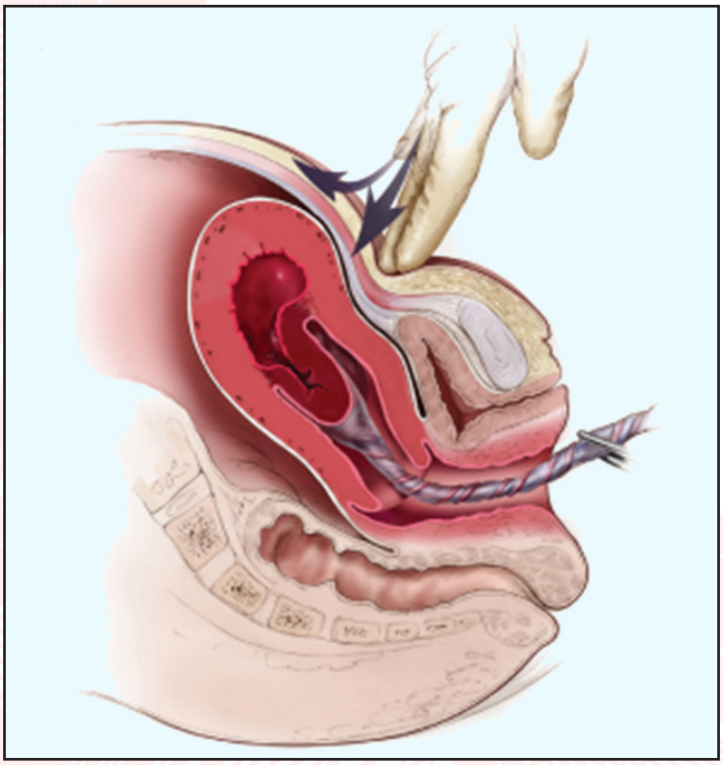
Table 10.4: Strategies to reduce postpartum hemorrhage complications morbidity and mortality

Readiness by every unit • Have a hemorrhage cart with medications, supplies, checklist, and instructuin cards immediately available • Establish a esponse team and know who to call when help is needed • Establish massive and emergency release transfusion protocols • Institute unit education on protocols and run unit-based drills

Recogonition and prevention efforts for every patient
• **Antenatal assessment**
  • Screen for and treat anemia antenatally
  • Screen for sickle cell disease and thalassemia in women of african, Southeast Asuan, or Mediterranean descent
  • Obtain sonograms for women at high risk of invasive placenta
  • Perform delivery in facility with blood bank and in-house surgical services if the patient has a high risk of hermorrhage
  • Identify Hehovah's Witnwsses and other patients who decline blood products
• **Intrapartum management**
  • Use active management of the third stage of labor in every delivery
  • Avoid routine episiotomy
  • Avoid instrumented deliveries, especially forceps
  • Use perineal warm compresses
  • Measure cumulative blood loss and track postpartum vital signs

Response for every hemorrhage • Use an emergency management plan with checklists • Provide support program for patients, families, and staff

Figure 10.1: The Brandt-Andrews maneuver



Brandt-Andrews maneuver for controlled cord traction. Firm traction is applied to the umbilical cord with one hand while the other hand applies suprapubic counterpressure.

Diagnosis

Diagnosing postpartum hemorrhage begins with identifying excessive bleeding and conducting a focused examination to ascertain its origin. Monitoring cumulative blood loss throughout labor, delivery, and postpartum is crucial, preferably with quantitative measurement. While some significant blood loss may occur intrapartum, such as from episiotomy or uterine rupture, most expelled fluid during the delivery of the infant is urine or amniotic fluid.

Quantitative measurement of postpartum bleeding should start immediately after the infant's birth, involving cumulative blood loss measurement with a calibrated drape placed under the buttocks or by weighing blood-soaked pads, sponges, and clots.

A combination of these methods may be used for an accurate assessment. Typically, healthy pregnant women can tolerate a blood loss of 500 to 1,000 mL without symptoms. Tachycardia might be the first sign of postpartum hemorrhage, while orthostatic, hypotension, nausea, dyspnea, oliguria, and chest pain can signal significant hemorrhage-induced hypovolemia.

Upon diagnosing excessive bleeding, the 'Four T's' mnemonic—uterine atony (Tone), laceration, hematoma, inversion, rupture (Trauma), retained tissue or invasive placenta (Tissue), and coagulopathy (Thrombin)—helps identify specific causes. Physicians should immediately call for additional help and initiate emergency hemorrhage protocols, regardless of the bleeding's cause.

Table 10.5: Four T's

Pathology	Specific cause	Approximate incidence(%)
Tone	Atonic uterus	70
Trauma	Lacerations, hematomas, inversion, rupture	20
Tissue	Retained tissue, invasive placenta	10
Thrombin	Coagulopathies	1

Adapted with permission from Evensen A, Anderson J. Chapter J. Postpartum hemorrhage: third stage pregnancy. In: Leeman L, Quinlan J, Dresang LT, eds. Advanced life Support in Obstetrics: Provider Syllabus. 5th ed. Leawood, Kan.: American Academy of Family Physicians; 2014:4.

Uterine atony

Uterine atony is the leading cause of postpartum hemorrhage. If brisk bleeding follows placental delivery and does not respond to transabdominal massage, immediate measures should be taken, including bimanual uterine compression and administration of uterotonic drugs.

The massage technique involves one hand inside the vagina pressing against the uterus, while the other hand compresses the fundus from the abdominal wall above.

Uterotonics such as oxytocin, ergot alkaloids, and prostaglandins are used, with oxytocin being the most effective for treating postpartum hemorrhage, even if previously administered for labor induction, or augmentation.

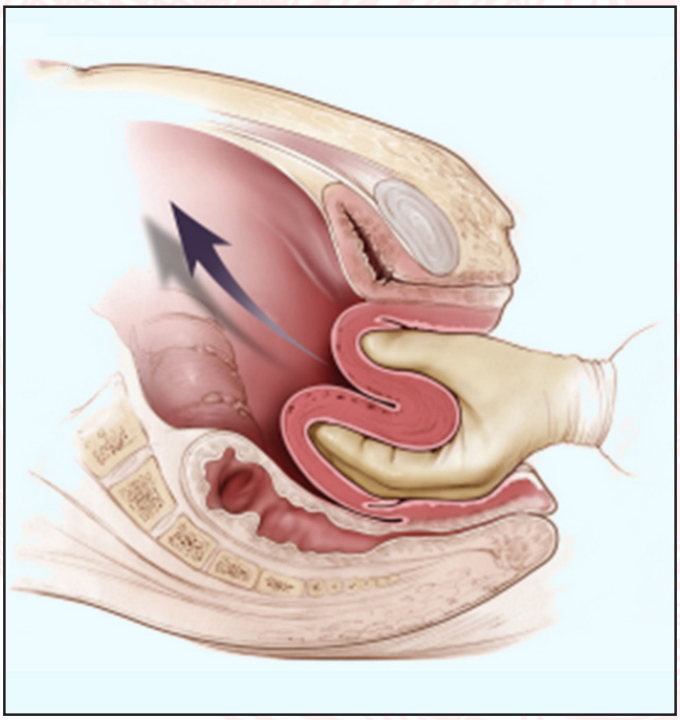


Figure 10.2: The massage technique

The selection of a secondary uterotonic agent should consider individual factors like hypertension, asthma, or protease inhibitor use. Tranexamic acid (Cyklokapron), though not a uterotonic, may reduce mortality from bleeding due to postpartum hemorrhage if administered within the first three hours, serving as a potential adjunct therapy.

Table 10.6: Medications used for postpartum hemorrhage

Medication	Dosage	Prevention	Treatment	Contraindications and cautions
First-line agent				
Oxytocin (Pitocin)	**Prevention:** 10 IU IM or 5 to 10 IU IV bolus **Treatment:** 20 to 40 IU in 1 L normal saline, infuse 5oo mL over 10 minutes then 250 mL per hour	+	+	Overdose or prolonged use can cause water intoxication Possible hypotension with IV use following cesarean delivery
Second-line agents				
Carboprost (Hemabate), a prostaglandin $F_{2\text{-alpha}}$ analogue	250 mcg IM or into myometrium, repeated every 15 to 90 minutes for a total dose of 2 mg	-	+	Avoid in patients with asthma or significant renal, hepatic, or cardiac disease
Methylergonovine (Methergine)	0.2 mg IM, repeat every two to four hours	-	+	Avoid in hypertensive disorders of pregnancy, including chronic hypertension Use with caution in patients with human immunodeficiency virus infection who are receiving protease inhibitors Use with caution in patients with cardiovasular disease
Misoprostol (Cytotec),† a prostaglandin E_1 analogue	Prevention: 600 mcg orally Treatment: 800 to 1,000 mcg rectally or 600 to 800 mcg sublingually or orally	Use only when oxytocin is not available	+	Use with caution in patients with cardiovasular disease
Tranexamic acid (Cyklokapron)†	1 g intravenously over 10 minutes, may be repeated after 30 minutes	-	+	Use within three hours of onset of bleeding Use with caution in patients with renal impairment and with other clotting factors such as prothrombin complex concentrate

IM = intramuscularly; IV = intravenous; NA = not available.

***__ Estimated retail price based on information obtained at http://online.lexi.com/action/home (login required; accessed June 10, 2016). Generic price listed first; brand price listed in parentheses.*

†__ Misoprostol and tranexamic acid are not approved by the U.S. Food and Drug Administration for use in prevention or treatment of postpartum hemorrhage.

Trauma

Hemostasis and quick repair can help minimize the severe blood loss that can occur from birth trauma-related hematomas and lacerations. Unless an urgent delivery is necessary and the perineum is a limiting factor, episiotomy should be avoided as it increases the risk of blood loss and tears in the anal sphincter.

Hemostases in the vagina and vulvar region can cause pain or a change in vital signs that is out of proportion to the amount of blood lost. Ice packs, analgesia, and observation are effective treatments for small hematomas.

Incision and clot evacuation are necessary for patients with large or expanding hematomas or those who exhibit persistent signs of volume loss despite fluid replacement. Hemostasis can be accomplished by ligating bleeding vessels, using figure-of-eight sutures, and performing a layered closure after the affected area has been irrigated. Only 0.04% of deliveries involve uterine inversion, which can result in postpartum hemorrhage.

It is unclear what part other elements like excessive cord traction, fundal pressure, and fundal placenta implantation play. Patients may have shock symptoms without severe blood loss, and an inverted uterus usually manifests as a bluish-gray mass extending from the vagina. In order to reduce bleeding, the placenta should stay in place until the uterus has been moved. It is essential that the uterus be moved quickly.

The Johnson technique entails lifting the uterus through the pelvis and back into the abdomen while holding the protruding fundus in the palm with fingers pointing toward the posterior fornix. Uterotonic medications can help preserve uterine tone and stop recurrence after reversion.

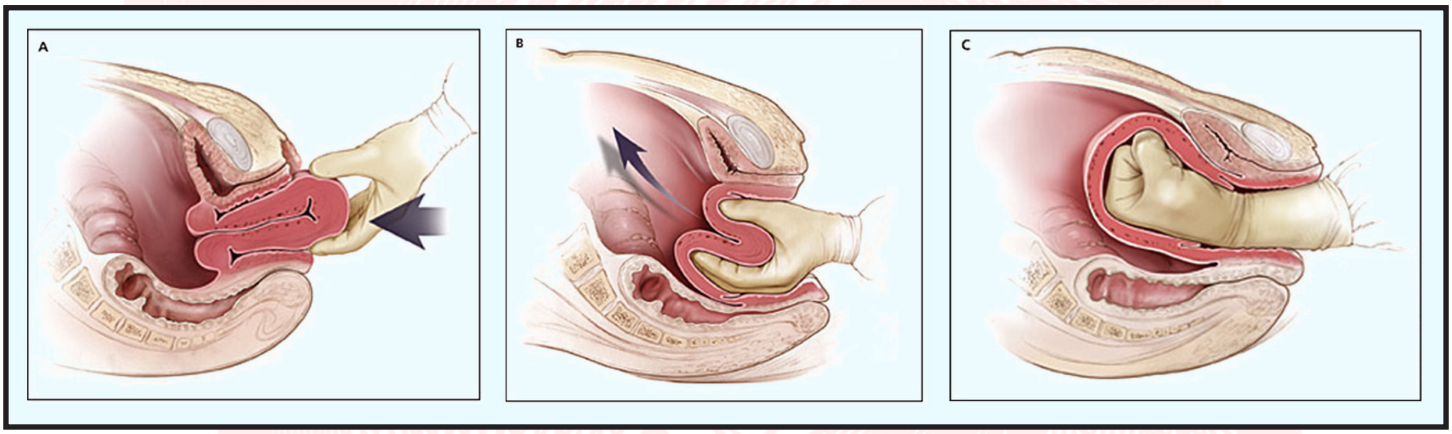


Figure 10.3: Uterine inversion (Johnson method). (A) The protruding fundus is grasped with fingers directed toward the posterior fornix. (B, C) The uterus is returned to position by pushing it through the pelvis and into the abdomen with steady pressure towards the umbilicus.

If initial efforts to reposition the uterus are unsuccessful or if contraction of the lower uterine segment develops, administering magnesium sulfate, terbutaline, nitroglycerin, or general anesthesia may provide enough relaxation of the uterus for manipulation.

Uterine rupture can lead to intrapartum and postpartum hemorrhage. While it is rare in an unscarred uterus, clinically significant uterine rupture occurs in 0.8% of vaginal births following a cesarean section with a low transverse incision. The risk of uterine rupture is heightened by induction and augmentation, particularly in patients with a previous cesarean section. The primary indication of uterine rupture before delivery is fetal bradycardia.

Tissue

The placenta, placental fragments, or blood clots are examples of retained tissue that prevents the uterus from contracting enough to reach the ideal tone. The classic signs of placental separation include a slight rise in the uterus, a small gush of blood, and the lengthening of the umbilical cord.

Placental expulsion typically occurs 8 to 9 minutes after delivery. With rates doubling after ten minutes, intervals longer than this are associated with a higher risk of postpartum hemorrhage. Less than 3% of vaginal deliveries result in retained placenta, which is defined as the placenta not being delivered within 30 minutes. Manual removal with suitable analgesia should be considered if the placenta is retained. The need for manual removal is not considerably decreased by saline and oxytocin injections into the umbilical vein.

If blunt dissection with the edge of a gloved hand fails to identify the tissue plane between the uterine wall and the placenta, an invasive placenta may be present. Invasive placenta, which includes placenta accreta, increta, or percreta, can lead to life-threatening postpartum hemorrhage.

The incidence of invasive placenta has risen over time, reflecting the increase in cesarean deliveries. Other risk factors for invasive placenta include placenta previa, advanced maternal age, high parity, and a history of invasive placenta. Treatment for invasive placenta may necessitate a hysterectomy or, in some cases, conservative management, such as leaving the placenta in place or administering weekly oral methotrexate.

Thrombin (Coagulation Defects)

Coagulation defects can lead to hemorrhage or result from one. These defects are suspected in patients unresponsive to standard postpartum hemorrhage treatments or those with oozing puncture sites. Suspect a coagulation defect if blood fails to clot in bedside containers or red-top (additive-free) lab tubes within five to ten minutes. Coagulation defects might be inherited or acquired. Assessments should include PLT, PT, PTT, fibrinogen levels, fibrin degradation products, and a quantitative D-dimer assay. Physicians should address the root disease, maintain intravascular volume, regularly check coagulation status, and administer necessary blood components via an emergency release protocol to expedite treatment and reduce the risk of dilutional coagulopathy.

Table 10.7: Causes of disordered coagulation

Acquired
Amniotic fluid embolism Consumptive coagulation secondary to excessive bleeding of any origin Disseminated intravascular coagulation secondary to abruption Fetal demise HELLP (hemolysis, elevated liver enzme levels, and low platelet levels) syndrome Placental abruption Preeclampsia with severe feature Sepsis Use of anticoagulants such as aspirin or heparin
Second-line agents
Hemophilia Idiopathic thrombocytopenic purpura Thrombotic thrombocytopenic purpura Von Willebrand disease
Information from: *Evensen A, Anderson J. Chapter J. Postpartum hemorrhage: third stage pregnancy. In: Leeman L, Quinlan J, Dresang LT, eds. Advanced Life Support in Obstetrics: Provider Syllabus. 5th ed. Leawood, Kan.: American Academy of Family Physicians; 2014.*

Ongoing or Severe Hemorrhage

Significant blood loss necessitates immediate resuscitation with an interdisciplinary team approach. Physicians should conduct a primary maternal survey and provide care and the assessment of blood loss. Patients require oxygen, possible ventilation, and intravenous fluids and blood replacement using normal saline or other crystalloids via two large-bore IV needles.

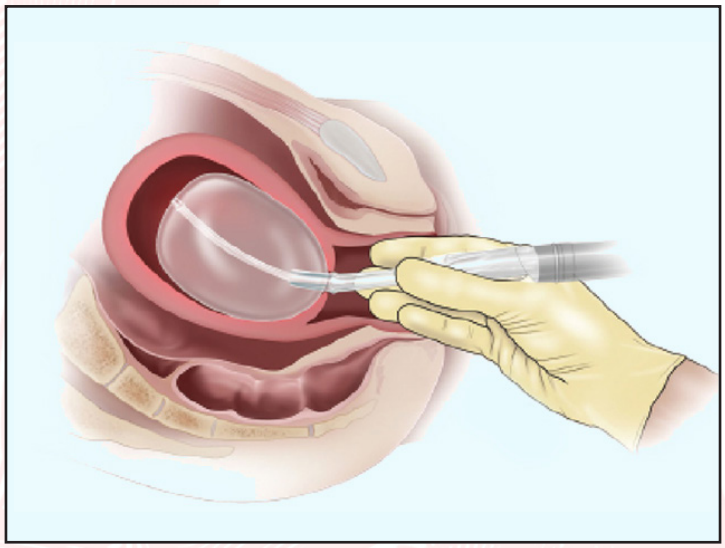
The fluid replacement should start with a bolus infusion and be adjusted based on the patient's vital signs and symptoms. O negative blood might be used temporarily while awaiting type-specific blood. Elevating the patient's legs can enhance venous return.

A Foley catheter can help improve uterine atony and allow urine output monitoring.

Established massive transfusion protocols aim to reduce the risk of dilutional coagulopathy and other complications from postpartum hemorrhage. These protocols often suggest four units of fresh frozen plasma and one unit of platelets for every four to six units of packed red blood cells administered.

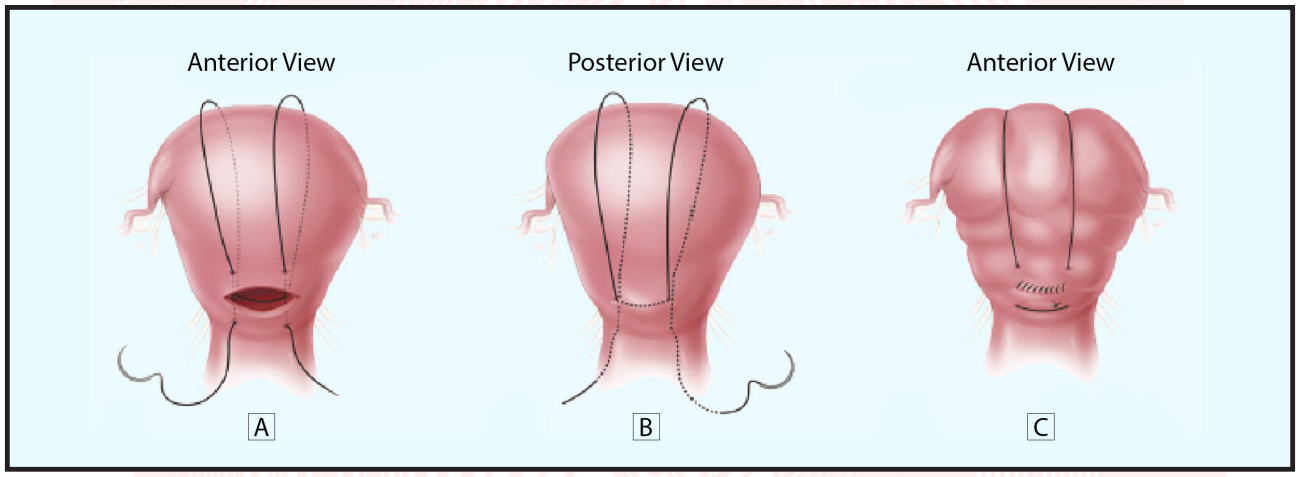
Treatments aimed at conserving the uterus include uterine packing with plain gauze or gauze soaked in vasopressin, chitosan, or carboprost as well as artery ligation, uterine artery embolization, B-Lynch compression sutures, and balloon tamponade. The latter involves applying direct pressure to potential bleeding sites using a balloon inserted through the vagina and cervix, then inflated with sterile water or saline.

Figure 10.4: Uterine tamponade balloon catheter



Uterine packing, aortic compression, and non-pneumatic anti shock garments can also be employed to control bleeding while awaiting definitive treatment or during transport. In cases of severe, uncontrollable hemorrhage, a hysterectomy is the definitive solution.

Figure 10.5: B-Lynch Suturing Techn



Postpartum hemorrhage management includes monitoring for continuous blood loss and vital signs, checking for anemia symptoms (such as fatigue, shortness of breath, chest pain, or lactation issues), and conducting debriefings with patients and staff.

Algorithm 10.1: Postpartum hemorrhage prevention and management

Active management of the third stage of labor
Oxytocin (Pitocin) 10 IU IM or 5 to 10 IU intravenously no earlier than delivery of anterior shoulder, controlled cord traction, uterine massage after placenta

If, despite active management, there is estimated blood loss ≥ 500 mL,* brisk bleeding, pulse rising, blood pressure falling, or maternal symptoms of hypotension, then initiate resuscitation, investigation of and treatment for postpartum hemorrhage, and quantitative measurement of ongoing blood loss

Resucitation
- Call for help
- Perform bimanual uterine massage
- Institute labor unit hemorrhage protocol
- Deliver Oxytocin 20 IU in 1 L normal saline, infuse 500 mL per hour
- Use two large-bore intravenous needles
- Provide oxygen by mask
- Monitor blood pressure, pulse, and urine output
- Consider laboratory testing such as type and crossmatch, complete blood count

Aftercare
- Monitor for ongoing blood loss (preferably quantitative measurement) and vital signs
- Assess for signs of anemia (fatigue, shortness of breath, chest pain, lactation problems)
- Debrief with and listen to patients and staff regarding their experience with the emergency

Determince cause and treat using thr Four T's mnemonic

Soft, boggy uterus **TONE**	Laceration or uterine inversion **TRAUMA**	Retained placenta or clot **TISSUE**	Blood not clotting **THROMBIN**
Oxytocin †: 20 to 40 IU in 1 L normal saline, infuse 500 mL over 10 minutes then 250 mL per hour Carboprost (Hemabate): 250 mcg IM or into the myometrium every 15 to 90 minutes (2 mg total) Methylergonovine (Methergine): 0.2 mg IM every two to four hours Misoprostol (Cytotec): 800 to 1,000 mcg rectally or 600 to 800 mcg sublingually or orally	Suture lacerations Drain expanding hematoma Replace inverted uterus	Inspect placenta Explore uterus Manual removal of placenta Curettage	Observe clotting Check coagulation studies Replace clotting factors, platelets Supply fresh frozen plasma

Severe postpartum hemorrhage
- Transfuse red blood cells, platelets, and clotting factors using massive transfusion or emergency release protocol
- Consult anesthesia, surgery, and an intensivist
- Support blood pressure with vasopressors
- Consider uterine packing, balloon tamponade, vessel embolization or ligation, compression sutures, and hysterectomy

*__ *The American College of Obstetricians and Gynecologists defines early postpartum hemorrhage as blood loss of 1,000 mL or more accompanied by symptoms of hypovolemia; cumulative blood loss of 500 to 999 mL alone should trigger increased supervision and potential interventions as clinically indicated.*

† __ *Oxytocin should be used as a first-line agent, with other agents added only if needed to control hemorrhage.*

Chapter Eleven

Maternal Resuscitation and Cardiac Arrest

Learning Objectives:

Upon completing this chapter, participants will be able to:

1. Discuss incidence and causes of maternal cardiac arrest during pregnancy.
2. Understand the pregnancy related physiologic changes.
3. Differences in ACLS algorithms during pregnancy.
4. Outline the emerging therapies for maternal cardiac arrest.

Introduction

Cardiac arrest (CA) during pregnancy, though rare, complicates approximately 1 in 30,000 pregnancies and presents one of the most challenging clinical scenarios. It uniquely involves two lives: the mother's and the fetus'. Therefore, to effectively prevent and manage CA during pregnancy, caregivers must thoroughly understand maternal mortality.

Various causes of CA in pregnancy include amniotic fluid embolism, pulmonary thromboembolic events, sepsis, hemorrhagic shock, and complications from anesthesia. Additionally, congenital cardiac anomalies, anaphylaxis, and trauma are less common causes.

The Physiological changes during pregnancy

In cases of CA, mothers receive cardiopulmonary resuscitation (CPR) similarly to other patients, with slight adjustments for pregnancy-related physiological changes. Departments of obstetrics and neonatology should be involved early on to ensure proper care for both the mother and neonate.

Late pregnancy induces physiological changes such as increased oxygen demand, reduced chest compliance, increased ventilation, an ineffective gastroesophageal sphincter, heightened intragastric pressure, a higher risk of regurgitation, and decreased functional residual capacity, all of which affect CPR.

Prompt action is critical upon detecting respiratory or cardiac arrest, including proper patient positioning and immediate initiation of basic life support. This continues while securing venous access, addressing any apparent causes like hypovolemia, and assembling necessary medications, staff, and equipment.

Knowledge gaps and suboptimal resuscitation techniques can significantly contribute to poor outcomes following CA. However, recent data suggest that the survival rate to hospital discharge after maternal CA can reach as high as 58.9%, surpassing that of the general population.

Understanding the physiological changes of the cardiopulmonary system during pregnancy is crucial for administering effective CPR to pregnant women. These changes include increased cardiac output, blood volume, ventilation, and oxygen consumption.

Airway

During pregnancy, the upper airway undergoes physiological changes such as hyperemia, hypersecretion, and edema. These alterations can lead to increased mucosal friability, potentially causing impaired visualization and heightened bleeding, particularly with repeated airway manipulations. Furthermore, the airway tends to be narrower during pregnancy, which is why the use of a smaller endotracheal tube for intubation is

advised.

Emergency staff must comprehend three critical aspects of airway management:

1. Effective basic life support can enhance ventilation, chest expansion, and oxygenation, potentially postponing the necessity for an advanced airway.
2. Placing an advanced airway can be challenging during maternal cardiac arrest, making thorough preparation essential.
3. During a maternal cardiac arrest, the most skilled individual should be responsible for securing and overseeing the advanced airway.

Breathing

During pregnancy, there's an elevated risk of rapid oxygen desaturation. This is primarily due to a diminished oxygen reserve, a consequence of increased oxygen consumption and decreased functional residual capacity. Pregnant individuals also experience increased intrapulmonary shunting, making them less tolerant of ventilation-perfusion mismatches. Therefore, optimal oxygenation is crucial, particularly before intubation attempts during cardiac arrest. Resuscitation teams must also consider the potential for uterine vasoconstriction and fetal hypoxemia from maternal respiratory alkalosis caused by overventilation.
The raised diaphragm in pregnancy may necessitate reduced ventilation volumes. The risk of aspiration is a concern during maternal cardiac arrest because of lower esophageal sphincter incompetence.

Emergency staff should note these four key points regarding breathing adjustments:

1. Ensure thorough oxygenation, continuous monitoring, and prevention of desaturation.
2. Avoid causing respiratory alkalosis.
3. Consider reducing ventilation volumes.
4. Recognize the aspiration risk.

Circulation

During maternal cardiac arrest, a significant concern is aortocaval compression by the gravid uterus. This compression can impede the inferior vena cava, leading to decreased preload and stroke volume.

Aortocaval compression is expected from 20 weeks gestational age, but mechanical venous effects can be noted as early as 12 weeks. While the specific hemodynamic and cardiovascular impacts of uterine compression during cardiac arrest are not well-studied, maximizing maternal hemodynamic status during arrest and compressions is crucial. Effective aortocaval decompression in a visibly pregnant patient is best achieved through manual Left Uterine Displacement (LUD).

Manual LUD maintains the patient in a supine position, facilitating better airway management, defibrillation, IV access, and allowing for high-quality chest compressions.

High-quality, effective chest compressions are vital for increasing the likelihood of successful resuscitation. Although left lateral tilt was previously advised for aortocaval decompression, recent studies have indicated that this position may diminish the effectiveness of chest compressions, potentially reducing survival chances.

Perimortem Cesarean Section (PMCS)

Perimortem Cesarean Section (PMCS) is indicated when anoxic brain injury is imminent within 4 minutes of cardiac arrest identification. If ROSC is not achieved within 4 minutes in a visibly pregnant patient, particularly those beyond 20 weeks of gestation, a PMCS should be considered.

PMCS facilitates complete aortocaval decompression following uterine evacuation. Reports indicate marked improvements in maternal hemodynamics post-PMCS, implying that manual methods may be inadequate for alleviating aortocaval compression during resuscitation.

The procedure should commence 4 minutes after maternal cardiac arrest onset, aiming for delivery within 5 minutes if ROSC is not attained despite optimized resuscitative efforts. To meet this delivery timeline, preparation for PMCS must begin immediately upon arrest confirmation, enabling the incision to be made timely when clinically warranted.

PMCS ought to be conducted at the arrest site to avoid delays associated with transferring to an operating room. It is also essential to have the neonatal team and resuscitation equipment ready to care for the newborn once delivered.

This extraordinary situation necessitates a coordinated intervention by obstetrics, anesthesiology, and neonatology teams, which must align on the same management objectives. It is imperative that these objectives and the maternal resuscitation algorithm are known in advance by all team members to ensure optimal management.

Causes

Causes of and contributing factors for cardiac arrest in a pregnant woman: (**BEAU-CHOPS**)

- **B**leeding/ Disseminated Intravascular Coagulation (DIC)
- **E**mbolism: pulmonary/coronary/amniotic fluid embolism
- **A**naesthetic complications
- **U**terine atony
- **C**ardiac disease: myocardial ischaemia/infarction, aortic dissection, cardiomyopathy
- **H**ypertension, preeclampsia, eclampsia
- **O**ther: differential diagnosis of cardiac arrest e.g. **The H's and T's**: Hypoxia, Hyper/Hypokalemia, Hypo/Hyperthermia, Hydrogen ions (acidosis), Hypoglycaemia, and Tension pneumothorax, Tamponade, Toxins, Trauma.
- **P**lacental abruption/previa
- **S**epsis

Emergency Management

Chest compressions

Chest compressions should be firm and rapid, performed on a solid, flat surface to achieve a depth of at least 5 cm and at a rate of at least 100- 120 compressions per minute. A backboard may be necessary if resuscitation occurs on a standard hospital mattress.

The optimal position for hands during chest compressions is the lower sternum. There is no scientific evidence to suggest a higher hand position on the sternum is beneficial, even though the gravid uter-

us may displace the myocardium superiorly and anterolaterally.

Left uterine displacement is crucial as the growing gravid uterus can hinder resuscitative efforts by reducing venous return due to vena cava obstruction in the supine position, starting at 20 weeks of gestation.

A gestational age of 20 weeks is likely if the fundus is at or above the umbilicus level. To prevent decreases in preload, left uterine displacement should be executed during resuscitation. Manual displacement is preferred to left lateral tilt because it's challenging to generate the proper compression force vector with the tilt.

Manual displacement can be done from the patient's left side, pulling the uterus upward and leftward, or from the right side, pushing it in the same direction.

One handed technique

Two handed technique

Figure 11.1: Left uterine displacement technique

Airway

Airway management and ventilation are critical as decreases in functional residual capacity and increased oxygen consumption by the fetus can quickly lead to hypoxaemia.

Vascular engorgement may cause edema in the oro- and nasopharynx, larynx, and trachea, potentially complicating intubation and requiring smaller tracheal tubes. Videolaryngoscopy is recommended for the first attempt at intubation, if possible, to improve success rates. Tracheal intubation should be confirmed with a capnometer. Nasopharyngeal airways may be utilized cautiously.

Nasopharyngeal airways must be utilized cautiously due to the heightened risk of bleeding. It is advised to ventilate with 100% oxygen, using tidal volumes ranging from 500 to 700 ml at a rate of 10 breaths per minute. The standard initial compression-ventilation ratio of 30:2 is designed to minimize interruptions in chest compressions. Hyperventilation can reduce survival chances in nonpregnant cardiac arrest victims, especially if it disrupts chest compressions.

Two-handed bag-mask ventilation is more effective than one-handed and should be employed once a second rescuer is available to compress the self-inflating bag. If mask ventilation fails to produce a visible chest rise or fog in the mask, the rescuer should reposition the airway and improve the mask's seal on the patient's face.

An oral airway may alleviate obstruction in the hypopharynx. Continuous airway patency is ideal for optimal

oxygen delivery. Conditions like obesity, sleep apnea, and airway edema can complicate face mask ventilation.

Defibrillation

Defibrillation should be administered for a shockable rhythm and is deemed safe for the fetus during maternal cardiac arrest. There is no need to adjust the energy levels, as thoracic impedance remains unchanged during pregnancy. The hypothetical risk of burns from fetal external and internal monitors should not postpone defibrillation; one should not wait to disconnect or remove them from the mother.

IV Access

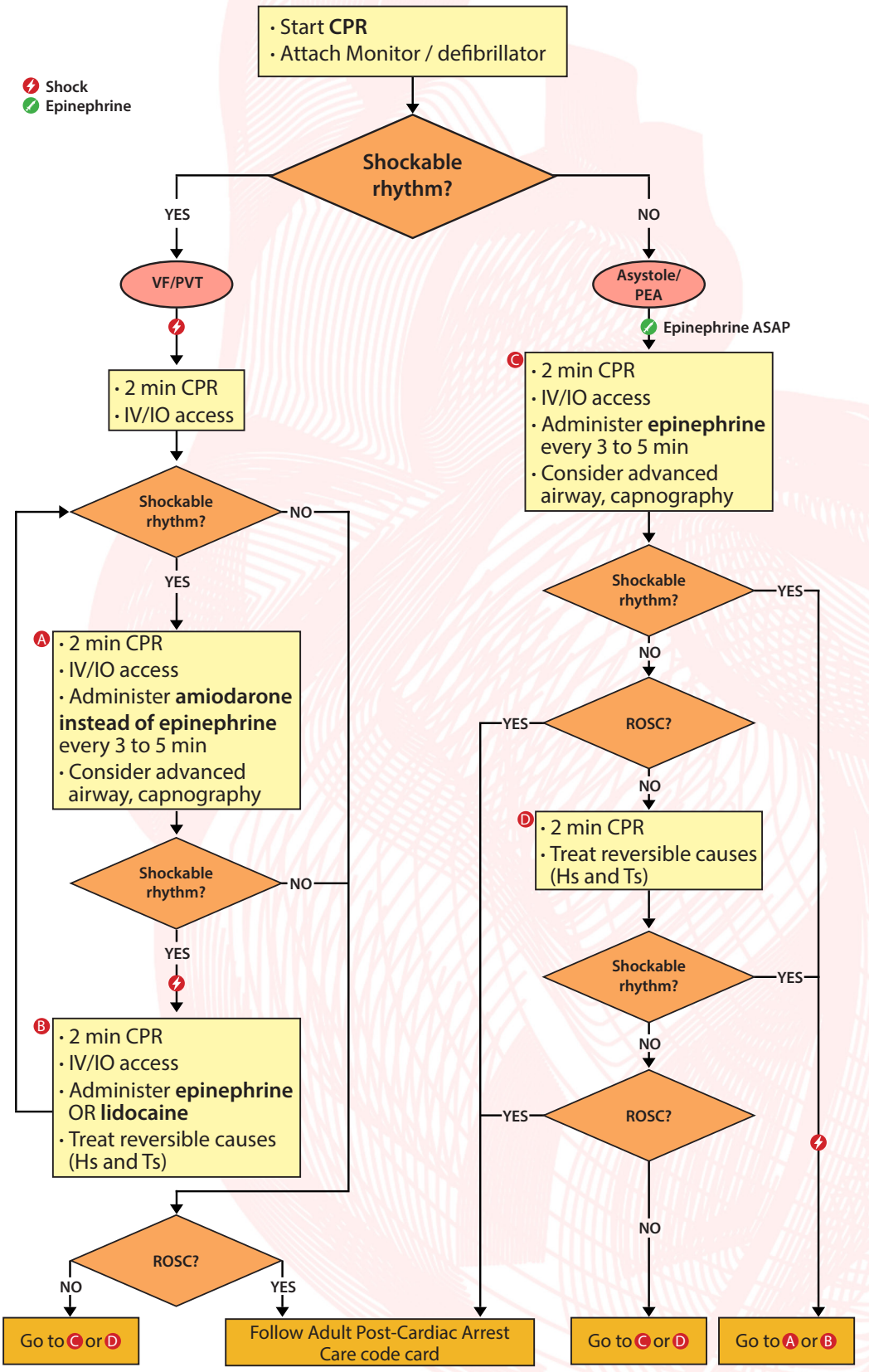
For intravenous access, a large-bore needle should be placed above the diaphragm, as uterine compression and bleeding may hinder adequate resuscitation from sites below the diaphragm. In cases where access is challenging, ultrasound-guided venous access or intraosseous access in the proximal humerus may be required.

Medication

Regarding medication, during pregnancy, the circulating blood volume increases disproportionately compared to the rise in hemoglobin, leading to physiological anemia. This increase in blood volume and a decrease in protein binding could theoretically slightly change the distribution volume of administered drugs, but these changes are minimal in the state of low flow during arrest. Resuscitation drugs should be given according to standard SHA guidelines, with no drugs deemed contraindicated.

Oxytocin should be stopped due to its vasodilatory and negative inotropic effects. Similarly, neuraxial local anesthetic infusions should be halted. If magnesium is causing significant hypotension, it should also be stopped and give calcium chloride or gluconate.

Algorithm 11.1: Adult Cardiac Arrest Algorithm



Defibrillation Energy Doses

Biphasic: Per manufacturer's recommendations (e.g., 120 to 200 J) or if unknown, max available; subsequent doses equal to or greater than first dose Monophasic: 360 J for all doses

Medications

Epinephrine
1 mg IVAO bolus every 3 to 5 min
Amiodarone
First dose: 300 mg IV/iO bolus
Seond dose: 150 mg after 3 to 5 min
Lidocaine
First dose: 1 to 1.5 mg/kg IVIO
Subsequent doses: 0.5 to 0.75 mg/kg IV/IO every 5 to 10 min, up to a max dose of 3 mg/kg

High-Quality CPR

Compress at a rate of 100 to 120 compressions per min and a depth af at least 2 inches (5 cm); allow for full chest recoil
Minimize interruptions to chest compressions to less than 10 sec
Avoid excessive ventilations. Each ventilation should last about 1 sec and make the chest begin to rise
Without advanced airway: 30 compressions: 2 ventilations
With advanced airway: continuous compressions; deliver 1 ventilation every 6 sec without pausing compressions
Rotate compressor every 2 min
Monitor CPR quality with ETCO, arterial blood pressure (if available)

What Is ROSC?

- Sudden and sustained increase in $ETCO_2$,
- Arterial pulse waveform on an A-line when no compressions are being delivered
- Additional signs, including patient movement, normal breathing

Hs and Ts

- Hypovolemia
- Hypoxemia
- Hydrogen ion excess (acidosis)
- Hyperkalemia/hypokalemia
- Hypothermia
- Hyperglycemia/hypoglycemia
- Tamponade (cardiac)
- Tension pneumothorax
- Thrombosis (pulmonary embolism)
- Thrombosis (myocardial infarction)
- Toxins

Perimortem Cesarean Delivery (PCD)

Perimortem Cesarean delivery, also known as resuscitative hysterotomy, improves maternal and neonatal survival if performed within 5 minutes of cardiac arrest. Removing the fetus decreases oxygen consumption and eliminates the anatomical obstruction to vena cava flow, enhancing pulmonary mechanics. Notably, maternal survival rates are higher (72% vs 36%) when resuscitative hysterotomy is done on-site rather than transferring to an operating theater. Therefore, equipment essential for Cesarean delivery, particularly a scalpel, should be readily accessible.

Figure 11.2: Perimortem Cesarean Delivery (PCD) Tips

Teamwork

Team preparedness is crucial for high-stakes, low-frequency events such as maternal cardiac arrest. Obstetricians, anesthesiologists, neonatologists, and labor and delivery nurses should regularly review response plans and mobilization strategies through didactic and simulation sessions.

Simulated drills have proven to reduce the time to start cardiopulmonary resuscitation (CPR) and resuscitative hysterotomy.

Effective leadership and teamwork are vital. Team members must engage in closed-loop communication, acknowledging and completing tasks assigned by the leader, and feel empowered to suggest improvements. The leader must direct and maintain team organization amidst the chaos. When additional support arrives, the code leader should oversee task completion, diagnose, and treat appropriately.

Transesophageal echocardiography

Transesophageal echocardiography can be instrumental where available, identifying the cause of arrest and evaluating resuscitation efforts. It can detect gross pathology—such as spontaneous coronary artery dissection, aortic dissection, pericardial and pleural effusions, saddle pulmonary embolism, ventricular thrombus—and assist in ECMO cannula placement.

It also evaluates chest compression efficacy by visualizing the compression vector and myocardial function return. However, acquiring transthoracic or subcostal images is challenging during resuscitation.

ECMO CPR

ECMO CPR has been instrumental in stabilizing critically ill obstetric patients, serving as rescue therapy in maternal cardiac arrest cases related to cardiovascular complications.

While there are minimal absolute contraindications for obstetric patients, those with significant hemorrhage or disseminated intravascular coagulopathy require careful consideration, as extracorporeal circulation could exacerbate thrombosis or coagulopathy by activating coagulation factors. It is advisable for obstetric patients with a high risk of cardiopulmonary decompensation to be treated at facilities equipped with ECMO capabilities.

Return Of Spontaneous Circulation (ROSC)

Once spontaneous circulation is restored, standard post-resuscitation care should commence. Patients might need additional surgery to mend or seal the resuscitative hysterotomy wound. Proper hemostasis, antibiotic therapy, and adherence to intensive care protocols, including controlled hypothermia when suitable, are essential. However, inducing hypothermia in the mother may exacerbate coagulopathy. Those regaining consciousness will need suitable pain management and sedation.

Algorithm 11.2: Maternal Cardiac Arrest Pathway

Maternal Unresponsiveness

- **Shout for Help**
- **Note the time**
- **Activate Emergency team**

Maternal Cardiac Arrest

- **Start CPR Immediately without delay**
- **Think of the treatable causes**

CAUSES

GENERAL

- A: Anaphylaxis
- B: Bleeding
- C: Cardiac
- D: Drugs
- E: Embolism

OBSTETRIC

- U: Uterine
  - 4 Ts
  - Uterine Rupture
  - Abnormal Placentation
- P: Pulmonary
- S: Sepsis

EMERGENCY CART

- Adrenaline
- Amiodarone
- %20 Intralipid
- Calcium Gluconate
  Magnesium Sulphate
- Naloxone
- Sodium Bicarbonate
- Automated Extemal Defibrillator

BASIC LIFE SUPPORT

HIGH QUALITY CHEST COMPRESSION

- Perform over the Center of the Lower Half of the Stemum (Same as in Non Pregnant State)
- Rate: 100-200 Per Min
- Depth: Atleast 2 Inches
- Allow Full Chest Recoil
- Chest Compression to be Maintained tll ROSC
- Avoid Interruption for > 10 Sec

MANUAL LEFT UTERINE DISPLACEMENT

- Mandatory for Gestational Age > 20 wks or Uterus Above Umbilicus
- Bimanual Displacement by a Dedicated Person Either Pulling from Left or Pushing From Right
- Should Be Maintained Throughout without any Interruption
- This Maneuver is a Life Saver

AIRWAY & PARTURIEN POSITION

- Continue Compression only CPR till Help Arrives
- Bag Mask Ventilation with %100 O, using Two Hands is More Effective
- Keep Parturient in Supine Position on a Firm Hard Surface on Backboard
- Avoid Left Lateral Tilt, as it Interferes with High Quality CPR
- 2 :30 Compression

ADVANCED LIFE SUPPORT

DEFIBRILLATION

- Identify Shockable Rhythms
- Shock Early without Delay
- Thoracic Impedance Remains the Same in Presnancy
- Energy Requirements Same as Non-pregnant State

ADVANCED AIRWAY

- Obstetric Airway is Difficult
- Secure Early to Minimise the Risk of Aspiration & Hypoxic Brain Injury
- Use a Smaller Size ET tube 6 or 7 mm
- Secure the Airway with SGA Device in Case of Difficult/Failed Intubation
- Ventilate 10-8 Breaths per Min with %100 Oxygen

ACLS & $ETCO_2$

- Follow ACLS Algorithm
- Secure IV Access Above the Diaphragm
- Must use ETCO, to Optimise & Monitor the Quality of CPR
- Maintain ETCO, Above 10mmHg

RESUSCITATIVE UTERINE INTERVENTIONS

CONSIDER EARLY

- If ROSC is Not Achieved within 5 Minutes of Arrest
- Strongly Recommended for Gestational Age > 20 wks
- Lower the Arrest-Delivery Interval Higher is the Survival

DO IT FAST

- To be Performed at the Site of Arrest Without Shifting to the Operation Room
- Abbreviated Antisepsis
- Use Scalpel & Clamps
- Maintain High Quality Chest Compressions & Manual Left Uterine Displacement Throughout

POST ARREST CARE

- Be Careful with Uterotonics
- Achieve Swift Hacmostasis and Surgical Closure
- Organ Support and Protective Strateries should be initiated
- Targeted Temperature Management must be Planned

Chapter Twelve

Third-and Fourth-Degree Perineal Lacerations

Learning Objectives:

Upon completing this chapter, participants will be able to:

1. List the different kinds of perineal lacerations.
2. Describe the causes of third- and fourth-degree lacerations.
3. Understand the different techniques for repair.
4. Outline the complications of third- and fourth-degree lacerations.

Introduction

A perineal tear is an injury to the perineum, the area between the vagina and anus. These tears are common during vaginal births, though most are not severe. Third and fourth degree perineal tears are more serious, extending to the anus or rectum and involving the anal sphincter muscle.

First and second degree tears may require stitches, but typically women recover in a few weeks or months. Third and fourth degree tears necessitate surgical repair and can lead to short- and long-term complications, impacting physical, psychological, and sexual health. However, most women heal well from third or fourth degree tears with proper treatment and support, though some may require specialized care for optimal recovery.

While it's not possible to prevent all third and fourth degree tears, the risk can be minimized.

The classification and terminology outlined in this manual are recommended for describing any obstetric anal sphincter injuries (OASIS). In cases of uncertainty regarding the extent of a third-degree tear, it is better to classify it as the more severe degree. The classification system that is adopted by the International Consultation on Incontinence and the RCOG, is as follows:

First-degree tear involves injury to the perineal skin and/or vaginal mucosa.

Second-degree tear involves injury to the perineum and perineal muscles but not the anal sphincter.

Third-degree tear involves injury to the perineum and the anal sphincter complex, categorized as:

- Grade 3a tear with less than 50% of external anal sphincter (EAS) thickness torn,
- Grade 3b tear with more than 50% of EAS thickness torn, and
- Grade 3c tear with both EAS and internal anal sphincter (IAS) torn.

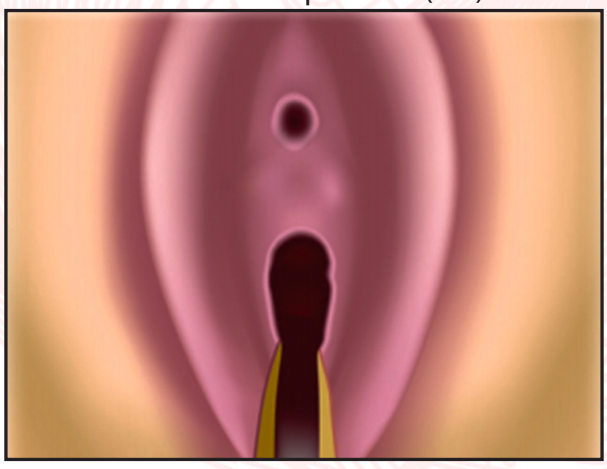


Figure 12.1: Third degree perineal tear

Fourth-degree tear involves injury to the perineum, the anal sphincter complex (EAS and IAS), and the anorectal mucosa. The anal canal's lining varies due to embryological origins, with the proximal part lined by rectal mucosa (columnar epithelium) and the distal 1–1.5 cm by modified squamous epithelium.
To prevent confusion, 'anorectal mucosa' is used in this guideline instead of 'anal epithelium.' OASIS includes both third- and fourth-degree perineal tears. Anal incontinence is defined as the involuntary loss of flatus and/or feces that impacts the quality of life.

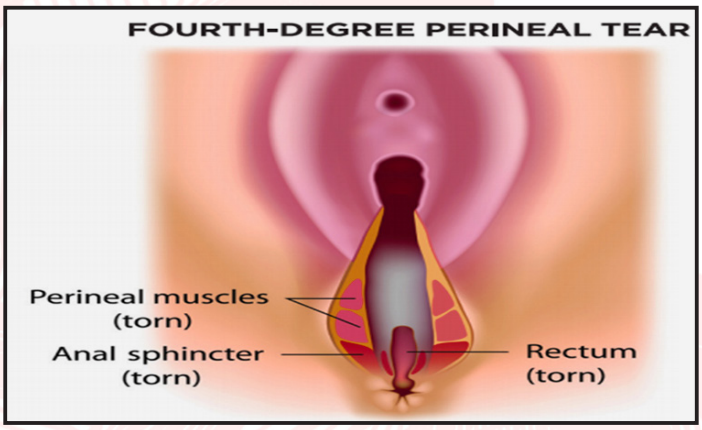


Figure 12.2: Fourth degree perineal tear

Episiotomy: A surgical incision made by a clinician in the vaginal wall and perineum to enlarge the opening for the baby's delivery.

Selective episiotomy: This surgical incision in the vagina and perineum is performed as needed for women during vaginal childbirth.

Medio-lateral episiotomy: This type of episiotomy begins within 3 mm of the midline at the posterior fourchette and extends laterally at a minimum angle of 60° from the midline towards the ischial tuberosity.

Midline episiotomy: Also known as a median episiotomy, this cut starts within 3 mm of the midline at the posterior fourchette and extends straight down between 0° and 25° from the sagittal plane.

Female genital mutilation: The partial or total removal of the female external genitalia or other injury to the female genital organs for non-medical reasons.

Risk factors for perineal injury

Clinicians must be cognizant of the risk factors for obstetric anal sphincter injuries (OASIS). However, it is important to note that these risk factors do not enable the precise prediction of OASIS.

Risk factors for perineal tears during childbirth include a first vaginal birth, instrumental delivery, an extended second stage, macrosomia with a birth weight exceeding 4 kg, midline episiotomy, occipitoposterior fetal position at delivery, labor induction, epidural analgesia, and shoulder dystocia.

Many of these factors are not easily actionable for the prevention or prediction of third or fourth degree tears. Moreover, pudendal nerve damage increases with each successive vaginal birth.

Preventive Measures

Clinicians ought to inform women that the evidence regarding the protective effect of episiotomy is mixed.

Mediolateral episiotomy may be advisable for instrumental deliveries.

When an episiotomy is necessary, the mediolateral approach is suggested, ensuring the incision is angled 60 degrees from the midline as the perineum stretches. Protecting the perineum during crowning may offer benefits. Applying warm compression in the second stage of labor can lower the incidence of OASIS.

Allow adequate time for perineal stretching, avoid assisted vaginal delivery, and assume the maternal lateral birth position. It is recommended for nulliparous women to perform perineal massage in the weeks leading up to delivery for perineal protection at crowning.

Perineal protection during crowning can be beneficial. The advantageous outcomes of perineal support indicate that it should be encouraged over the 'hands-off' or 'poised' approach to safeguard the perineum and lessen the occurrence of OASIS.

For manual perineal protection or 'hands-on' techniques:

- Use the left hand to slow the delivery of the head.
- Use the right hand to protect the perineum.
- Instruct the mother not to push when the head is crowning.

Consider an episiotomy for those in risk groups and ensure the correct angle is used.

Manual perineal protection, also known as 'hands-on' techniques, involves:

- Using the left hand to slow the delivery of the head.
- Employing the right hand to protect the perineum.
- Instructing the mother not to push when the head is crowning.
- Considering an episiotomy for certain risk groups and ensuring the correct angle is used.

Assessment

With heightened awareness and improved training, there has been an increase in the detection of anal sphincter injuries. In cases of uncertainty regarding the extent of a third-degree tear, it is recommended to classify it as the higher degree rather than the lower. A defined classification system should be employed when documenting any obstetric anal sphincter injuries.

When assessing genital trauma, healthcare professionals should ensure adequate lighting and position the woman comfortably to clearly visualize the genital structures. The examination should be conducted gently and can be performed immediately after birth. If genital trauma is detected post-birth, a comprehensive assessment, including a rectal examination, should follow.

Repair

Expertise: The repair of third- and fourth-degree tears must be carried out by a clinician with the appropriate training or by a supervised trainee. Obstetric anal sphincter repairs should be executed by practitioners who have received proper training, and such training must be a mandatory part of obstetric education.

Place: The repair should be performed in an operating theatre, with either regional or general anesthesia, adequate lighting, and the necessary instruments. In cases of excessive bleeding, a vaginal pack must be inserted, and the patient should be transported to the theatre immediately. Under certain conditions, after consulting with a senior obstetrician, the repair of OASIS may be done in the delivery room.

Material

- 3-0 polyglactin should be used to repair the anorectal mucosa as it may cause less irritation and discomfort than polydioxanone (PDS) sutures.

- When repair of the EAS and/or IAS muscle is being performed, either monofilament sutures such as 3-0 PDS or modern braided sutures such as 2-0 polyglactin can be used with equivalent outcomes
- Suture material ---see table 1 for detail.
- 2-0 polydioxanone sulfate or polyglycolic acid on a large taper needle for external anal sphincter
- 2-0 polyglycolic acid on a large taper needle for internal anal sphincter and vagina/perineum repair
- 2-0 or 3-0 polyglycolic acid on a large taper needle for repair of vaginal and perineal muscle lacerations
- 3-0 or 4-0 polyglycolic acid on a small taper needle for perineal skin, labial, periurethral, and peri-clitoral lacerations
- 3-0 or 4-0 polyglycolic acid on a small taper needle for rectal mucosa repair

Equipment

- Allis clamp (at least two)
- Gelpi retractor
- Irrigation supplies
- Local anesthetic
- Needle holder
- Sharp tooth tissue forceps
- Suture scissors
- Sponges
- Syringe and needle for injection of local anesthesia with addition of Iowa trumpet needle guide for pudendal block
- Vaginal packing materials
- Needle/sutures (as mentioned in suture material)

Technique

- Figure of eight sutures should be avoided during the repair of OASIS because they are hemostatic in nature and may cause tissue ischemia.
- A rectal examination should be performed after the repair to ensure that sutures have not been inadvertently inserted through the anorectal mucosa. If a suture is identified it should be removed.
- The torn anorectal mucosa should be repaired with sutures using either the continuous or interrupted technique.
- Where the torn internal anal sphincter (IAS) can be identified, it is advisable to repair this separately with interrupted or mattress sutures without any attempt to overlap the IAS.
- For repair of a full thickness external anal sphincter (EAS) tear, either an overlapping or an end-to end (approximation) method can be used with equivalent outcomes. For partial thickness (all 3a and some 3b) tears, an end-to-end technique should be used.
- When obstetric anal sphincter repairs are being performed, the burying of surgical knots beneath the superficial perineal muscles is recommended to minimize the risk of knot and suture migration to the skin.

Post-operative care

The administration of broad-spectrum antibiotics is advised after OASIS repair to minimize the risk of post-operative infections and wound dehiscence. Additionally, the use of postoperative laxatives is recommended to decrease the risk of wound dehiscence.

Bulking agents should not be routinely administered with laxatives. Local protocols should be established concerning the use of antibiotics, laxatives, and the examination and follow-up of women undergoing obstetric anal sphincter repair. Furthermore, women should be informed about the potential benefits of physiotherapy after OASIS repair.

Complications

When the external anal sphincter is torn, the muscle fibers' ends tend to retract beneath the skin. Not recognizing the full extent of the trauma and failing to achieve a thorough repair can result in long-term consequences like fecal incontinence or rectovaginal fistula. The tissue is often swollen and bleeding right after delivery, which complicates the identification and repair of the muscle. Even partial damage to the anal sphincter can impact future continence as significantly as a complete tear.

Follow up visit

Women who have had obstetric anal sphincter repair should be evaluated at a suitable time, typically between 6 to 12 weeks after childbirth. Whenever possible, this evaluation should be conducted by clinicians who specialize in OASIS. If a woman suffers from incontinence or pain during the follow-up, a referral to a specialist gynecologist or colorectal surgeon may be necessary. It is also important to inform them that 60-80% of women do not exhibit symptoms 12 months after delivery and EAS repair.

Subsequent delivery plan

All women who have experienced OASIS during a previous pregnancy should receive counseling on delivery methods, and this information must be clearly recorded in their medical notes.

The efficacy of prophylactic episiotomy in subsequent pregnancies remains uncertain; hence, it should only be conducted when clinically necessary. Women with a history of OASIS who exhibit symptoms or show abnormalities on endoanal ultrasonography and/or manometry should be informed about the possibility of choosing an elective caesarean birth.

Documentation and risk management

Units must establish a clear protocol for managing OASIS. Documentation should detail the anatomical structures involved, the repair method, and the suture materials used. Additionally, the patient must be thoroughly informed about the nature of her tear and provided with an offer of follow-up, all supported by pertinent written information.

Table 12.1: Suture material

Suture	Brand Name Examples	Composition	Qualities	Duration
Polyglycolic acid	Vicryl	Braided synthetic of a glycolic acid homopolymer	Better and Superior tensile, strength than chromic. Mild tissue response. less temporary pain	Predictable absorption by hydrolysis. Completely absorbed at 60 to 90 days
Polyglycolic acid and trimethylene	Maxon	Monofilament composed 1:3 of the noted polymers	Excellent tensile strength. Smooth and resists kinking	Absorbed completely by hydrolysis at 180 days
Polydioxanone sulfate	PDS Duracryl	Monofilament long lasting, delayed	Excellent tensile strength. Smooth and pliable	Absorbed completely by hydrolysis at 180 days
Chromic gut	Chromic	absorbable Twisted lengths of proteinaceous sheep or beef intestinal lining	Good tensile strength. Strong inflammatory response	Absorption by phagocytosis, which is unpredictable Maintains tensile strength from 7 to 10 days. Faster absorption in infected tissue

Chapter Thirteen

Diagnostic Ultrasound in Labor and Delivery

Learning Objectives:

Upon completing this chapter, participants will be able to:

1. Understand the basic principles and clinical applications of diagnostic ultrasound in maternity care.
2. Learn to assess fetal life, presentation, and well-being during pregnancy and labor.
3. Use ultrasound to measure cervical length and identify risks for preterm birth.
4. Identify placental location and abnormalities, such as placenta previa and placental abruption.
5. Recognize the role of ultrasound in guiding procedures like external cephalic version (ECV).
6. Understand the benefits and limitations of ultrasound in routine and emergency prenatal care.

Introduction

Diagnostic ultrasound is a crucial tool in pregnancy care, helping maternity providers make important clinical decisions at the bedside. Ultrasound can assess fetal health by determining viability, number, position, amniotic fluid levels, and placental location. Mastery of ultrasound requires practice, and while basic skills like estimating gestational age can be learned with moderate training, advanced applications such as anatomical surveys and Doppler assessments require significant additional expertise.

Color Doppler Imaging: This method helps identify conditions like fetal cardiac defects by showing the direction and velocity of blood flow in color. The flow direction in relation to the transducer is indicated by the color.

Power Doppler Imaging: In contrast to Color Doppler, Power Doppler shows the blood flow volume independent of direction or velocity. It can be used to identify structures such as the umbilical cord in the amniotic fluid and to differentiate between various tissues.

Indications for Ultrasound

Most pregnant women will require diagnostic ultrasonography at some point. First introduced by the NIH in 1984 and reinforced by organizations like AIUM, ACR, and ACOG, medical indications for ultrasound include:

- **First Trimester:** Confirming intrauterine pregnancy, assessing gestational age, viability, fetal number, ectopic pregnancy, vaginal bleeding, and pelvic masses.
- **Second and Third Trimester:** Evaluating fetal anatomy, detecting anomalies, confirming gestational age, fetal growth, presentation, placental location, and managing complications like vaginal bleeding and abnormal amniotic fluid.

Types of Ultrasound Examinations

Ultrasound examinations during pregnancy are classified into:

1. Standard Examinations: Performed in the first trimester, assessing the embryo/fetus, uterus, and adnexa. In the second or third trimester, biometry, anatomic surveys, placental position, amniotic fluid levels, and fetal presentation are documented.

2. Limited Examinations: Focused on specific clinical questions, such as fetal presentation or amniotic fluid levels, and are common in labor and delivery settings.
3. Specialized Examinations: These include fetal echocardiography or umbilical Doppler and are performed for specific medical indications.

Point-of-care ultrasound can guide clinical decisions, but limited scans should not replace a full anatomical survey if one has not been performed previously. Providers need formal training to perform and interpret ultrasounds and should understand equipment operation, including transducer selection and image storage .

Liability and Safety Considerations

Ultrasound can improve patient care and reduce liability when used correctly, but healthcare providers must ensure they are properly trained. Misinterpretation of ultrasound findings or failure to perform a comprehensive anatomical survey could lead to missed diagnoses. Patients should be informed of the limitations of a limited scan, and verbal or written consent is advisable.

Institutions may require credentialing for ultrasound use, and consultations should be sought if there is any uncertainty about findings or management.

Technical Aspects of Ultrasound

Maternity care providers should be familiar with the basic operation of ultrasound technology.This includes understanding how to select the correct transducer, adjust controls for depth and gain, perform fetal measurements, and store images when needed. A basic ultrasound scan during labor focuses on limited assessments, but a full anatomical survey typically examines the following:

- **Head, Face, Neck:** Ventricles, cerebellum, midline structures, upper lip
- **Heart:** Four-chamber view, outflow tracts, 3-vessel view
- **Abdomen:** Stomach, kidneys, bladder, umbilical cord insertion
- **Spine:** Cervical to sacral segments
- **Extremities:** Presence of limbs and hands/feet

Evidence-Based Insights

Several studies have highlighted the benefits of point-of-care ultrasound in improving maternal and fetal outcomes, especially in resource-limited settings. A review by Levine et al. (2020) demonstrated that timely ultrasound assessments can reduce adverse outcomes by guiding early interventions in cases like preterm labor or placental abnormalities. Additionally, research supports the accuracy of ultrasound in determining gestational age, crucial for managing women presenting in labor without prior prenatal care.

Transabdominal Scanning

Transabdominal ultrasound is commonly used in all trimesters and during labor. However, certain factors such as fetal position, oligohydramnios, maternal obesity, or low fetal station can limit visibility.
Steps for Transabdominal Scanning:

1. **Positioning:** To avoid supine hypotension, place the woman in a comfortable position and, if required, tilt her left side. Talk about the exam's goals and parameters.
2. **Machine Setup:** Switch on the ultrasound machine and enter the patient's information according to

the guidelines.

3. **Transducer and Gel:** Cover the abdomen or the transducer with ultrasonic gel. In accordance with the sagittal and transverse plane conventions, hold the transducer correctly to guarantee correct image orientation on the screen.

   Scanning and Modifications: Make a number of longitudinal and transverse abdominal sweeps while varying the depth and gain.

   Key features to note include:
   - Fetal cardiac activity
   - Number of fetuses
   - Fetal lie, presentation, and position
   - Amniotic fluid assessment (largest vertical pocket or amniotic fluid index)
   - Placental location

4. **Documentation:** Record and print significant findings, then discuss results and a management plan with the patient.

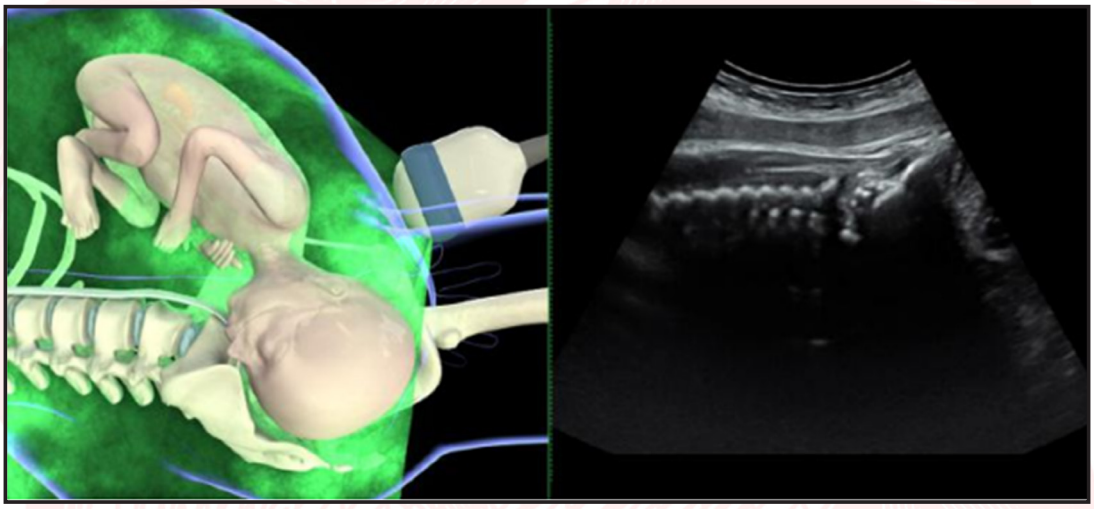


Figure 13.1: Transabdominal Ultrasound Imaging of the fetus (in occiput-anterior position) in the sagittal plane.

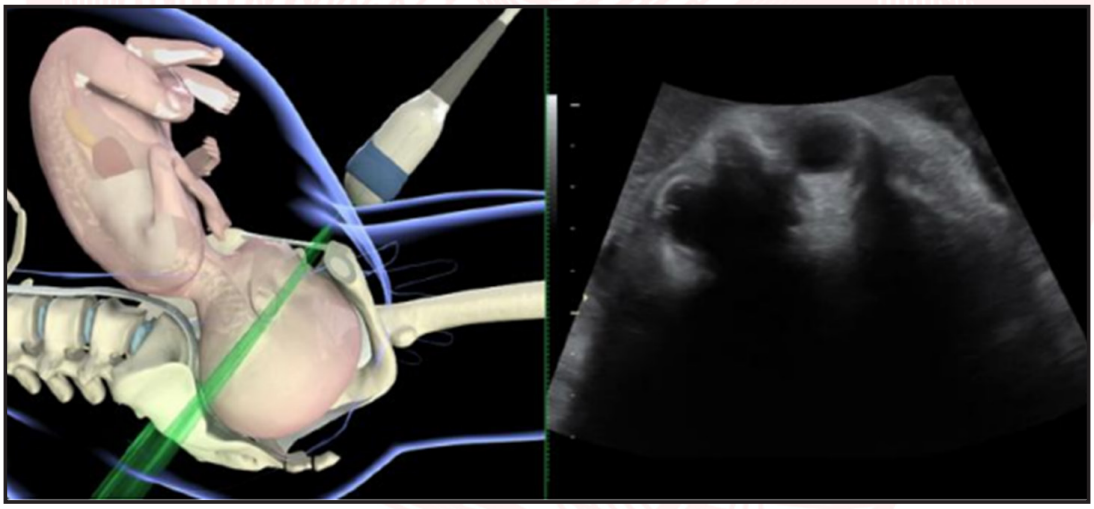


Figure 13.2: Transabdominal Ultrasound Imaging of fetus (in occiput-posterior position) in the sagittal plane

Transvaginal Scanning

Transvaginal ultrasound is particularly useful in the first trimester and for detailed views of the cervix in later stages. It is effective for assessing early pregnancy, estimating gestational age, and diagnosing complications such as incompetent cervix or placenta previa.

Steps for Transvaginal Scanning:

1. **Preparation:** Explain the procedure to the patient and position her in the lithotomy position.
2. **Equipment Preparation:** Apply scanning gel to the transvaginal transducer and cover it with a condom or commercial sheath. Lubricate and gently insert the transducer into the vagina, ensuring visualization of key structures such as the cervix and lower uterine segment.
3. **Image Acquisition:** Adjust gain and depth controls as needed. The transducer handle should be moved toward the opposite side of the body to visualize specific areas (e.g., moving right for left adnexal visualization). M-mode is used for fetal heart rate (FHR) assessment. Spectral Doppler is not recommended in the first trimester due to higher energy levels.
4. **Orientation:** Like transabdominal scanning, sagittal images are oriented with the woman's head on the left of the screen and feet on the right. In coronal views, the woman's right side appears on the left of the screen .
5. **Safety Considerations:** Adhere to ALARA (As Low As Reasonably Achievable) principles by minimizing exposure and using the lowest gain necessary for satisfactory images.

Transperineal Scanning

For visualizing the cervix and endocervical region during the second and third trimesters, transperineal ultrasound is an alternative to transvaginal scanning, particularly in cases of preterm labor, placenta previa, or suspected cervix issues. It is non-invasive and avoids entering the vagina, making it useful for identifying fetal position when vaginal or transabdominal assessment is challenging.

Steps for Transperineal Scanning:

1. **Preparation:** Apply scanning gel to a transabdominal transducer, cover it with a sterile glove, and add lubricating gel.
2. **Positioning and Imaging:** Place the transducer against the perineum and introitus. Images are oriented similarly to transvaginal scans but have lower resolution.
3. **Use Cases:** This technique is particularly helpful for assessing occiput posterior position, brow presentation, and asynclitism when manual or assisted vaginal delivery is planned.

Key Considerations for Scanning Techniques

- **Positioning:** Proper positioning ensures comfort and reduces complications such as supine hypotension.
- **Image Orientation:** Understanding image orientation is critical for consistent and accurate diagnosis. Sagittal and coronal views follow the same principles used in other cross-sectional imaging techniques.
- **Documentation:** After each scan, findings must be clearly documented, along with labeled images. Consultation with a specialist is advised if any uncertainty arises in the diagnosis or management plan .

Basic Applications of Ultrasound in Obstetrics

1. Fetal Life:

Ultrasound is used to confirm fetal life, particularly if the heartbeat cannot be detected using auscultation or Doppler. M mode tracing can document cardiac activity, and if there is doubt, consultation is necessary before diagnosing fetal demise. Sensitivity and communication are crucial when delivering such news to the family.

2. Fetal Number:

Determining the number of fetuses is essential, especially to avoid missing twins or higher-order multiples. A structured scan of all quadrants is necessary, and care must be taken to avoid false diagnoses due to viewing the same structure from different angles.

3. Fetal Presentation, Lie, and Position:

Ultrasound helps clarify fetal presentation (e.g., breech), lie (e.g., transverse), and position (e.g., spine orientation). Identifying these factors is crucial in labor, as they may influence delivery methods or the risk of complications like cord prolapse. Ultrasound can also verify the success of manual rotation .

4. Basic Placental Location:

Ultrasound is useful for determining placental location, particularly to diagnose or exclude placenta previa, which could complicate delivery. It can also help identify placental abruption, although ultrasound has limited sensitivity for this condition and clinical judgment is vital.

5. Amniotic Fluid Assessment:

Amniotic fluid volume is an indicator of fetal well-being. It can be assessed subjectively or quantitatively using methods like the amniotic fluid index (AFI) or single largest vertical pocket (LVP). Oligohydramnios (low fluid) may signal placental insufficiency or fetal anomalies, while polyhydramnios (high fluid) could indicate conditions like gestational diabetes or fetal anomalies.

Advanced Applications of Ultrasound in Obstetrics

Biophysical Assessment:

Advanced ultrasound applications like biophysical profiles (BPP) assess fetal well-being by integrating fetal movements, tone, breathing, and heart rate with an amniotic fluid assessment. This helps identify fetal distress or chronic issues like placental insufficiency. The BPP is especially helpful in nonreactive non-stress tests (NST) and can be used as early as 26-28 weeks gestation. A modified BPP (MBPP) combines an NST with amniotic fluid volume assessment for a more efficient evaluation.

Doppler Velocimetry:

Doppler ultrasound measures blood flow in fetal vessels, which is crucial for managing conditions like intrauterine growth restriction (IUGR) and preeclampsia. While not recommended for low-risk pregnancies, it helps reduce perinatal mortality and interventions in high-risk pregnancies. Doppler is useful in assessing uteroplacental circulation but is beyond basic applications.

Fetal Biometry:

Accurate pregnancy dating is essential and best done via ultrasound during the first trimester. Measurements like crown-rump length, biparietal diameter, and femur length help estimate gestational age, adjusting the estimated date of conception when discrepancies with the last menstrual period (LMP) are significant. Proper plane identification and accurate measurement techniques are crucial for reliability.

Estimating Fetal Weight:

Fetal weight estimation becomes particularly important in the third trimester and is crucial in the management of pregnancies complicated by diabetes, where large fetal size increases the risk of complications like shoulder dystocia. Ultrasound estimates of fetal weight can be inaccurate by about 500g (1.1 lb) and often overestimate the actual birth weight. It's recommended to consider cesarean delivery when estimated fetal weight exceeds 4,500g (9.9 lb) in diabetic women and 5,000g (11 lb) in non-diabetic women.

Determining Cervical Length

Cervical length assessment via **transperineal** or **transvaginal ultrasound** is valuable for detecting early signs of preterm labor or cervical incompetence, such as cervical shortening, funneling, and dilation. A cervical length of 2 to 2.5 cm in the second trimester is a known risk factor for preterm delivery. Short cervical length can be managed with progesterone therapy to reduce the likelihood of preterm birth.

A Cochrane review found insufficient evidence to recommend routine cervical length screening for preterm birth prevention.

Guidance for External Cephalic Version (ECV)

ECV, the manual turning of a fetus from breech or transverse presentation to cephalic, is often guided by **ultrasound**. Ultrasound ensures fetal well-being by allowing visualization of fetal biometry, anomalies (which are more frequent in breech presentations), and the fetal heart rate throughout the procedure.

Evaluating for Placenta Previa

Diagnosing **placenta previa** via ultrasound can be challenging depending on the fetus's position, amniotic fluid volume, and bladder filling. An optimal ultrasound for diagnosing previa is performed with a partially filled and then empty bladder, ideally without uterine contractions. **Transperineal** or **transvaginal ultrasound** with 3-7.5 MHz transducers is often used for a clearer image.

Evaluating for Placental Abruption

Placental abruption has variable sonographic appearances depending on the age of the bleed. Fresh hemorrhage appears sonolucent, while clotted blood becomes echogenic, resembling placental tissue. Abruption diagnosis should not rely solely on ultrasound, as negative results do not exclude the diagnosis.

Anatomic Survey for Anomalies

A comprehensive **anatomic survey** of fetal anatomy requires specialized training. The standard antepartum ultrasound, endorsed by professional organizations, aims to detect major anomalies but may not identify all.

If no previous standard survey was performed, the limited labor and delivery scan provider should explain the limitations of their examination.

Intrapartum Twin Management

For twins, ultrasound is useful in **determining fetal lie and presentation**. After delivering the first twin, ultrasound is crucial for monitoring the second twin's position and heart rate. Techniques like **external cephalic version**, internal podalic version, or **breech extraction** are often guided by ultrasound.

Amniocentesis Guidance

Ultrasound-guided amniocentesis is used in the third trimester to test for fetal lung maturity or rule out amnionitis. Particularly in cases of preterm labor, it helps find a safe pocket for sampling that is either close to the placenta or free from the umbilical cord.

Routine Scanning During Pregnancy

Routine ultrasounds before 24 weeks of gestation help in more accurate gestational dating, detection of multifetal pregnancies, and reducing postterm inductions. However, routine **scans after 24 weeks** in low-risk populations do not reduce perinatal mortality. **Second-trimester anatomic surveys** are common but haven't shown significant improvement in perinatal outcomes.

The **2016 ACOG Practice Bulletin** recommends a single ultrasound at 18-22 weeks for pregnancy dating and anatomic surveys, even in the absence of other indications.

Ultrasound in Low-Resource Settings

Although ultrasound has the potential to become as essential as the stethoscope, its high cost limits widespread use in **low-resource settings**. Issues like **portability**, **affordability**, and **maintenance** are key considerations for machines used in developing countries. While **compact, inexpensive ultrasound devices** show promise, more **outcomes research** is needed. **Teleradiology** can also help extend access to ultrasound services in these regions.

Ultrasound can have a profound impact in low-resource settings by improving the diagnosis of life-threatening conditions like **ectopic pregnancy**, **IUGR**, **placenta previa**, **malpresentation**, and **multiple gestations**. In a study conducted in Rwanda, midwives demonstrated **100% agreement with sonographers** when evaluating multiple gestation, malpresentation, and fetal viability. Additionally, 39% of abnormal ultrasound findings helped with diagnosis, and 22% led to a change in management.

Chapter Fourteen

First-trimester pregnancy complications

Learning Objectives:

Upon completing this chapter, participants will be able to:

1. List risk factors predisposing patients to First-trimester pregnancy complications
2. Describe symptoms and physical findings suggestive of ectopic pregnancy
3. Understand methods and test used to confirm the diagnosis of First-trimester pregnancy complications
4. Outline The management of common First-trimester pregnancy complications
5. Outline the symptoms, diagnosis, and treatment of gestational trophoblastic disease, ectopic pregnancy, and miscarriage.

Introduction

The first trimester of pregnancy (weeks 1-12) is a crucial period of development, and several complications can arise during this time. Here are some common first-trimester pregnancy complications that can significantly affect both maternal and fetal health.

1. Miscarriage (Abortion)

The loss of a pregnancy (expulsion of product of conception (POC) before 20 weeks of gestation which is before the period of fetal viability. Miscarriages with over 80% occur in the first trimester, and overall, in 10% to 30% of pregnancies.

Symptoms often include bleeding, passing of tissues, and cramping.

Risk factors:

- Advanced maternal age
- History of miscarriages
- Trauma
- Infections (TORCHES, malaria)
- Endocrine disorders (diabetes, hypothyroidism, PCOS)
- Abnormalities in the uterus (uterine fibroid)
- Psychological disorder (stress)
- Chromosomal abnormalities (Down syndrome)
- Exposure to chemical agents (tobacco, arsenic, pesticides)
- Chromosomal abnormalities in the fetus.

Types of Abortion:

- Threatened abortion.
- Inevitable abortion
- Incomplete abortion
- Missed abortion.
- Complete abortion
- Recurrent abortion

2. Threatened Abortion

Definition:

Painless vaginal bleeding, that occurs at any time between implantation and 24 weeks of gestation. POC has threatened to abort but has not done so yet.

Clinical features:

Bleeding (minimal, painless) and Associated with dull aching lower abdominal pain.

Examination:

- Size of uterus corresponds to period of amenorrhea (POA)
- Closed cervical os.
- U/S: well-formed, rounded gestational sac with fetus within it.

Management:

- Bed rest, Folic acid supplements and Avoid coitus.

3. Inevitable Abortion

Definition:

Painful vaginal bleeding from the retro-placental site and the POC is about to be aborted but not yet. It can progress to complete/ incomplete abortion depending on whether all fetal & placental tissues have been expelled from the uterus.

Clinical features:

Vaginal bleeding (painful) and Associated with cramping pain in the lower abdomen.

Examination:

The Size of the uterus corresponds to/less than POA and Dilated cervical os.

Management:

Hospitalization and Analgesics to control pain

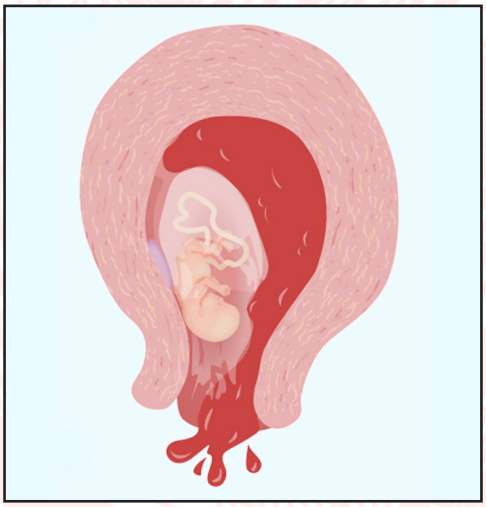


Figure 14.1: Inevitable Abortion

Incomplete Abortion

Definition:

POC has aborted but not completely.

Clinical features:

A vaginal bleeding (heavy, passed out POC as fleshy mass) which Associated with colicky pain in the lower abdomen with or without signs of shock

Examination:

- The size of the uterus is smaller than POA.
- Open cervical os
- U/S: reveal retained POC in the uterine cavity.

Management:

Resuscitate if bleeding is severe, do blood group and crossmatch, Give analgesia for pain and Evacuation retained the product of conception.

Definition:

Figure 14.2: Missed Abortion

When the embryo/fetus is already dead, but remains in the uterine cavity for a period of time, without symptoms of miscarriage

Clinical features:

Decreased in pregnancy symptoms and vaginal bleeding (absent, minimal)

Examination:

- The size of the uterus is smaller than POA.
- Closed cervical os.
- U/S: crumpled gestational sac.

  : revealed fetal pole but no signs of activity (no heart activity)

Management:

Wait for spontaneous expulsion and retained products of conception (ERPOC).

Complete Abortion

Definition:

All the POC has completely aborted.

Clinical features:

History of pain and passage of product followed by absence of pain and minimal bleeding.

Examination:

- The size of the uterus is smaller than POA.
- Closed cervical os.
- U/S: empty uterine cavity

Management:

U/S to look for an empty uterine cavity.

Recurrent Abortion

Definition:

Three or more consecutive spontaneous abortions. These can be divided into 2 groups.

1st trimester abortion (<12 weeks)

Etiology:

1. Uterine abnormality (uterine fibroid)
2. Endocrine (DM, thyrotoxicosis, PCOS)
3. Autoimmune (SLE)
4. Infection (TORCHES)

2nd trimester abortion (>12 weeks)

Etiology:

1. Cervical incompetence (History of termination of pregnancy, vigorous dilatation of cervix, History of cone biopsy)
2. Uterine abnormalities (septate or subseptate uterus)

2. Ectopic Pregnancy

This occurs when a fertilized egg (pregnancy) implants outside the uterus, typically in a fallopian tube. It can cause severe abdominal pain and requires immediate medical attention.

Symptoms:

- Vaginal Bleeding
- Sharp Lower abdominal pain, back or pelvic pain
- Shoulder pain
- Syncopal attacks (hemoperitoneum)
- Symptoms of hypovolemic shock

Risk factors:

- Previous ectopic pregnancies
- Pelvic inflammatory disease
- Induction of ovulation
- Previous procedure on fallopian tube
- Previous pelvic surgery
- Smoking
- Structural: Uterine fibroid and Abnormal uterine anatomy

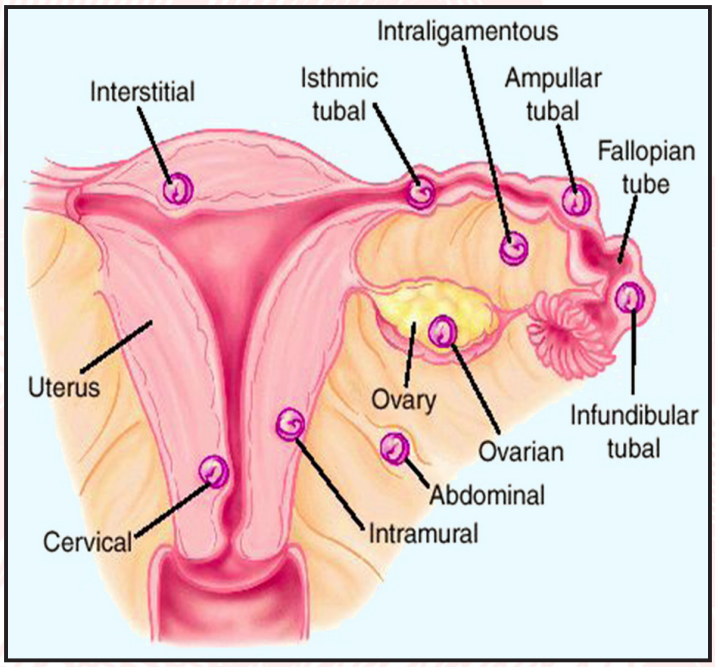


Figure 14.3: Ectopic Pregnancy

Sites of implantation:

1. In fallopian tube (fimbriae, ampullary isthmus, interstitial)
2. In the ovary
3. In the abdominal cavity
4. In the cervical site

Examination:

- Vital signs – Hypotension, Tachycardia, Fever
- Generally – Pale
- Abdominal Palpation – Uterus not palpable, tenderness, guarding.
- Per speculum & Viginal examination – os closed, cervical excitation, adnexal mass, bimanual examination of uterus.

Investigations:

1. Urinary Pregnancy Test: Positive
2. Beta hCG: If a patient has a beta subunit of human chorionic gonadotropin level of 1,500 mIU per mL or greater, but the transvaginal ultrasonography does not show an intrauterine gestational sac, ectopic pregnancy should be suspected.

3. Transvaginal ultrasound
   - Empty uterus
   - Presence of free fluid especially in the Pouch of Douglas
4. Diagnostic laparoscopic

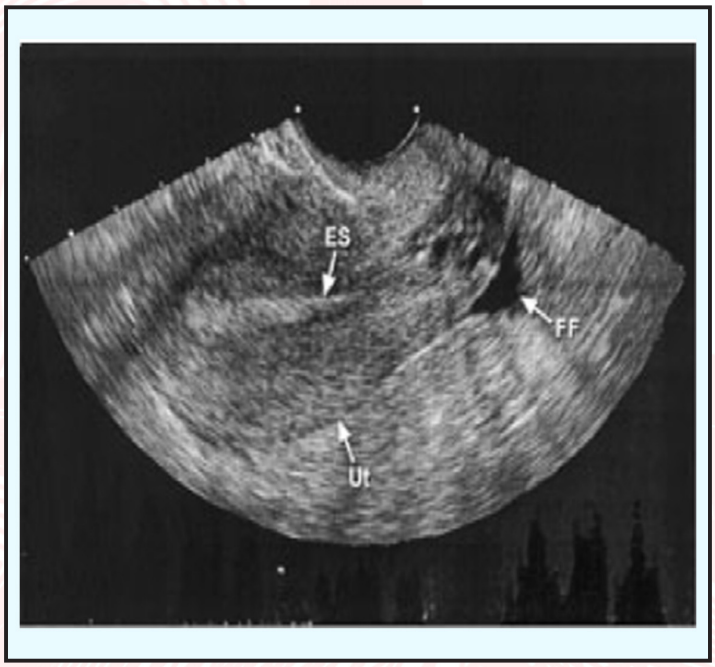


Figure 14.3: Ectopic Pregnancy

Management:

- Stabilize patients.
- Surgical: Salpingectomy/ Salpingotomy either by laparotomy/laparoscopy
- Medical: Methotrexate; Intramuscular/direct into tubal pregnancy

3. Hyperemesis Gravidarum

Characterized by severe nausea and vomiting, that leads to dehydration, electrolytes imbalance, weight loss, necessitating medical intervention.

Symptoms:

Inability to keep food or water down, Severe vomiting and Extreme fatigue.

Risk factors:

History of hyperemesis in prior pregnancies, Carrying multiples (twins, triplets) and Having a molar pregnancy.

4. Bleeding

About 25% of pregnant women experience some bleeding early in pregnancy. While light spotting may be normal, heavy bleeding accompanied by pain could indicate miscarriage or ectopic pregnancy.

5. Gestational Trophoblastic Disease (Molar Pregnancy)

A rare condition complication where abnormal tissue grows inside the uterus instead of a viable fetus. It requires monitoring and possibly treatment to prevent complications.

Symptoms:

Severe nausea, rapid uterine growth, and dark brown or grape-like vaginal discharge.

Risk factors:

- Maternal age over 35.
- Previous molar pregnancy.

Molar Pregnancy can be **classified** as

- Complete hydatiform mole: no normal fetal tissue forms
- Partial hydatiform mole incomplete fetal tissues develop alongside molar tissue
- Choriocarcinoma (invasive mole): contains many villi, but these may grow into or through the muscle layer of the uterus wall: can spread to tissues outside of the uterus.

Table 14.1: Complete Molar Pregnancy

Most common type of hydatidiform mole
Diffuse trophoblastic hyperplasia, hydropic swelling of chorionic villi, no fetal tissue or membrane present.
46XX or 46XY
2 sperm fertilize 1 empty egg or 1 sperm with reduplication
15-20 % risk of progression to malignant sequela.

Table 14.2: Incomplete Molar Pregnancy

Hydropic villi and focal trophoblastic hyperplasia are associated with fetus or fetal parts.
Often triploid (XXY, XYY, XXX) with chromosome complement from both parents.
Single ovum fertilized with 2 sperms.

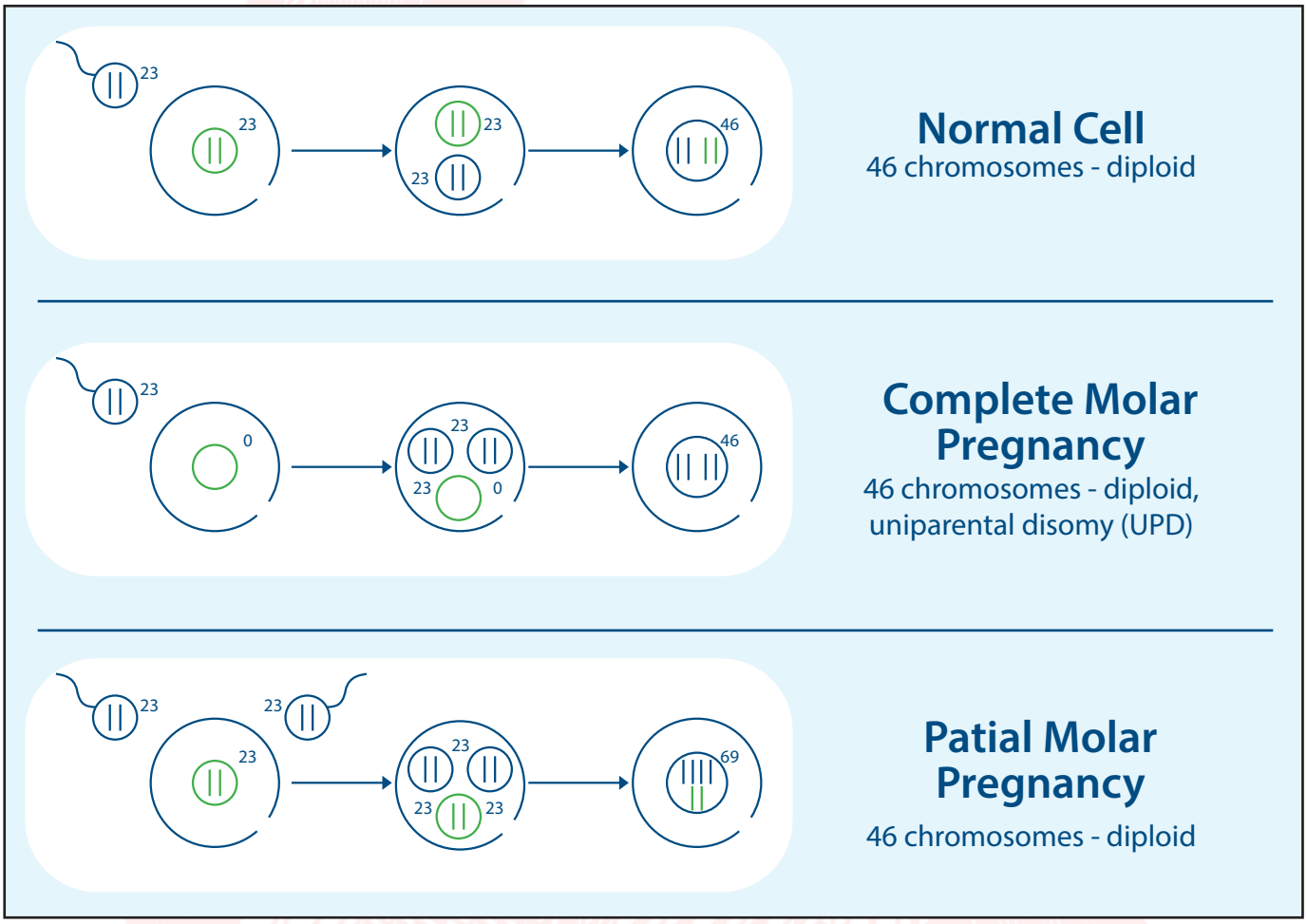


Figure 14.5: Chromosomes distributions in molar pregnancy

Table 14.3: Clinical features of molar pregnancy

Clinical features	
Complete	Incomplete
Vaginal bleeding -97%	Presentation is similar to threatened/ spontaneous/ missed abortion.
Uterine larger than date -51%	
Hyperemesis gravidarum – 26%	
B-hCG > 100,000	
No fetal heartbeat	

Investigation

- Urinary Pregnancy test
- B-hCG level
- U/S
  - Complete – no fetus, classic snowstorm
  - Incomplete – molar degeneration of placenta +/- fetal anomalies, multiple echogenic regions corresponding to hydropic villi and focal intrauterine hemorrhage.
- CXR – may show metastatic lesions.
- Features of high risk of neoplasm
  - Local uterine invasion
  - B-hCG >100,000
  - Excessive uterine size
  - Prominent theca- lutein cyst

Figure 14.6: U/S for molar pregnancy

Treatment:

- Suction and curettage.
- Rhogam in rhesus negative.
- Consider hysterectomy if the patient no longer desires fertility.
- Chemo for carcinoma

Follow up:

- TCA 2/52 till the urinary pregnancy test is negative.
- B-hCG 2/52 till normal
- Follow up monthly until 1 year.
- Follow up 3 monthly until 1 year.

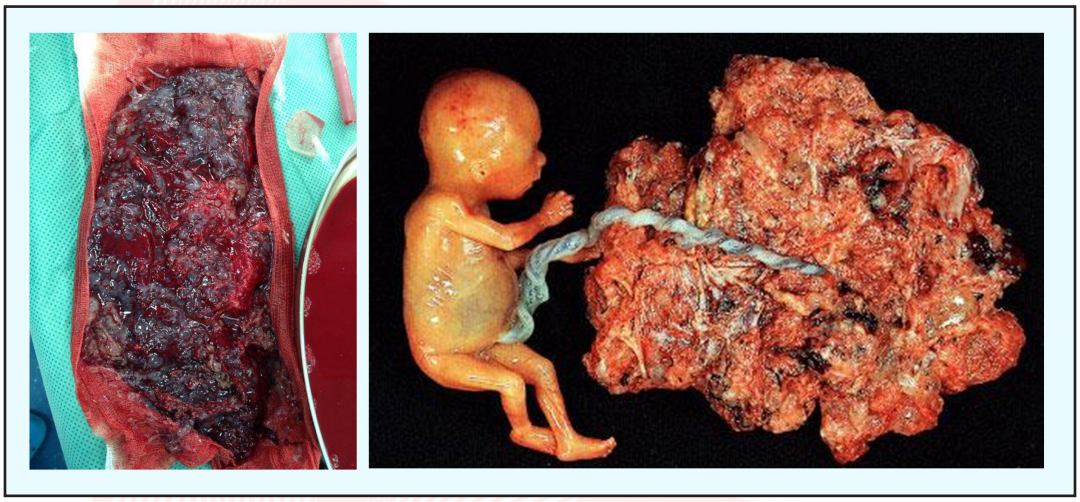


Figure 14.6: Suction and curettage for molar pregnancy

6. Subchorionic Hemorrhage (Subchorionic Hematoma)

A blood clot that forms between the uterine wall and the chorionic membrane, which surrounds the embryo.

Symptoms include vaginal bleeding or spotting, often without pain. Risk factors are unknown, but some women may develop small bleeds early in pregnancy.

7. Threatened Miscarriage

When there is vaginal bleeding and cramping, the cervix remains closed, and the pregnancy continues.

Symptoms include, Light to heavy vaginal bleeding and cramping. Risk factors are hormonal imbalances or issues with the placenta.

8. Blighted Ovum (Anembryonic Pregnancy)

A fertilized egg implants in the uterus but does not develop into an embryo.

Symptoms include vaginal bleeding or cramping and an ultrasound showing an empty gestational sac. Risk factors are chromosomal abnormalities in the embryo.

9. Infections

Infections like urinary tract infections (UTIs), sexually transmitted infections (STIs), and others can cause complications.

Symptoms include painful urination, pelvic discomfort, fever, or abnormal vaginal discharge. Risk factors are unprotected sexual activity, poor hygiene, or underlying health conditions.

10. Severe Cramping

Mild cramping is normal, but severe cramping may indicate a more serious issue such as miscarriage or ectopic pregnancy.

Symptoms include intense, persistent abdominal or pelvic pain. Risk factors are history of pelvic surgeries, infections, or certain structural abnormalities of the uterus.

11. Rh Incompatibility

Occurs when a Rh-negative mother carries a Rh-positive fetus, which can cause the mother's immune system to attack the fetus.

Symptoms include usually asymptomatic early on but can lead to serious complications if untreated. Risk factors are Rh-negative blood type.

If a pregnant woman experiences symptoms like severe abdominal pain, heavy bleeding, or severe nausea, it's important to seek medical attention promptly. Early detection and treatment can reduce risks and improve outcomes for both the mother and the baby.

Chapter Fifteen

Cesarean Delivery

Learning Objectives:

Upon completing this chapter, participants will be able to:

1. Differentiate between planned and emergency cesarean deliveries and understand their indications.
2. Recognize the benefits of family-centered practices, like clear drapes and immediate skin-to-skin contact.
3. Understand the factors influencing the choice between LAC and repeat cesarean, and ensure LAC is performed in appropriate facilities.
4. Be aware of the impact of cesarean delivery rates and the importance of patient education in various settings.
5. Know the basics of managing cesarean delivery complications and the importance of patient safety.

Introduction

Cesarean delivery is a common surgical procedure used to deliver babies when a vaginal birth isn't possible or safe. Over the years, practices around cesarean deliveries have evolved to include more family-centered approaches, like allowing skin-to-skin contact and using clear drapes.

Cesareans can be planned or performed in emergencies, with various risks and considerations for each. The decision to attempt a vaginal birth after a cesarean Labor After Cesarean Delivery (LAC) involves weighing risks and benefits, with the choice ultimately guided by patient preferences and medical advice. Globally, cesarean rates vary, and both low and high rates pose health risks, highlighting the need for appropriate use and access to quality care.

Background

Frequency:

Historical Trends: Cesarean delivery rates in the U.S. have increased from 4.5% in 1965 to 32.9% in 2009, peaking at 31.9% in 2018. This rise is attributed to higher primary cesarean rates and fewer vaginal births after cesarean.

Preventing Primary Cesarean Delivery Safely:

Concerns: Concerns regarding overuse have arisen as a result of the sharp rise in cesarean rates between 1996 and 2011, which was not accompanied by a drop in maternal or neonatal morbidity or mortality.

Suggestions: The following are important measures to lower the rates of primary cesarean sections:

- reexamining how labor dystocia is defined.
- enhancing and standardizing the interpretation of fetal heart rate (FHR).
- expanding the availability of ongoing labor assistance.
- making an attempt at malpresentation using the external cephalic version (ECV).
- taking twin gestation labor trials into consideration (ACOG & SMFM, 2014).

Death and Morbidity:

Maternal Mortality Rate: In the United States, the maternal mortality rate for elective repeat cesarean deliveries is 13.4 per 100,000 births, with complications ranging from infection and bleeding to thromboembolic events.

Prevention

Understanding the risk factors for stillbirth is critical to prevention efforts, particularly the modifiable factors. Maternity care providers should focus on identifying and managing these risks to reduce the incidence of stillbirths.

Table 15.1: Safe Prevention of Primary Cesarean Delivery according to Stage of Labor

Recommendations	Grade of Recommendations
First stage of labor	
A prologed latent phase (eg, greater than 20 hours in nullipators womaen and greater than 14 hours in multiparous women) should not be an indication for cesarean delivery.	1B Strong recommendation, moderate quality evidence
Slow but progressive labor in the first of labor should not be an indication for cesarean delivery.	1B Strong recommendation, moderate quality evidence
Cervical dilation of 6 cm should be considered the threshold for the active phase of most women in labor. Thus, before 6 cm of dilation is achieved, standards of active phase progress should not be applied.	1B Strong recommendation, moderate quality evidence
Cesarean delivery for active phase arrest inthe first stage of labor should be reserved for women at or beyond 6 cm of dilation with ruptured membranes who fail to progress despite 4 hours of adequate uterine activity, or at least 6 hours of oxytocin administration with inadequate uterine activity and no cervical change.	1B Strong recommendation, moderate quality evidence

Recommendations	Grade of Recommendations
Second stage of labor	
A specific absolute maximum length of time spent in the second stage of labor beyond which all women shoul undergo operative delivery has not been identified.	1C Strong recommendation, low quality evidence
Before diagnosing arrest of labor in the second stage, if the maternal and fetal conditions permit, allow for the following: • At least 2 hours of pushing in multiparous women (1B) • At least 3 hours of pushing in nulliparous women (1B) Longer durations may be appropriate on individualized basis (eg, with the use of eqidural analgesia or with fetal malposition) as long as progress is being documented. (1B)	1B Strong recommendation, moderate quality evidence
Operative vaginal delivery in the second stage of labor by experienced and well trained physicians should be considered a safe, acceptable alternative to cesarean delivery. Training in, and ongoing maintenance of, practical skills related to operative vaginal delivery should be encouraged.	1B Strong recommendation, moderate quality evidence
Manual rotation of fetal occiput in the setting of fetal malposition in the second stage of labor is a reasonable intervention to consider before moving to operative vaginal delivery or cesarean delivery . In order to safely prevent cesarean deliveries in the setting of malposition, it is important to assess the fetal position in the second stage of labor, particularly in the setting of abnormal fetal descent.	1B Strong recommendation, moderate quality evidence

Indications and Contraindications

Cesarean delivery is a common surgical procedure used to deliver babies when a vaginal birth isn't possible or safe. Over the years, practices around cesarean deliveries have evolved to include more family-centred approaches, like allowing skin-to-skin contact and using clear drapes.

Caesareans can be planned or performed in emergencies, with various risks and considerations for each. The decision to attempt a vaginal birth after a cesarean (LAC) involves weighing risks and benefits, with the choice ultimately guided by patient preferences and medical advice. Globally, cesarean rates vary, and both low and high rates pose health risks, highlighting the need for appropriate use and access to quality care.

- **Repeat Cesarean Delivery:** The most common overall indication.
- **Primary Cesarean Delivery:** Key reasons include:
  - Labor dystocia (34%)
  - Abnormal or indeterminate fetal heart rate (23%)
  - Fetal malpresentation (17%)
  - Multiple gestations (7%)
  - Suspected fetal macrosomia (4%) [18, 20].

Contraindications:

- **General Principle:** Prioritize the health of the woman, which generally benefits the fetus. If the woman is unstable and the fetus is nonviable, stabilize the mother first. If the fetus is viable, stabilize the mother and then consider cesarean delivery based on obstetric or fetal needs.
- **Exception:** Resuscitative hysterotomy, which may be performed in critical emergencies.

Table 15.2: Summary of Common Indications for Caesarean Delivery

Accepted
Failed induction Cephalopelvic disproportion Failure to progress in labor Proven fetal distress Placental abruption Placenta previa Umbilical cord prolapse Obstructive benign and malignant tumors Active genital herpes infection Abdominal cerclage Conjoined twins
Controversial (or selective)
Breech presentation Repeat cesarean Congenital fetal anomalies, major Cervical carcinoma Prior vaginal colporrhaphy Large vulvar condylomata HIV infection

HIV, human immunodeficiency virus.

Elective Caesarean Deliveries

Optimal Timing: Elective cesarean deliveries are ideally scheduled at or after 39 weeks gestation to avoid neonatal complications linked to fetal immaturity. Deliveries performed before 39 weeks have

been associated with increased respiratory disorders, infection, decreased blood sugar, and longer hospital stays.

Exceptions: If the mother or fetus has serious medical problems, delivery before 39 weeks may be considered., such as:

- Placenta previa
- Prior classical uterine incision
- Gestational hypertension
- Pre-eclampsia
- Intrauterine growth restriction with abnormal Doppler results.

Anatomy and Physiology Relevant to Cesarean Delivery

Cardiovascular Changes During Pregnancy

Pregnancy induces significant alterations in maternal cardiovascular physiology, which impact cesarean delivery. Increased perfusion in the pelvic organs during pregnancy heightens the risk of serious hemorrhage during cesarean delivery.

Pelvic Blood Supply

1. Uterine Artery

- **Origin and Route:** At the fourth level of the lumbar vertebra, the aorta splits into the common iliac arteries. The external and internal iliac arteries split off from each common iliac artery. The internal iliac (also known as the hypogastric) artery divides into anterior and posterior segments as it travels medially along the psoas muscle.
- **Branching:** One of the main visceral branches of the anterior division of the hypogastric artery is the uterine artery. After a brief descent, it enters the base of the broad ligament and rotates medially in the direction of the uterus.
- **Surgical Significance:** The uterine artery crosses over the ureter about 2 cm laterally to the cervix. This anatomical relationship is important because clamping and ligating the uterine vessels, particularly in cases of hysterectomy or postpartum hemorrhage (PPH), can cause damage to the ureter.

2. Ovarian Artery

- **Origin and Pathway:** It arises from the abdominal aorta, distal to the origin of the renal arteries. The artery descends towards the pelvis, crossing the pelvic brim and the origin of the external iliac vessels. It moves medially, dividing into an ovarian branch and tubal branches, which supply their respective structures.

3. Uterine and Ovarian Veins

- **Uterine Veins:** The uterine vein is a vein of the uterus. It is found in the cardinal ligament. It drains into the internal iliac vein. It follows a similar course to the uterine artery. It helps to drain blood from the uterus, and removes waste from blood in the placenta during pregnancy.
- **Ovarian Veins:** Ovarian veins run anterior to the psoas muscle and the ureter after emerging from the plexus in the broad ligament close to the ovary and fallopian tube and communicating with the uterine plexus. In most people, the left ovarian vein empties into the left

renal vein, while the right ovarian vein empties into the inferior vena cava.

Vaginal Blood Supply

- **Sources:** Although some sources claim that the vaginal artery can originate from the uterine artery, the phrase "vaginal branches of uterine artery" refers to the blood supply to the vagina that originates from the uterine artery. The vaginal artery is typically a branch of the internal iliac artery.

  Two or three branches are commonly used to represent the vaginal artery. These provide the mucous membrane of the vagina by descending to it. It can send branches to the fundus of the bladder, the contiguous part of the rectum, and the bulb of the vestibule. They anastomose with branches from the uterine artery

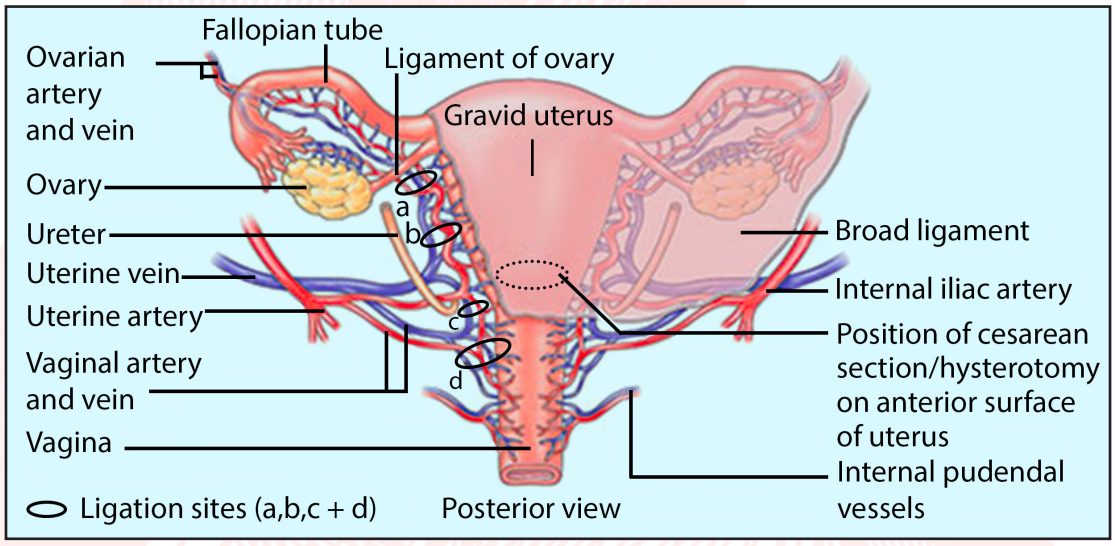


Figure 15.1 : Pelvic Blood Supply

Physical Findings and Diagnosis for Cesarean Delivery

History

1. **Medical History:** Obtain details on the patient's overall health, including any medical conditions.
2. **Surgical and Obstetric History:** Include previous surgeries and obstetric events.
3. **Gynecologic History:** Document past gynecological issues and treatments.
4. **Family History:** Record any relevant family medical conditions.
5. **Lifestyle Factors:** Note tobacco and drug use.
6. **Transfusion History:** Include any previous blood transfusions.
7. **Medications and Allergies:** List current medications and any known allergies.
8. **Thrombotic and Anesthetic Complications:** Gather information on past issues related to blood clotting and anaesthesia.
9. **Current Obstetric Indication:** Document specifics such as the length of labor, duration of ruptured membranes, and timing of the last food and drink intake.

Physical Examination

1. **General Examination:** Assess the patient's overall medical condition and readiness for surgery.
2. **Obstetric Examination:** Evaluate the progress of labor. Perform a vaginal examination in laboring women before surgical draping to determine if vaginal delivery is still possible.
3. **Anesthetic Considerations:** Be prepared for the possibility of converting regional anesthesia to general anesthesia during the procedure.
4. **Herpes Screening:** Examine women with a history of herpes for active lesions to prevent transmission during delivery.

Ancillary Tests

1. **Laboratory Evaluation:**
   - **Complete Blood Count (CBC):** Assess overall blood health.
   - **Blood Type and Screen:** Determine blood type and check for antibodies.
   - **Crossmatch Blood Tube:** Ensure availability for transfusions if needed.
2. **HIV Status:** Know prenatal HIV status to implement measures to reduce vertical transmission risk.
3. **Kleihauer-Betke Test:** This may be performed in Rh-negative women in cases of major trauma to quantify fetal-maternal hemorrhage.

Procedure for Cesarean Delivery

Preoperative and Nonsurgical Considerations

Table 15.3: Enhanced Recovery Pathway

Operative phase	Clinical components	Organisational components
Preoperative	1. Patient education 2. Fluid restriction timing 3. Food restriction timing	1. Consultant delivered care
Intraoperative	4. Immediate skin to skin contact 5. Avoidance of maternal hypothermia 6. Breast feeding in theatre 7. Subcuticular wound closure	2. WHO checklist
Postoperative	8. Regular analgesia 9. Bladder care plan 10. IVI discontinuation in recovery 11. Early mobilisation 12. Postoperative surgical team review 13. Fluids and food given in recovery 14. Infant temperature monitoring 15. Breastfeeding education	3. Early discharge package 4. Post-discharge support 5. Access to food overnight

1. **Preparation:**
   - **Skin and Vaginal Preparation:** Follow standard procedures for major abdominal surgeries.
   - **Surgical Time Out:** Conduct a time out to ensure all necessary steps are reviewed and completed.

2. **Fluid Management:**
   - **Preoperative Fluids:** Administer a 1 L IVF (isotonic) before epidural or spinal analgesia to counteract peripheral vasodilation, labor loss, and anticipated blood loss.
   - **Blood Loss Management:** Blood transfusion of blood loss more than 1 L.
3. **Antibiotic Prophylaxis:**
   - **Antibiotic Administration:** Administer intravenous (IV) antibiotics before skin incision, unless contraindicated (e.g., ongoing appropriate antibiotics for chorioamnionitis). This practice helps reduce the incidence of postoperative infections.
   - **Recommended Agents:** Ampicillin and first-generation cephalosporins are effective in preventing endometritis. Clindamycin (900 mg IV) is recommended for patients with penicillin allergy.
   - **Additional Prophylaxis:** For procedures lasting over 4 hours, re-dosing should be considered. For obese patients (BMI ≥30 kg/m^2 or body weight ≥80 kg), consider increasing cefazolin dosage to 3 g IV.
   - **Azithromycin:** Administering 500 mg IV azithromycin, in addition to cefazolin, has shown a 50% reduction in infections but is not recommended for scheduled cesarean deliveries 24].
4. **Infective Endocarditis Prophylaxis:**
   - **Guidelines:** No longer advised.
5. **Abdominal Hair Removal:**
   - **Protocol:** Hair removal is often unnecessary. If removal is needed, it should be done by clipping in the operating room rather than shaving the evening before to minimize infection risk.

Informed Consent

1. **Discussion and Documentation:**
   - **Consultation:** The surgeon must discuss the risks and benefits of the cesarean delivery with the patient and a family member, if available. This should be done in both medical and lay terms.
   - **Documentation:** Use a narrative form or pre-printed form to document the discussion. Ensure it includes diagnosis, the procedure to be performed, common and significant risks, alternatives, and potential additional procedures.
   - **Consent Form:** The patient and surgeon should sign and date the consent form, which should outline risks such as bleeding, infection, organ damage, anesthesia risk, hysterectomy, fetal injury, need for further procedures, and maternal mortality.

Preoperative Considerations

1. **Surgical Planning:**
   - **Preoperative Huddle:** Prior to moving the patient to the operating room, the surgical team may conduct a pre-op or huddle to discuss the procedure and potential complications based on the clinical scenario.
   - **Time-Out Procedure:** A time-out should be performed to verify patient identity, review pre-

operative consent documentation, and confirm the procedure details. Address any specific obstetric, neonatal, or anesthesia risks, and confirm if additional procedures like intrauterine device (IUD) placement or tubal ligation will occur.

Abdominal Wall Incision Options

1. **Pfannenstiel Incision:**
   - **Description:** Two finger-breadths (3 cm) above the symphysis pubis, the Pfannenstiel incision is a transverse skin incision that extends toward the anterior superior iliac spine (ASIS) and terminates on both sides 2–3 cm medial to ASIS.
   - **Considerations:** Although this incision can be made beneath the pannus in obese patients, the postoperative period may become more complicated due to the increased risk of bacterial colonization.
2. **Joel-Cohen (Misgav Ladach Modification):**
   - **Description:** The Joel-Cohen incision involves a transverse cut 15-17 cm long, made 3 cm below the anterior superior iliac crests. It emphasizes stretching tissues rather than sharp dissection.
   - **Advantages:** Associated with reduced blood loss, shorter operating time, decreased postoperative pain, and fewer analgesic injections compared to the Pfannenstiel incision. It requires fewer instruments, making it suitable for use in remote areas.
   - **Evidence:** Studies indicate that Joel-Cohen techniques have better short-term outcomes compared to Pfannenstiel but no long-term outcome evidence.
3. **Midline Vertical Incision:**
   - **Description:** This incision provide a quick access and good exposure because it runs from the pubic symphysis to within 2 cm of the umbilicus.
   - **Usage:** Although less common in the U.S., it is often used in other countries and can be selected for specific indications or repeat cesarean deliveries.
4. **Other Incisions:**
   - **Maylard Incision:**
     - To reveal the rectus muscle, the rectus sheath incision is extended laterally to the iliac spine.
     - Transverse cuts are made to the rectus muscles.
     - The rectus sheath is sutured to the cut edges of muscles.
     - exposed transversalis fascia and ligated epigastric vessels
     - The peritoneum and transversalis fascia are cut across.
     - The urachus is bound.
   - **Cherney Incision:** transverse rectus sheath incision.
     - The rectus muscles are separated from the lower sheath.
     - The tendons are cut and exposed 1.5 cm above the symphysis's periosteum.
     - Closing: Above the symphysis, the tendons are sutured to the lower rectus sheath.

Peritoneal Incision

1. **Parietal Peritoneum:**

- **Entry Point:** To prevent bladder damage, especially during repeat procedures, the parietal peritoneum should be entered in the highest position feasible.
- **Technique:** It can be entered using sharp dissection or blunt digital dissection, followed by stretching the peritoneum open.

2. **Urinary Bladder:**
   - **Anatomy:** The bladder consists of the dome (thin and distensible) and the base (thicker and less distensible). The base is in contact with the upper vagina and cervix.
   - **Encounter Points:** When the peritoneum is opened, the bladder is visible, and it is once more encountered when the bladder flap is being created. By palpating the catheter bulb, the bladder's extent is verified.
3. **Visceral Peritoneum:**
   - **Bladder Flap:** Creating a bladder flap can reduce operating time and incision-to-delivery interval, though evidence on long-term effects is lacking. It is generally required if a cesarean hysterectomy is planned.
   - **Technique:** One centimeter above the bladder reflection onto the lower uterine segment, the vesicouterine peritoneum is raised and opened transversely. The bladder flap develops inferiorly and transversely by 10–12 cm. Making a bladder flap can be difficult when there is scar tissue from prior cesarean deliveries.

Uterine Incision

1. **Low Transverse Incision:**
   - **Description:** The low transverse incision is made in the noncontractile lower uterine segment. It is the most commonly used incision due to its benefits of reduced immediate and subsequent wound dehiscence, less blood loss, and minimal formation of adhesions.
   - **Technique:** To prevent fetal harm, the incision is carefully made 1-2 cm above the bladder margin. Techniques include blunt dissection with scissors or raising the lower uterine segment with Allis clamps. In order to prevent fetal harm and extension into lateral vessels, the incision is carefully managed and extended about 10 cm transversely and slightly cephalad.
2. **Classical/Vertical Incision:**
   - The classical vertical incision is used to treat uterine abnormalities, dense adhesions, poorly developed lower uterine segment, and significant prematurity. Malpresentation or anterior placenta previa can also be treated with it.
   - **Method:** In certain complicated cases, this vertical incision into the active myometrium may be required.
3. **Low Vertical Incision:**
   - **Description:** The low vertical incision extends cephalad as necessary, starting 2 cm above the bladder. The lower uterine segment may be used for the procedure.
   - **Risks:** There is less data on this incision type, but it has a rupture rate of 1-2%. Risks include potential extension into the uterine fundus or other structures, and difficulty in clinically identifying the detachment between the lower and upper uterine segments.

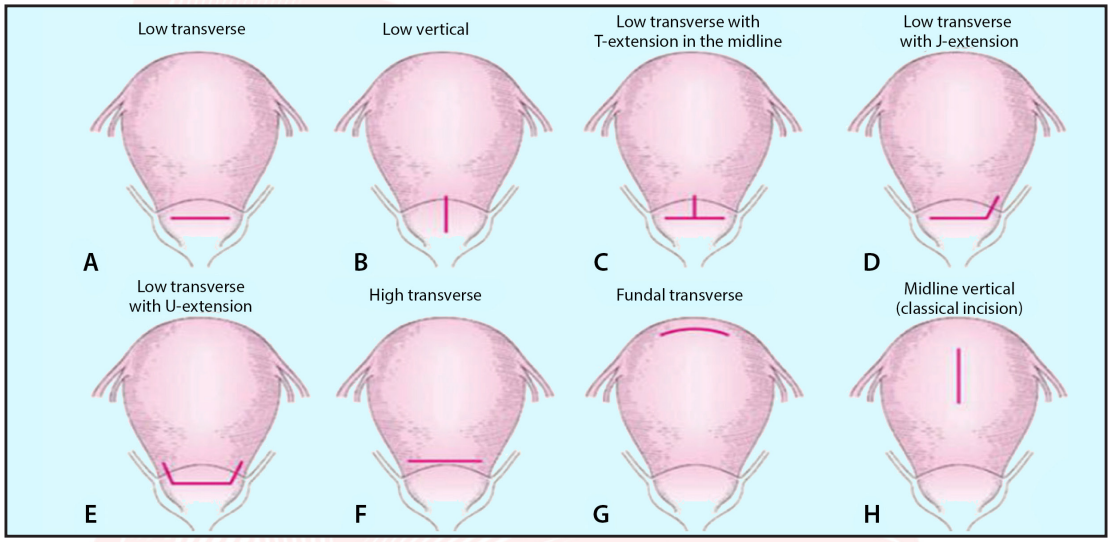


Figure 15.2: Uterine Incisions

Anterior Placenta Management

1. **Placental Separation:**
   - **Procedure:** To expose the fetus, the placenta must be separated from the uterine wall if it is anterior. If the delivery is not quick, there is a chance of fetal bleeding.
   - **Management:** The operator should deliver the baby right away and clamp the cord if the placenta is lacerated. In these situations, a vertical incision may be required. Finding the placenta can be aided by preoperative ultrasound.
   - **Considerations:** The risk of placenta accreta should be evaluated in women who have had a previous cesarean delivery, and the surgical team should be ready for potential bleeding and the requirement for a hysterectomy.

Delivery of the Fetus

Cephalic Presentation

1. **Preparation:**
   - **Retractor Removal:** Start by removing retractors and manually elevating the presenting part of the fetus.
   - **Trans-Abdominal Pressure:** An assistant applies pressure to the uterine fundus to aid in lifting the fetus.
2. **Manual Techniques:**
   - **If Deeply Applied:** In order to break suction and use it as a lever to raise the presenting part, carefully insert a hand into the uterus using side-to-side motions if the presenting part is deeply engaged.
   - **Avoid Using Incision as Fulcrum:** The uterine incision should not be used as a fulcrum to avoid extending the incision.
3. **Fundal Pressure:**
   - **Application:** When the presenting portion is sufficiently raised, apply fundal pressure, mak-

ing sure the force pushes the fetus out of the pelvis rather than deeper into it.

- **Flexion:** Aim for fetal flexion, especially in occiput posterior or anterior positions. Be cautious to avoid excessive manipulation of a thin lower uterine segment, which can cause cervical laceration.

4. **Additional Assistance:**
   - **High Presenting Part:** Use a vacuum device or a single forceps blade as necessary if the presenting part is high.
   - **Torso Delivery:** Apply fundal pressure to gently work out each shoulder individually. Deliver the fetal feet first, as an alternative.
   - **Newborn Transfer:** After clamping and cutting the umbilical cord, transfer the newborn to an attendant.

Breech Presentation

1. **Preoperative Confirmation:**
   - **Ultrasound:** Confirm breech presentation with preoperative ultrasound.
2. **Incision Requirements:**
   - **Incision Size:** For proper exposure, a larger abdominal wall and uterine incision might be required.
   - **Vertical Incision:** In cases of underdeveloped lower uterine segment (e.g., very preterm), a vertical uterine incision might be required.
3. **Delivery Techniques:**
   - **Similar to Breech Vaginal Delivery:** Use techniques similar to those for breech vaginal deliveries.
   - **Extension of Incisions:** Extend the uterine incision vertically into the active myometrium if the fetal head is difficult to deliver. This can take the form of a J or an inverted T.
4. **Documentation and Future Deliveries:**
   - **Operative Report:** Document any incision extensions in the operative report.
   - **Future Pregnancies:** Inform the woman that a T incision is generally considered a contraindication for future laparoscopic-assisted deliveries (LAC) due to increased risk of uterine rupture.

After Delivery

1. **Cord Blood Collection:**
   - **Tests:** To determine an infant's blood type, Rh status, Coombs test, and potentially HIV and/or rapid plasma reagent testing, obtain cord blood.
   - **Cord Segment:** To measure blood gas, keep a 10- to 15-cm section of the umbilical cord.
2. **Clamping and Delayed Clamping:**
   - **Cord Clamping:** Clamp the cord close to the placenta to get a sufficient arterial pH specimen.
   - **Delayed Clamping:** If the baby is active and the uterine bleeding is not severe, think about delaying the cord clamping for 1 minute. Preterm babies especially benefit from this practice.

Delivery of the Placenta

1. **Oxytocin Infusion:**
   - **Administration:** Immediately after delivery, administer an infusion of oxytocin (10 to 40 units in 1 liter of isotonic crystalloid).
2. **Placental Delivery Techniques:**
   - **Assisted Spontaneous Delivery:** This entails gently pulling on the umbilical cord and massaging the fundus. Because of the lower risks, it is preferred over manual extraction.
   - **Manual Extraction:** May be necessary in some cases, but assisted spontaneous delivery generally results in fewer complications like endometritis, reduced blood loss, and shorter hospitalization. It does not significantly increase operative time.
3. **Uterine Inspection and Cleaning:**
   - **Inspection:** A laparotomy sponge should be used to examine and clean the uterine cavity.
   - **Cervical Dilation:** It is not necessary to perform routine manual or instrumental cervical dilation prior to uterine closure, and it has no effect on the rates of blood loss or postoperative infection.

Repair of the Uterus

1. **IUD Placement:**
   - **Timing:** If an intrauterine device (IUD) is requested and consented to, it can be inserted either before or after starting the repair of the uterus. The IUD strings are left untrimmed until the uterus returns to its pre-pregnancy size.
   - **Outcomes:** Studies show that intraoperative IUD placement can increase use rates at 6 months but may also lead to higher expulsion rates.
2. **Uterine Repair Methods:**
   - **Exteriorization vs. In Situ Repair:**
     - **Exteriorization:** Involves repairing the uterus outside the abdominal cavity. It offers better exposure and ease of fundal massage. There are no significant differences in complications between exteriorized and intra abdominal repair, although exteriorization may reduce blood loss.
     - **In Situ Repair:** Involves repairing the uterus within the abdominal cavity. This method may lead to an earlier return of bowel function but does not significantly differ in other outcomes like blood loss or nausea.
3. **Closure of the Uterine Incision:**
   - **Initial Closure:** Use a single layer of absorbable running suture (No. 0 or No. 1). Lock the suture if significant bleeding occurs; otherwise, either locked or unlocked sutures are acceptable.
   - **Suturing Technique:** Traditionally, the surgeon sutures toward themselves and places sutures just beyond each apex of the incision while avoiding lateral vessels.
   - **Second Layer:** Although it is not required if a tubal ligation is done, unless hemostasis is required, a second layer of imbricating sutures is advised if the woman may become pregnant again. There is conflicting evidence regarding the benefit of a second layer.

- **Vertical Incision:** Requires a two- or three-layer closure with No. 0 or No. 1 absorbable suture.

4. **Considerations for Future Pregnancies:**
   - **LAC Candidates:** For women considering laparoscopic-assisted cesarean (LAC), a two-layer closure is recommended to prevent issues with being considered a candidate for LAC in future pregnancies, though data on this is not conclusive.

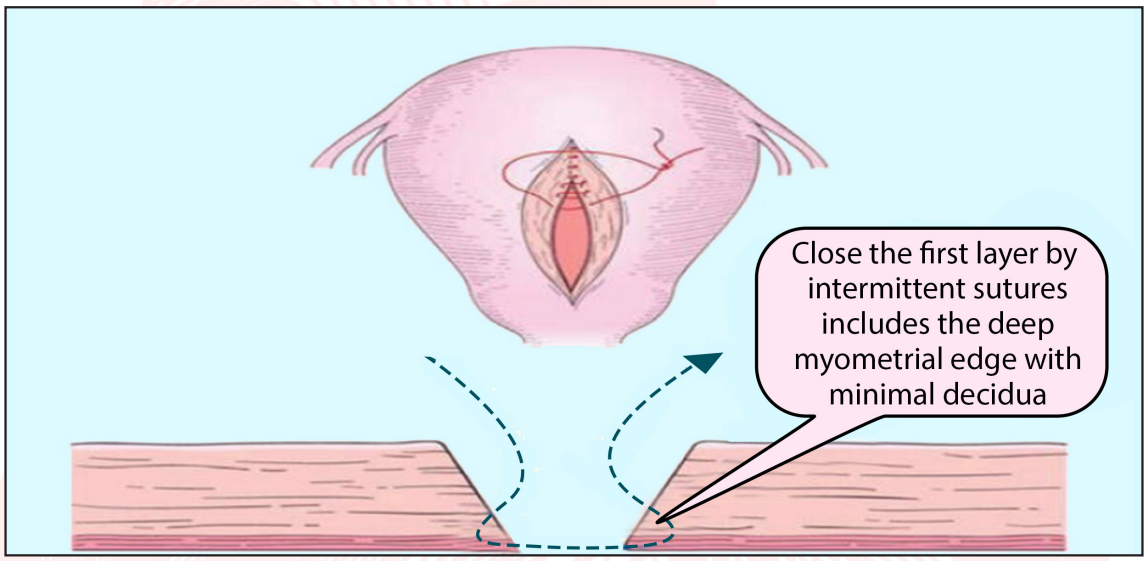


Figure 15.3: First Layer of Closure Sutures

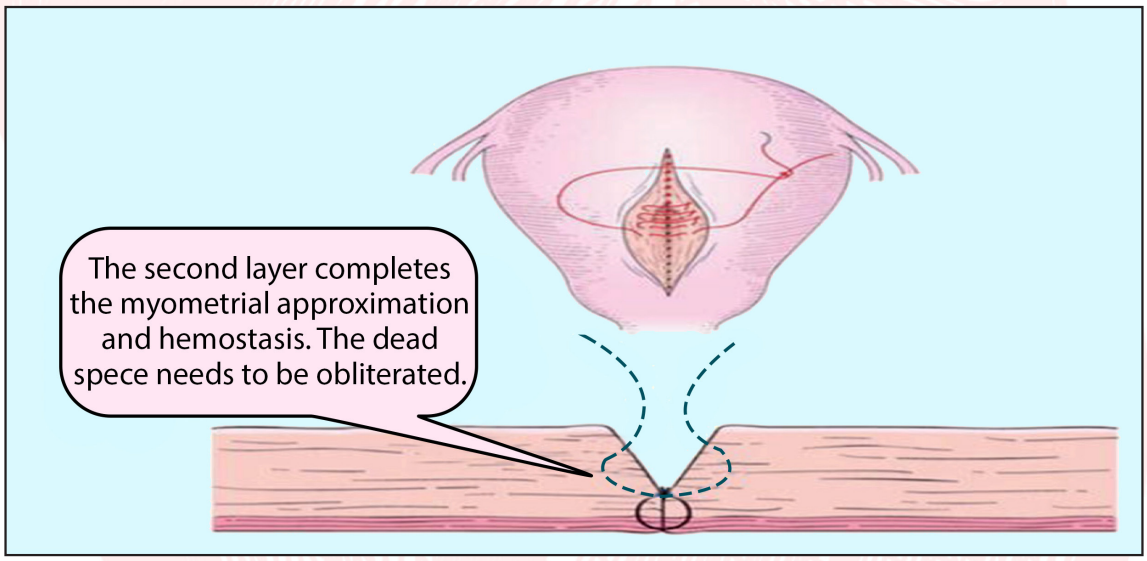


Figure 15.4: Second Layer of Closure Sutures

Instrument and Soft Material Count

- **Timing of Counts:** Accurate counts of instruments and soft materials (e.g., sponges) should be done as soon as closure begins. If accurate counts before the procedure were not possible due to an emergent situation, an X-ray should be performed before closing the surgical site.
- **Identification Systems:** Use radiofrequency sponges, barcoded sponges, or other identification systems to prevent retained surgical sponges.

Technical Pitfalls

1. **Closing the Uterine Incision:**
   - **Common Errors:** Avoid placing sutures beyond the uterine incision, which can lead to increased bleeding and potential ureteral injury.
   - **Identification:** To avoid mistakes, clearly mark the uterine incision, the uterine edge, and any extensions before closing.
2. **Malpresentation Deliveries:**
   - **Version Techniques:** Consider intraoperative version to convert breech or transverse presentations to cephalic before uterine incision to prevent traumatic delivery or the need for complex incisions (e.g., classical or inverted T incision).
   - **Exposure:** Make sure the uterus and abdominal wall are exposed enough for an atraumatic delivery, particularly in cases of malpresentation. When dealing with the fetal head during breech presentations, skilled assistance is essential.

Postoperative Care

- **Early Oral Intake:** There is no evidence supporting the need to withhold oral fluids after uncomplicated cesarean delivery. Early intake within 6 to 8 hours can improve gastrointestinal function without increasing complications.

Choice of Procedure

1. **Modified Joel-Cohen Method:**
   - **Benefits:** Compared to conventional methods, the modified Joel-Cohen cesarean delivery is linked to a shorter length of stay, fewer complications, and less operating time.
2. **Uterine Closure Techniques:**
   - **Single-Layer Continuous Suture:** Provides short-term benefits and is effective for uterine closure.
   - **Single vs. Double-Layer Closure:** Both are associated with similar rates of cesarean scar defects, uterine dehiscence, and rupture in future pregnancies. The decision may depend on clinical context and resource availability.
   - **Locked Sutures:** Generally associated with higher rates of scar weakness and dehiscence/rupture. Full-thickness suturing, including the decidua/endometrium, may improve scar strength.
3. **Cost-Effective Choices:**
   - In resource-constrained environments, methods like spinal analgesia combined with the Joel-Cohen approach, which requires less suture material and is less complex, may be preferred.

These guidelines aim to optimize surgical outcomes and minimize complications in cesarean deliveries.

Maternal Antifibrinolytic Trial (WOMAN) and Tranexamic Acid (TXA)

- **TXA Administration:**
  - **Dosage:** 1 g IV (100 mg/mL) administered over 10 minutes (1 mL/minute).

- **Second Dose:** 1 g IV if bleeding persists after 30 minutes.
- **Timing:** Administer TXA as soon as possible, ideally within 3 hours of birth, since most PPH-related deaths occur within the first 2 to 3 hours .

- **Guidelines:**
  - **WHO:** Recommends TXA use as soon as possible and supports a second dose if necessary.
  - **ACOG:** Suggests TXA should be considered if initial medical therapies fail, with earlier administration being more beneficial.

Surgical Management of Hemorrhage

1. **Initial Steps:**
   - **O'Leary Sutures:** Just cephalad to the ureter, in the lateral aspect of the uterus, place absorbable sutures No. 0 or No. 1.
   - **Bilateral Ligation of Uterine Vessels:** Performed just medial to the ovaries if bleeding persists.
2. **Uterine Compression Sutures:**
   - **B-Lynch Suture:** Effective for controlling uterine bleeding from atony when other methods fail. It compresses the uterus similarly to manual compression and has shown no adverse effects on future pregnancies in limited studies.
3. **Bilateral Ligation of Internal Iliac Arteries:**
   - **Challenges:** Difficult with a large uterus, small incision, or significant bleeding. Largely replaced by uterine artery ligation and compression sutures due to high failure rates.
4. **Tamponade:**
   - **Foley Catheters:** Place one or more No. 30 French Foley catheters with a full 30 cc balloon through the cervix for tamponade.
   - **Bakri and Ebb Balloons:** Designed for uterine tamponade, with the Bakri balloon having a capacity of 500 mL of saline.
5. **Selective Arterial Embolization:**
   - **Use:** To control bleeding if other methods fail .
6. **Hysterectomy:**
   - **Indications:** Uterine hemorrhage unresponsive to treatment, uterine rupture, placenta accreta, major pelvic vessel laceration, or advanced cervical dysplasia/carcinoma.
   - **Complications:** increased anesthesia duration, infection, blood loss, and the psychological toll of unanticipated sterility.

Extensions of the Uterine Incision

- **Common Extensions:** Malpresentations, macrosomia, or a thin lower uterine segment. Extensions can be into the broad ligament or vagina.
- **Repair:** Expose and visualize the full extent of the laceration. Place sutures just beyond the apex of the laceration and repair with locked or interrupted sutures as needed. Cystoscopy should be performed if ureteral injury is suspected.

Urinary Tract Injury

- **Bladder Injury:**
  - **Incidence:** more frequent in cases of cesarean hysterectomy, uterine rupture, or repeat cesarean deliveries.
  - **Repair:** Dome of the bladder with two layers of 2-0 absorbable suture; consultation recommended for involvement of the base or trigone.
- **Ureteral Injury:**
  - **Identification:** Dissect the ureter and perform cystoscopy to confirm bilateral ureteral flow. Ureteral repair often requires consultation from urology or gynecological oncology.

Gastrointestinal Injury

- **Incidence:** occurs more frequently in cases of adhesions from previous surgeries and occurs in 0.04% to 0.08% of cesarean deliveries.
- **Repair:** For full-thickness defects, use a double-layered transverse closure. Consult a general or colorectal surgeon for larger or complex lacerations.
- **Contamination Management:** Copious irrigation and broad-spectrum antibiotics are required if there is fecal contamination. Antibiotics include cefoxitin, cefotetan, and possibly metronidazole or ampicillin/sulbactam.

Anesthetic Complications

- **Risks:** Anesthesia-related complications include intubation difficulties, aspiration, inadequate ventilation, and local anesthetic toxicity. Regional anesthesia is preferred for cesarean deliveries due to its safety profile, but complications can still occur.
- **Recommendations:** Neuraxial anesthesia (spinal or epidural) is generally preferred, though no evidence shows it to be superior to general anesthesia in major outcomes. Ensure vigilance for potential complications such as systemic toxicity or spinal hematoma, especially in patients on anticoagulants.

Management of Anticoagulation and Analgesia

- **Anticoagulation Management:**
  - **Discontinuation:** Discontinue anticoagulation at least 12 to 24 hours before labor induction or scheduled cesarean delivery.
  - **LMWH Dosage:** For women on once-daily prophylactic doses of low-molecular-weight heparin (LMWH), administer 50% of the usual dose in the morning before delivery.

Analgesia and Anesthesia:

- **Adverse Effects:**
  - **Hypotension:** Treat with fluids and/or vasopressors.
  - **Pruritus:** Managed better with naloxone than antihistamines.
  - **Nausea and Vomiting:** Treat with antiemetics like droperidol, promethazine, or ondansetron.
  - **Respiratory Depression:** Managed with small doses of opioid antagonists.

- **Regional Analgesia Concerns:**
  - **Potential Issues:** Long-term backache, labor progress and outcome, breastfeeding success. However, no clear cause-and-effect relationship is established.
  - **Benefits:** Compared to general anesthesia, regional analgesia is linked to less blood loss and a smaller postoperative drop in HCT.

Postoperative Care After Cesarean Delivery

- **General Care:**
- **Wound Management:**
  - Remove dressings after 24 hours.
  - Staples: Removed in 4 days for transverse incisions, 7-10 days for vertical incisions. Steri-Strips and topical adhesives can be used post-staple removal.
- **Breastfeeding: Encourage all women to breastfeed.**
- **Iron Replacement: Based on postoperative hemoglobin levels.**
- **Discharge: Typically in 2-4 days. Activity should be based on comfort level, with early am5**

Postoperative Orders:

1. Check vital signs and fundal status every 4 hours for the first four hours, then every 4 hours for the next 24 hours, and finally every 8 hours.
2. Uterine massage: Proceed as planned; report any further lochia.
3. Monitoring of Intake and Output: For the first 24 hours, every 4 hours.
4. Activity: Promote walking three times a day; start with assistance.
5. Cough, deep breathing, and incentive spirometry every hour while awake are all part of respiratory care.
6. Foley Catheter: For closed drainage, stop using it the first morning after surgery or as soon as you can walk normally.
7. Diet: As tolerated once the nausea has subsided.
8. IV fluids: oxytocin-containing D5 lactated Ringer solution, which is changed to heparin lock once oral intake is tolerated.
9. Pain Management: Morphine sulfate 2-8 mg IV every 2 hours as needed. NSAIDs for pain, but avoid beyond 24 hours postpartum if hypertension is present.
10. Antiemetics: Droperidol, promethazine, or ondansetron as needed.
11. Oral Analgesics: Oxycodone 5 mg every 3-4 hours as needed after tolerating oral intake.
12. Laboratory Testing: Hemoglobin/hematocrit on the first postoperative day.
13. Vaccinations: Administer Rho(D) immune globulin, rubella, hepatitis, varicella, and Tdap vaccines as indicated.

Patient Instructions:

- **Contact for Issues:** Redness, fever, dehiscence of the wound, increased abdominal pain, vaginal bleeding, or depression.
- **Wound Care:** Keep the abdominal wound dry, cleanse with warm water and mild soap. Notify

the provider if redness, increased warmth, drainage, or fever develops.

- **Follow-Up:** Discuss eligibility for future labor after cesarean delivery, risk of uterine rupture, and need for repeat cesarean delivery based on the uterine incision type.
- **Opioid Use:** Balance pain management with the risk of opioid use disorder. Avoid codeine in breastfeeding women due to risk of neonatal toxicity. Provide sufficient pain relief while being cautious of long-term opioid use.

Early Postoperative Complications

- **Common Complications:**
  - **Infection:**
    - **Wound Infection, Endometritis, Serious Infectious Complications, and Antibiotic Prophylaxis:** A single dose of a first-generation cephalosporin or ampicillin is effective in reducing complications .
  - **Endomyometritis:**
    - **Diagnosis:** Uterine tenderness, fever beyond 24 hours, and leukocytosis. Blood cultures are often negative.
    - **Treatment:** Use IV clindamycin and gentamicin or ampicillin/sulbactam. Additional oral antibiotics are not needed after symptoms resolve.
  - **Wound Separation/Infection:**
    - **Incidence:** Occurs in approximately 5% of cases; two-thirds of these are infected.
    - **Signs:** Erythema, tenderness, purulence, and fever.

Postoperative Care

1. **Wound Management:**
   - Dressings are typically removed after 24 hours.
   - Staples are removed within 4 to 10 days, depending on the type of incision.
   - The wound should be monitored for signs of infection or dehiscence.
2. **Pain Management:**
   - Pain is managed with IV morphine, NSAIDs, and oral opioids as needed.
   - For nausea and vomiting, antiemetics like ondansetron or promethazine may be used.
3. **Activity and Recovery:**
   - Early ambulation is encouraged.
   - Discharge usually occurs within 2 to 4 days, depending on recovery.
4. **Postoperative Instructions:**
   - Women should report any complications such as increased pain, wound issues, or signs of infection.
   - Guidance on activity resumption should be based on comfort and evidence-based advice.

Early Postoperative Complications

1. **Infections:**
   - Common infections include wound infections and endometritis.
   - Prophylactic antibiotics can reduce infection rates.
2. **Wound Separation/Infection:**
   - Treatment involves broad-spectrum antibiotics and possibly surgical intervention if the wound does not heal.
3. **Urinary Tract Infections:**
   - Often associated with catheter use. Treatment is based on culture results.
4. **Gastrointestinal Complications:**
   - Ileus and bowel obstruction may occur, requiring specific management approaches.
5. **Thromboembolic Complications:**
   - DVT and pulmonary embolism risks are higher after cesarean delivery. Prophylactic measures include early mobilization and pharmacotherapy.
6. **Septic Thrombophlebitis:**
   - Diagnosis involves ruling out other causes of persistent fever despite antibiotic treatment.

Delayed Postoperative Complications

1. **Uterine Dehiscence and Rupture:**
   - Diagnosed in subsequent pregnancies. Risks are discussed in the context of future deliveries.
2. **Placenta Accreta:**
   - The risk increases with the number of previous cesarean deliveries. Management may involve hysterectomy if necessary.
3. **Repeat Cesarean Delivery:**
   - Associated with higher risks of adhesions, chronic pain, and subfertility.

Controversies

1. **Electronic Fetal Monitoring:**
   - Its widespread use has not significantly reduced newborn morbidity or mortality rates.
2. **Breech Presentation:**
   - Cesarean delivery is often preferred due to reduced risk compared to vaginal breech delivery.
3. **Incidental Procedures:**
   - Routine performance of additional procedures during cesarean delivery is generally discouraged due to increased morbidity.
4. **Macrosomia:**
   - Prophylactic cesarean delivery for suspected macrosomia has mixed results, and the decision should be individualized.

5. **Litigation:**
   - Concerns over malpractice litigation influence the rates of cesarean deliveries, with some evidence suggesting that tort reform could impact these rates.

Family-Centered, Gentle Cesarean Delivery

- **Concept:** Introduced to improve the delivery experience by allowing more family involvement and early skin-to-skin contact.
- **Features:** Includes lowering the surgical drape for the mother to see the baby, using clear drapes, delayed cord clamping, and quieter, dimmed environments.
- **Applicability:** Suitable for planned cesarean deliveries but not for emergency situations requiring immediate intervention.

Resuscitative Hysterotomy

- **Definition:** Emergency cesarean performed in cases of maternal cardiac arrest to potentially save both the mother and infant.
- **Timing:** Best performed within 4 minutes of ineffective maternal circulation to improve survival rates.
- **Indications:** Requires appropriate skills, equipment, and a gestation of at least 20 weeks. No consent from family is required in these emergencies.

Labor After Cesarean Delivery (LAC)

- **Terminology:** "Labor after cesarean" is preferred over "trial of labor after cesarean" to be more optimistic.
- **Success Rate:** About 75% of women with a single previous cesarean can have a successful vaginal birth.
- **Risks:** The primary risks are uterine rupture and dehiscence. The latter is less severe but still notable.

Induction of Labor

- **Options:** Induction remains an option for women attempting LAC. However, prostaglandins are discouraged due to higher risks of uterine rupture.
- **Oxytocin:** Used with caution; increases rupture risk but is lower compared to prostaglandins.

Regional Analgesia

- **Use:** Epidural analgesia can be used during LAC to manage pain, with the caveat that it should not mask signs of uterine rupture.

External Cephalic Version (ECV)

- **Feasibility:** Generally considered safe for women with a prior cesarean if they are at low risk for complications.

Unknown Type of Previous Uterine Incision

- **Safety:** VBAC is still considered in cases where the type of previous uterine incision is unknown, assuming there is no high suspicion of a classical incision.

Level of Care

- **Recommendation:** LAC should be conducted in facilities capable of managing emergencies to ensure appropriate care if complications arise .

Recommendations for Labor After Cesarean (LAC)

- **Facility Requirements:** ACOG guidelines suggest that LAC should be attempted in facilities equipped to handle emergency cesarean deliveries if needed. This includes having obstetric, pediatric, anesthesiology, and operating room staff available.
- **Patient Counseling:** Women should receive counseling regarding the advantages and disadvantages of a repeat caesarean section versus a LAC, as well as the capabilities of their delivery environment. The woman should consult her care provider before making the final decision.
- **Documentation:** It is important to document counseling and management plans in the medical record.

Global Considerations for Cesarean Delivery

- **Cesarean Delivery Rates:** A caesarean delivery rate of roughly 15% is advised by the WHO. Increased morbidity and mortality can result from either too low or too high rates.
  - **Low Rates:** Underuse of cesarean delivery can result in higher maternal and neonatal mortality and morbidity. In some low-resource settings, cesarean rates are below 10%, and not all facilities are equipped to perform them.
  - **High Rates:** In some regions, particularly in private hospitals in Latin America, rates exceed 50%, leading to increased fetal mortality, preterm deliveries, and longer neonatal ICU stays.
- **Education:** Women should be informed about the indications for their cesarean delivery and how their type of incision may affect future delivery options.

Chapter Sixteen

Management of Birth Crisis

Learning Objectives:

Upon completing this chapter, participants will be able to:

1. Define various birth crises and their clinical implications.
2. Recognize the emotional and psychological impact of birth crises on patients and health-care providers.
3. Apply evidence-based management strategies during birth crises, including maternal and neonatal emergencies.
4. Utilize effective communication techniques during sensitive situations involving fetal or maternal death.
5. Understand global disparities in birth outcomes and the healthcare provider's role in reducing these disparities.

Introduction

A birth crisis encompasses a wide range of unexpected, adverse outcomes that occur during labor, delivery, or immediately postpartum. These events include fetal death, severe maternal complications, or neonatal morbidity. Birth crises are often traumatic and emotionally charged for both patients and healthcare providers, requiring not only medical expertise but also compassionate care. This handout provides an overview of birth crisis management, aiming to guide junior doctors in dealing with these situations clinically and emotionally.

Background

Globally, approximately 2.6 million stillbirths and 303,000 maternal deaths occur annually. Birth crises can vary widely in nature and severity, from fetal or neonatal loss to maternal conditions such as postpartum hemorrhage or eclampsia. Despite advances in obstetric care, disparities in outcomes persist, particularly in resource-limited settings.

Key Definitions

1. **Birth Crisis:** A birth crisis refers to any unexpected adverse event during pregnancy, labor, delivery, or the immediate postpartum period that significantly impacts maternal or fetal health. This can include fetal death, severe maternal complications (e.g., postpartum hemorrhage, eclampsia, maternal death), or neonatal morbidity.
2. **Fetal Death:** Fetal death is the spontaneous intrauterine death of a fetus at any gestational age. In the United States, the 2022 fetal death rate was 5.61 per 1,000 live births, with rates higher among non-Hispanic black women (10.53) compared to non-Hispanic white women (4.88).
3. **Stillbirth:** Stillbirth is defined as fetal death at 20 weeks' gestation or more, or for fetuses weighing 350g or more if the gestational age is unknown. The CDC categorizes stillbirths as:
   - **Early stillbirth:** 20-27 weeks' gestation.

- **Late stillbirth:** 28-36 weeks' gestation.
- **Term stillbirth:** 37 weeks' gestation or more. Globally, the World Health Organization (WHO) defines stillbirth as fetal death after 22 weeks' gestation. Legal definitions vary by country, complicating global data collection and research.

4. **Neonatal Death:** Neonatal death refers to the death of an infant within the first 28 days of life. In 2020, the neonatal mortality rate in the United States was 3.4 per 1,000 live births. Causes of neonatal death may include complications from the birth process (e.g., birth asphyxia), infections (e.g., sepsis), or congenital anomalies.
5. **Maternal Mortality:** Maternal mortality is defined as the death of a woman while pregnant or within 42 days of termination of pregnancy, from any cause related to or aggravated by the pregnancy or its management. The US maternal mortality rate for 2022 decreased to 22.3 deaths per 100,000 live births, compared with a rate of 32.9 in 2021.
6. **Postpartum Hemorrhage (PPH):** PPH is defined as blood loss exceeding 500 mL after vaginal delivery or 1,000 mL after cesarean section. It is a leading cause of maternal mortality worldwide, particularly in low-resource settings. Early recognition and prompt management are critical in preventing life-threatening outcomes.

Risk Factors and Methods of Prevention

Understanding the risk factors for stillbirth is critical to prevention efforts, particularly the modifiable factors. Maternity care providers should focus on identifying and managing these risks to reduce the incidence of stillbirths.

Key Risk Factors for Stillbirth:

1. **Modifiable Risk Factors:**

   The leading modifiable cause of stillbirth is obesity. Managing obesity through weight control and lifestyle interventions can lower risk. Poorly controlled diabetes increases stillbirth risk. The American College of Obstetricians and Gynecologists (ACOG) recommends a hemoglobin A1c level of less than 7% for women planning pregnancy.
   Hypertension and Thyroid Disease: Proper management of these conditions is crucial.
   Substance Use: Smoking, secondhand smoke, alcohol, methamphetamine, cocaine, and other illicit drugs all increase the risk of stillbirth.

2. **Other Risk Factors:**

   Non-Hispanic black race, nulliparity, grand multiparity, maternal age under 15 or over 35 years, unmarried status, male fetal sex, assisted reproductive technology, and multiple gestation all contribute to increased stillbirth risk.

   Lupus, renal disease, cholestasis of pregnancy, and antiphospholipid antibody syndrome are significant risk factors .

   Between 6% and 13% of stillbirths are caused by chromosomal abnormalities, the most common being trisomy 21 (31%), monosomy X (22%), trisomy 18 (22%), and trisomy 13 (6%).

   Fetuses with an estimated fetal weight (EFW) less than 10% for gestational age are at increased risk of stillbirth. Serial ultrasound monitoring and early delivery can reduce this risk.

3. **Gestational Age:**

The risk of stillbirth rises with gestational age, especially after 41 weeks. ACOG recommends induction by 42 weeks to prevent stillbirth.

Table 16.1: Maternal and Fetal Risk Factors for Stillbirth

Advanced maternal age Chromosomal and genetic abnormalities (e.g., monosomy X; trisomy 13, 18, or 21 syndrome) Hypertension Infection (e.g., malaria, cytomegalovirus, human parvovirus B19, syphilis, listeriosis, goup B streptococcus) Low educational status Medical disease (e.g.; renal disease, thyroid disorders, systemic lupus erythematosus, cholestasis of pregnancy, diabetes mellitus)	Multiple pregnancy Preeclampsia Prepregnancy body mass index greater than 30 kg per m_2 Prior stillbirth Smoking more than 10 cigarettes per day Thrombophilia Uteroplacental insufficiency or growth restriction

Methods of Prevention:

1. **Lifestyle Modifications:**

Weight management: Reducing obesity through diet and exercise is essential. Women with diabetes should maintain optimal glucose control, targeting hemoglobin A1c below 7%.

Stopping the use of tobacco, alcohol, and illicit drugs is vital.

2. **Medical Monitoring:**

Regular prenatal checkups and tests, such as serial umbilical artery Doppler measurements, can help monitor fetal well-being and detect issues like Intrauterine Growth Restrictions (IUGR).

For women with IUGR, induction is recommended between 38 and 39 6/7 weeks, or earlier if there are additional risk factors.

3. **Infection Control:**

Infections such as Group B Streptococcus, E. coli, and viruses like cytomegalovirus and Zika are associated with stillbirth. Proper prenatal screening and treatment of infections are critical.

4. **Placental and Umbilical Cord Issues:**

Preventing conditions like placental abruption (often caused by smoking and drug use) can reduce stillbirth risk. Blood pressure management may help prevent abruptions.

By addressing these modifiable risk factors and using evidence-based methods for early detection and intervention, maternity care providers can significantly reduce the risk of stillbirth.

Overview of Birth Crises

- **Fetal loss:** Miscarriage, stillbirth, neonatal death
- **Maternal complications:** Eclampsia, postpartum hemorrhage (PPH), maternal cardiac arrest
- **Neonatal crises:** Birth asphyxia, prematurity, congenital anomalies

Types of Birth Crises

1. **Fetal or Neonatal Loss**
   - **Spontaneous Pregnancy Loss (Miscarriage):**
     Occurs in 10-20% of clinically recognized pregnancies and the management involves patient counseling, medical or surgical interventions, and psychological support.
   - **Stillbirth:**
     Defined as fetal death at 20 weeks gestation or later and occurs globally at a rate of 2.6 million annually, often due to placental insufficiency, infection, or congenital anomalies.
   - **Neonatal Death:**
     Neonatal death occurs within the first 28 days of life, with major contributors being prematurity and birth asphyxia.
     Early detection of neonatal complications is critical for improving outcomes.
2. **Maternal Complications**
   - **Postpartum Hemorrhage (PPH):**
     A leading cause of maternal mortality globally and management includes uterotonics, transfusions, and surgical interventions.
   - **Eclampsia and Severe Preeclampsia:**
     Life-threatening hypertensive disorders associated with seizures, headache, and visual disturbances and it is managed with magnesium sulfate, antihypertensives, and timely delivery.
   - **Maternal Cardiac Arrest:**
     Caused by amniotic fluid embolism, hemorrhage, and anesthetic complications and emergent management involves cardiopulmonary resuscitation and perimortem cesarean within 4 minutes to optimize neonatal survival .

Evaluation

Effective evaluation of a birth crisis requires rapid and systematic assessment of both the mother and the fetus.

1. **Maternal Assessment:**
   - **Vital signs:** Check for signs of hemorrhage, sepsis, or eclampsia (blood pressure, heart rate, respiratory rate).
   - **Physical exam:** Look for uterine atony (in cases of hemorrhage), neurological symptoms (eclampsia), or signs of infection (sepsis).
   - **Laboratory tests:** CBC, coagulation profile, liver function tests in suspected eclampsia.
2. **Fetal/Neonatal Assessment:**

- **Fetal heart rate monitoring:** Continuous monitoring to detect distress.
- **Apgar score:** Evaluate neonate's condition post-delivery (heart rate, respiratory effort, muscle tone, reflexes, and color).
- **Cord blood gas analysis:** Helps assess fetal oxygenation and acid-base status.

Table 16.2: Evaluation of StillBirth

Amniotic fluid analysis Autopsy* Fetal Karyotype analysis (cord blood, placenta and cord, or fetal tissue) Internal fetal tissuespecimen	Maternal studies: Prenatal genetic evaluation (amniocentesis at time of diagnosis of anomalies or stillbirth) Thrombophilia workup Photographs of fetus (front and profile) Placental examination
**-- If autopsy is declined, a limited fetal physical examination, ultrasonography, whole-body high-field magnetic resonance imaging, and placental examination should be performed.*	

Clinical Management of Birth Crises

Fetal/ Neonatal Complications:

1. **Preterm Birth**
   - Management of Preterm Birth:
   - Corticosteroids must be administered to enhance fetal lung maturity if delivery before 34 weeks is anticipated and Neonatal Intensive Care must be provided For ongoing care of extremely preterm infants.
2. **Fetal Loss**
   - **Subsequent Pregnancy Care:**
     - **Risk Assessment:** There is an increased risk of stillbirth in subsequent pregnancies following an unexplained stillbirth. A subsequent pregnancy carries a risk of roughly 9 to 20 per 1,000 live births.
     - **Induction of Labor:** Routine early induction before 39 weeks is no longer recommended. Risks of preterm birth must be balanced with benefits. Consider induction after 39 weeks if complications arise.
     - **Growth Surveillance:** If fetal growth is a concern, start serial growth ultrasounds at 28 weeks. At 32 weeks, or one to two weeks earlier than in the prior pregnancy, begin fetal surveillance.
     - **Amniocentesis:** Assessing fetal lung maturity for early delivery is not recommended. Consider alternative strategies if delivery before 39 weeks is chosen.
     - **Maternal Monitoring:** Maternal monitoring of fetal kick counts has not shown to prevent stillbirth. Regular antenatal visits can offer reassurance and address anxiety.

Second-Trimester Perinatal Death:

- **Options:** Choices include labor induction or dilation and evacuation (D&E). Induction allows for evaluation of fetal anomalies and parent interaction with the infant, while D&E is typically used for chromosomal analysis.
- **Induction:** Misoprostol (vaginal or sublingual) is effective for labor induction before 28 weeks, with

doses varying by gestational age. Mifepristone can reduce delivery time.

- **Counseling:** Provide emotional support and counseling, considering the parents' choice of procedure and ensuring all options and implications are discussed.

Infant with Disability:

Offer comprehensive emotional support, including information on community resources and support groups.

Family-centered care is beneficial, involving long-term support from family physicians and access to community resources.

Maternal Critical Illness and Death:

Identify high-risk pregnancies early (e.g., obesity, hypertension) and refer to maternal-fetal medicine teams. Facilities must be prepared for emergencies with protocols for massive blood loss, seizures, and sepsis.

Regular team drills and evidence-based protocols are crucial for managing emergencies effectively.

Support for Maternity Care Providers:

Providers may experience guilt, self-blame, and personal grief after a perinatal loss. It is essential to address these feelings with appropriate support.

Implement reflection and review processes, provide emotional and practical support, and ensure access to counseling services.

Incorporate education on communication, grief management, and handling perinatal loss into training programs. Continuous professional development is necessary.

Develop institutional policies to support staff, including counseling services and support networks. In some regions, professional supervision frameworks are used to provide ongoing support .

Safety Bundle for Severe Maternal Events:

Follow the "Support After a Severe Maternal Event" safety bundle, which includes readiness, recognition, response, and reporting/systems learning to guide local standards of practice.

Table 16.3: Guidelines for Initial Management of Adverse Birth Outcomes

Meet with family members as soon as possible Sit at eye level Call infant by name Avoid medical jargon Inform both parents to gether, assure privacy, encourage attendance of support person as soon as posible after crisis presents Allow parents to express feelings Recognize that guilt and self-blame are common Avoid assignment of blame or premature diagnostic labels Review facts but acknowledge their limits	Recognize that parents must attach before letting go, and that parental grief may be equal but expressed differently (maternal reactions are based on degree of prenatal attachment, whereas paternal reactions are based on connectedness to pregnancy, a sense of fatherhood, and the image of the infant) Encourage parents to see and hold the infant Review normal developmental aspects of the infant Offer mementos such as footprints, hair, photographs Plan timing of follow-up meetings Reassess family needs Attend to emotional concerns Monitor maternal health Address financial issues Anticipate anniversary grief

Emotional and Psychological Considerations

1. **Communication with Families**
   - **Key Principles:**
     - Be honest and clear in delivering information.
     - Allow time for families to process the situation.
     - Use culturally sensitive language.
2. **Emotional Support for Healthcare Providers**
   - **Impact on Providers:**
     - Birth crises increase provider stress and risk of burnout.
     - Debriefing sessions post-event help mitigate long-term effects.
3. **Long-Term Support for Families**
   - **Follow-Up Care:**
     - Ensure post-crisis consultations.
     - Refer families to specialized counseling and support groups.

Care for Women in Subsequent Pregnancies and Management of Perinatal Death

Women with a history of unexplained stillbirth have a higher risk of stillbirth in subsequent pregnancies. Although early induction before 39 weeks' gestation was previously common, it is now less recommended due to risks associated with preterm birth. Serial growth ultrasounds and fetal surveillance starting at 32 weeks can help monitor fetal health.

Emotional care is essential, with options for labor induction or dilation and evacuation (D&E) based on maternal preference and provider availability. Misoprostol is an effective agent for labor induction, and mifepristone may reduce time to delivery.

Parents should receive thorough counseling about the limitations and implications of prenatal tests. For parents who decide to end a pregnancy as well as those who lose a child on their own, emotional support and counseling are essential.

Parents of children with disabilities often experience significant stress and depression. They need support in accepting their child's condition, managing daily needs, and coping with ongoing stress. Family-centered care and support groups are beneficial in providing long-term support.

Continuous and empathetic support is critical for parents dealing with the loss or disability of an infant. Providers should offer comprehensive emotional support and connect families with appropriate community resources and support groups.

Maternal Critical Illness and Death

Pregnancy complications like preeclampsia, thromboembolism, or hemorrhage, as well as pre-existing conditions like obesity or hypertension, can cause critical illness in expectant mothers. Referral to specialized care and early detection of high-risk pregnancies are essential.

Facilities need to be prepared to deal with serious situations like sepsis, seizures, and significant blood loss. Regular team-based exercises and evidence-based procedures can enhance emergency response and results.

Maternal deaths are uncommon in developed nations, but they are frequently unanticipated and impacted by variables like obesity and cesarean delivery. Maternal mortality rates are higher in developing

nations, despite notable advancements in certain areas.

Maternal death has profound effects on families and healthcare providers. Providers may experience significant emotional distress, similar to that faced by emergency responders in disasters. Near-miss events, such as severe hemorrhage, also require support and time for emotional processing.

Support for Maternity Care Providers

1. **Emotional Impact and Support Needs:**

   Providers often experience guilt and self-blame following a perinatal loss. They may fear they missed something that could have prevented the outcome.

   Providers may compartmentalize their grief to manage it later, especially in busy environments where there is little time to process emotions.

   Providers need robust emotional and practical support, including counseling services, peer support, and a supportive work environment.

2. **Strategies for Support:**

   Regular meetings to discuss and review cases can help providers process their experiences and learn from them. Fear of litigation should be acknowledged to prevent it from negatively impacting future practice.

   Support from colleagues and a no-blame culture can enhance provider well-being. Time pressure can be a barrier to receiving support, so leaders should actively seek out and support staff involved in perinatal loss.

   Bereavement counselors, peer support groups, and formal debriefings can assist providers in coping with their emotional responses.

   Initial and ongoing training should include communication skills, handling perinatal loss, and providing appropriate support to families. Training programs should also emphasize the emotional aspects of loss and grief.

3. **Policies and Guidelines:**

   - **Institutional Support:** Developing clear policies and guidelines for supporting staff after perinatal loss is essential. This includes access to counseling and support networks.
   - **Supervision and Reflection:** In some regions, structured supervision provides a framework for support and reflection after adverse incidents.
   - **Personal Experience:** Providers should be aware of their own emotional responses and avoid premature admissions of wrongdoing. Sharing personal experiences with families can sometimes help in addressing their grief, but this is a personal decision.

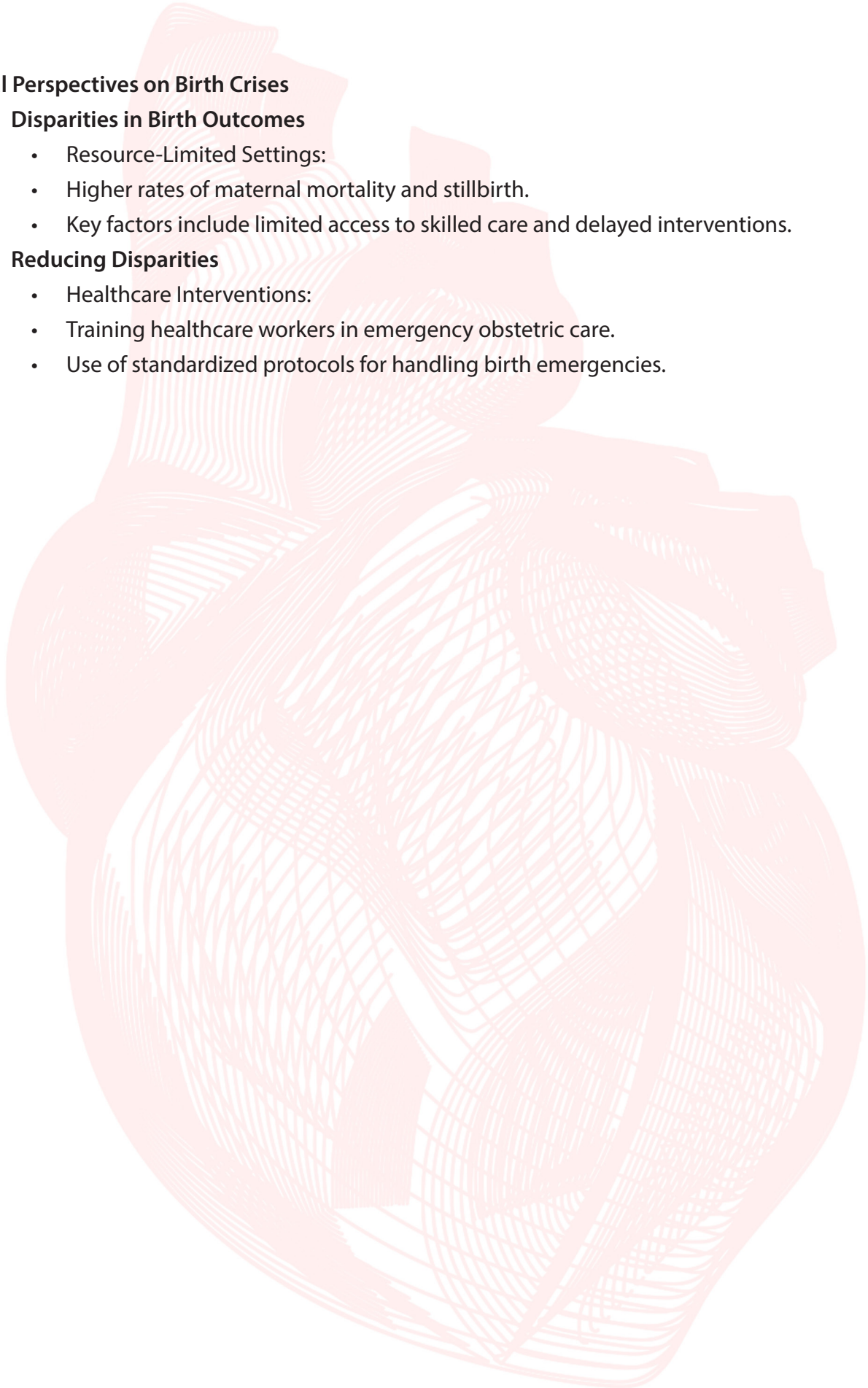
4. Safety Bundle for Support:

   - **Support After a Severe Maternal Event:** This safety bundle provides a standardized approach for managing severe maternal events and includes readiness, recognition, response, and reporting/systems learning to guide practice (available at Safe Healthcare for Every Woman).

These elements collectively help address the emotional and professional challenges faced by maternity care providers after a perinatal loss, ensuring they receive the necessary support to continue providing effective care.

Global Perspectives on Birth Crises

1. **Disparities in Birth Outcomes**
    - Resource-Limited Settings:
    - Higher rates of maternal mortality and stillbirth.
    - Key factors include limited access to skilled care and delayed interventions.
2. **Reducing Disparities**
    - Healthcare Interventions:
    - Training healthcare workers in emergency obstetric care.
    - Use of standardized protocols for handling birth emergencies.



Chapter Seventeen

Neonatal Resuscitation

Learning Objectives:

Upon completing this chapter, participants will be able to:

1. Identify the signs and symptoms of cardiorespiratory distress in neonates.
2. Outline the initial evaluation steps.
3. Describe the indications for positive pressure ventilation during neonatal resuscitation.
4. Understand the chest compression indications.
5. Discuss the indications and contraindications for medications administered during neonatal resuscitation.

Introduction

The birth process brings significant physiological changes that may expose issues previously undetectable during intrauterine life. This necessitates the presence of a neonatal resuscitation expert at every birth. The likelihood of newborn pathology can be assessed using gestational age and growth characteristics.

In general, 10% of newborns require some form of respiratory assistance at birth, with only 1% needing extended resuscitation. Various factors necessitate resuscitation at birth, leading to depression. Additionally, maternal or fetal comorbidities can significantly increase the need for resuscitation. Early fatalities and the risk of adverse neurodevelopmental outcomes in survivors are greatly influenced by the newborns' inability to initiate and sustain adequate or spontaneous breathing.

Therefore, efficient and prompt resuscitation at birth can improve newborn outcomes. For more information on the physiological changes that occur during the transition from intrauterine to extrauterine life, please refer to additional resources.

The physiology of the transition from intrauterine to extrauterine

cardiorespiratory function involves numerous changes as a newborn adapts from life inside the uterus to the external environment. In the fetus, cardiovascular function and normal circulation feature a patent ductus arteriosus, connecting the pulmonary artery to the aorta, and a foramen ovale, linking the right and left atria. These facilitate right-to-left blood shunting around the unventilated lungs. High resistance in the pulmonary arterioles and low resistance in systemic blood flow, including the placenta, promote shunting. Consequently, 90 to 95% of the right heart's output circumvents the lungs and enters systemic circulation. Prostaglandins produced locally and low fetal systemic oxygen levels (approximately 25 mm Hg) keep the ductus arteriosus open. The left atrial pressure remains low due to minimal blood return from the lungs, while the right atrial pressure is higher due to substantial blood return, which keeps the foramen ovale open. Oxygenated blood from the placenta enters the right side of the fetus' heart. With non-functional lungs, only a minimal volume of blood passes through the pulmonary artery. The majority of the blood from the right heart side passes through the foramen ovale and ductus arteriosus, which typically close shortly after birth.

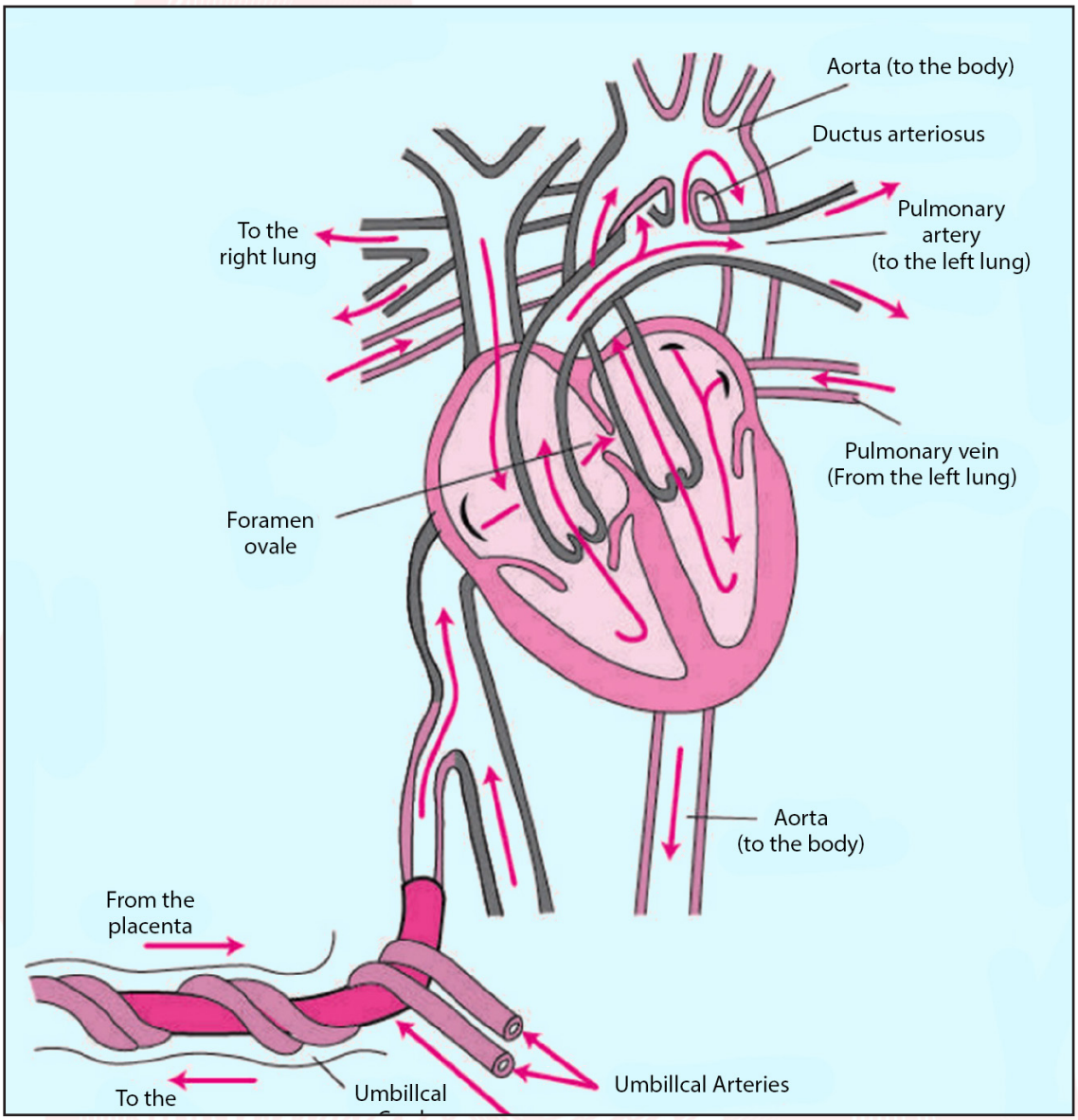


Figure 17.1: Fetal circulation path

Neonatal Pulmonary Function

involves organogenesis and differentiation processes during fetal lung development. Type II pneumocytes, which produce surfactant, first appear around the 25th week of gestation and proliferate throughout pregnancy. The lungs continuously secrete a fluid composed of transudate from pulmonary capillaries and surfactant from type II pneumocytes. To facilitate proper gas exchange at birth, lung alveolar and interstitial fluids must be rapidly expelled. This is primarily achieved by activating sodium channels in the lung epithelium, enabling fluid absorption into lung cells.

Fetal thoracic compression during delivery has minimal impact on pulmonary fluid clearance. A delay in this process likely leads to transient tachypnea in newborns. During delivery, alveoli create air-fluid interfaces due to the ribs' elastic recoil and strong inspiratory efforts that draw air into the lungs. Surfactant is then released into these interfaces with the first breath, reducing surface tension to prevent atelectasis and decrease breathing effort.

However, some newborns may not produce sufficient surfactant, resulting in respiratory distress syndrome. Factors like maternal hyperglycemia, neonatal meconium aspiration, and neonatal sepsis can negatively affect surfactant function and development. Administering corticosteroids to the mother 24 to 48 hours before delivery can enhance surfactant production in preterm infants. Post-delivery, newborns can also be treated with intratracheal surfactant.

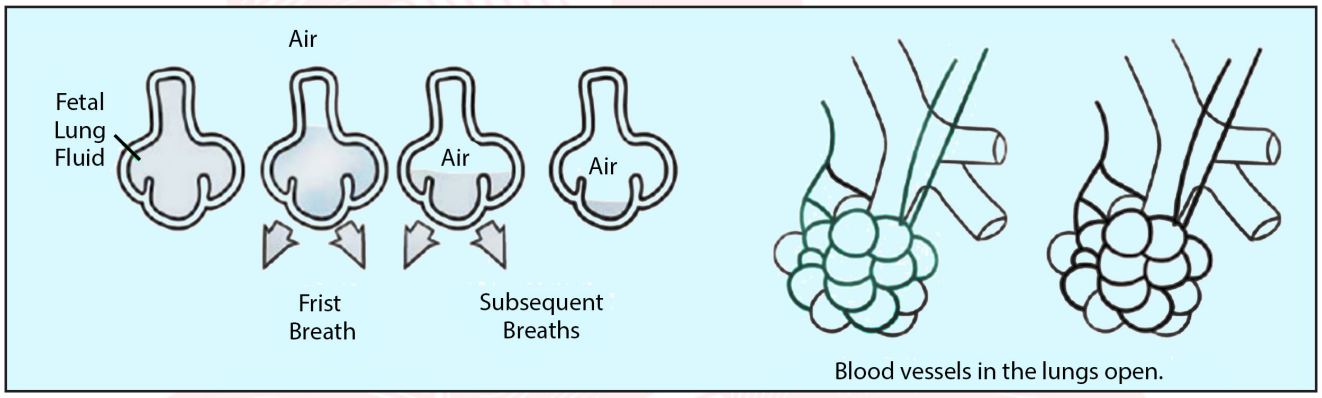


Figure 17.2: Air Replaces fluid in alveoli

The likelihood of requiring resuscitation, NICU admission, and the risk of perinatal mortality are heightened by various perinatal risk factors. These factors are detailed in the attached appendix. Pregnancy risk is determined using a validated antenatal risk score index, which categorizes pregnancies into low, moderate, and high-risk groups. Depending on the risk category, the institute may develop guidelines to facilitate the transfer of high-risk pregnancies to tertiary centers, allocate suitable personnel and resources, and determine the necessity for a specialized team's presence in the delivery room.

Table 17.1: Perinatal risk factors

Antepartum Risk Factors	
Gestational age less than 30 0/7 weeks Gestational age greater than or equal to 41 0/7 weeks Preeclampsia or eclampsia Maternal hypertension Multiple gestation Fetal anemia	Polyhydramnios Oligohydramnios Fetal hyydrops Fetal macrosomia Intrauterine growth restriction Significant fetal malformations or anomalies No prenatal care
Intrapartum Risk Factors	
Emergency cesarean delivery Forceps or vacuum-assisted delivery Breech or other abnormal presentation Category II or III fetal heart rate pattern Maternal general anesthesia Placenta abruption	Intrapartum bleeding Chorioamnionitis Opioids administered to mother within 4 hours of delivery Shoulder dystocia Meconium-stained amniotic fluid Prolapsed umbilical cord

The Apgar Score

The Apgar Score is a measure used to describe the cardiorespiratory and neurological status of a newborn at birth. It is not used to predict a patient's prognosis or guide resuscitation or future care. The Apgar score assesses five indicators of neonatal health: appearance, pulse, grimace, activity, and respiration, with each receiving a score from 0 to 2. These scores are influenced by factors such as physiological maturity, birthweight, maternal perinatal therapy, and fetal cardiorespiratory and neurological conditions. A score of 7 to 10 at five minutes is considered normal, 4 to 6 is intermediate, and 0 to 3 is

low. Low Apgar scores may result from a range of causes, from acute conditions that are treatable with a good prognosis to severe, chronic conditions with a poor prognosis. However, a low Apgar score is an observation, not a diagnosis.

Table 17.2: Apgar score

			Score*	
Criteria	Mnemonic	0	1	2
Color	Appearance	All blue, pale	Pink body, blue extremities	All pink
Heart rate	Pulse	Absent	<100 beats/minute	>100 beats/minute
Reflex response to nasal catheter/ tactile stimulation	Grimace	None	Grimace	Sneeze, cough
Muscle tone	Activity	Limp	Some flexion of extremities	Active
Respiration	Respiration	Absent	Irregular, slow	Good, crying
*A total score of 7-10 at minutes is considered normal; 4-6, intermediate; and 0-3, low.				

Before every birth, it is vital for obstetric and neonatal healthcare professionals to establish effective communication to coordinate care. Assess the antepartum and intrapartum risk factors, and then pose the following four prenatal inquiries:

1. **What is the typical gestational age?**
2. **Is the amniotic fluid clear?**
3. **Are there any additional risk factors?**
4. **What is our plan for umbilical cord management?**

Based on the responses to these inquiries, gather the necessary team members and equipment.

Resuscitation Team

At every birth, there should be at least one person present trained in neonatal resuscitation's initial steps, including administering positive pressure ventilation (PPV). Additional staff capable of performing a full resuscitation should be readily available, even without specific risk factors (Low risk score 0-2). If risk factors are present (Moderate risk score 3-6), at least two skilled individuals should be present exclusively for the newborn's care.

The staff's number and qualifications may vary depending on the anticipated risk, the number of infants, and the hospital setting. For complex resuscitations, a team of four or more may be necessary, especially with high-risk factors (risk score >6). Ideally, the complete resuscitation team should be present before the birth. A certified team, fully trained in advanced resuscitation techniques like endotracheal intubation, chest compressions, emergency vascular access, and medication administration, should be on hand for every resuscitation. The fully qualified team should be at the birth if advanced resuscitation is anticipated.

Neonatal Resuscitation Team Members

- Team leader
- Compressor

- Airway manager
- I.V/I. O provider
- Time recorder/ documenter and monitoring

Equipment and Supplies for Neonatal Resuscitation

All necessary equipment and supplies for neonatal resuscitation should be present and in working order for each delivery, particularly for anticipated high-risk infants (refer to Figure 1.6). Utilizing a routine, standardized checklist prior to every birth can streamline the preparation process, ensuring immediate readiness and highlighting any missing equipment. Additionally, adjust the room temperature to between 23 and 25 °C before a preterm birth.

Figure 17.3: Equipment and supplies list

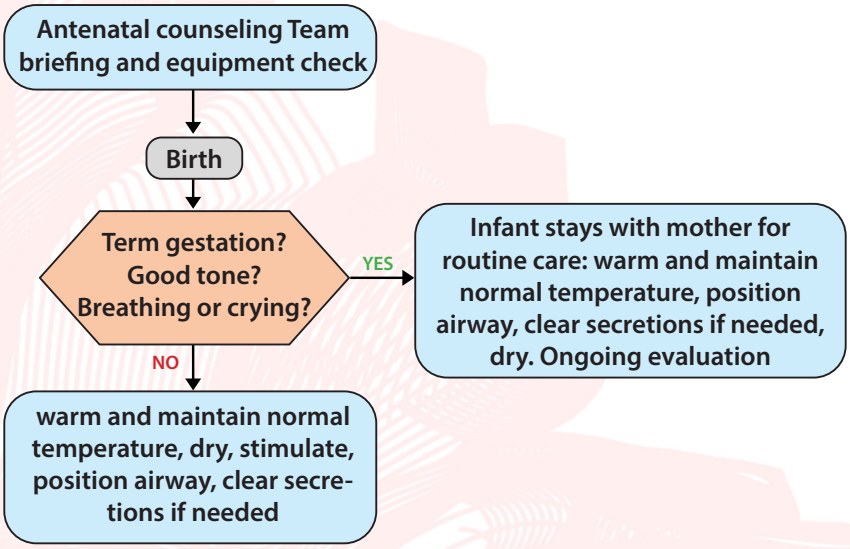
Initial Evaluation

The initial evaluation of a newborn should be conducted promptly. All infants must undergo a rapid assessment after birth to determine whether they can stay with their mothers or if they require additional warmth from a radiant warmer. This initial check can occur between the delivery and the clamping of the umbilical cord. The immediate post-birth evaluation of every newborn includes three critical questions:

1. Does the baby appear full-term?
2. Is the baby crying or breathing?
3. Does the infant have good muscle tone?

If the answer to all three questions is affirmative, the infant can stay with the mother while initial procedures are performed on her chest or abdomen. If any question is answered negatively, proceed to the next step of the assessment.

Algorithm: Neonatal resuscitation initial evaluation



Initial steps

1. Provide Warmth by placing the infant under a radiant warmer, attaching a temperature sensor to prevent hypo- or hyperthermia, and leaving the infant uncovered for better visualization, you can keep the infant's body temperature between 36.5 and 37.5 C.
2. Dry with the case of very preterm babies less than 32 weeks' gestation, drying is not essential and the baby should be covered immediately in polyethylene plastic, which reduces evaporative heat loss. Dry the baby with a warm blanket and remove the wet one and put in a new one to avoid heat loss.
3. Stimulate. Increase breathing but take note: 1. Gently rubbing the back or clicking the sole if there is inadequate respiration. 2. Refrain from intense stimulation 3. Don't ever shake a child.
4. Open the Airway to keep the baby's airway open and allow for unhindered air entry, keep the baby's head and neck in the sniffing position (neutral or slightly extended, with the eyes pointed straight up toward the ceiling.
5. Remove the secretions if the infant is gasping or not breathing, if the airway is blocked, if the baby is having trouble clearing their secretions, if PPV is predicted, or if they have weak muscle tone. Routine suctioning is not advised if the baby is active. With the baby's head turned to the side, gently clear the secretions; suction the mouth before nose to prevent aspiration

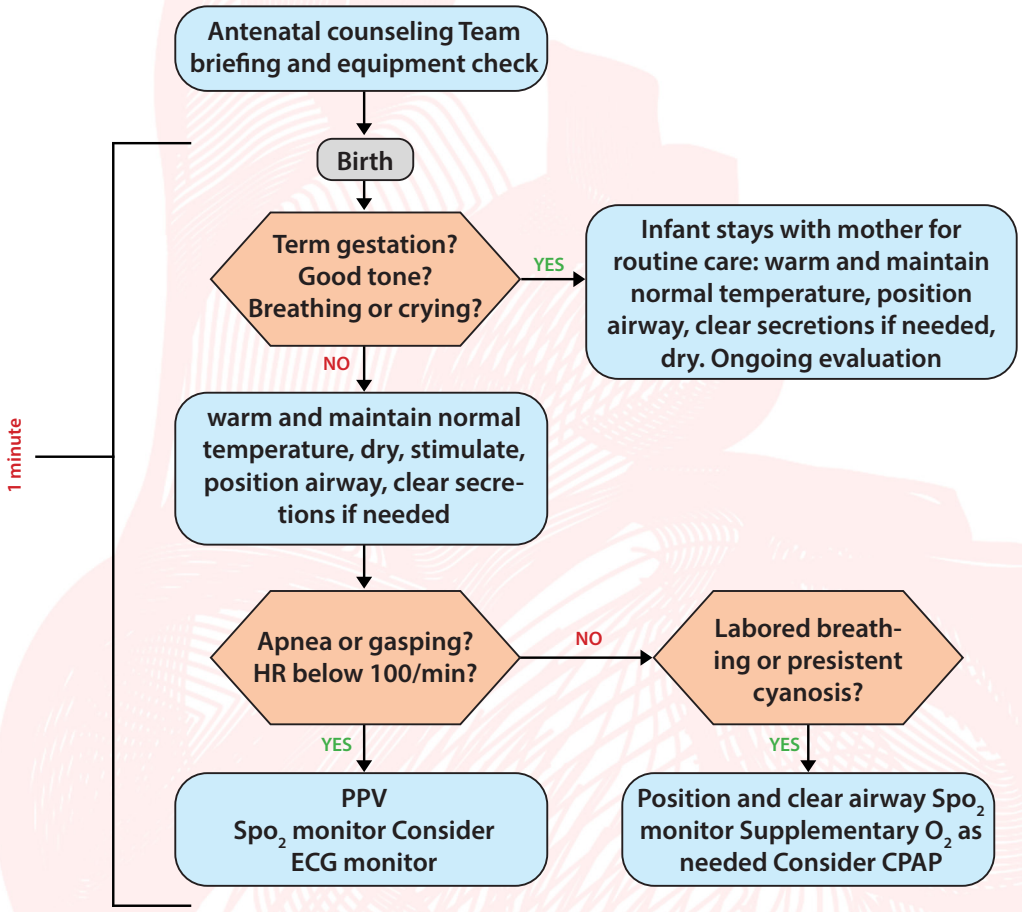


Table 17.3: Targeted SaO_2

Time from birth	Neonates' target concentration during resuscitation in %
1 min	60-65 %
2 min	65-70%
3 min	70-75 %
4 min	75-80 %
5 min	80-85 %
10 min	85-95 %

Positive Pressure Ventilation indications

Providing efficient breathing is one of the cornerstones of newborn resuscitation. After the initial steps, if the infant is still not breathing, is breathing abnormally (gasping), or has a heart rate below 100 beats per minute, positive pressure ventilation devices are used to start ventilation.

Positive pressure ventilation devices

1. A self-inflating bag

Figure 17.4: Self inflating bag

2. A flow-inflating bag, also known as an anesthetic bag, only fills when gas from a compressed source enters it and the outlet is sealed.

Figure 17.5: A flow-inflating bag

3. T-piece resuscitator

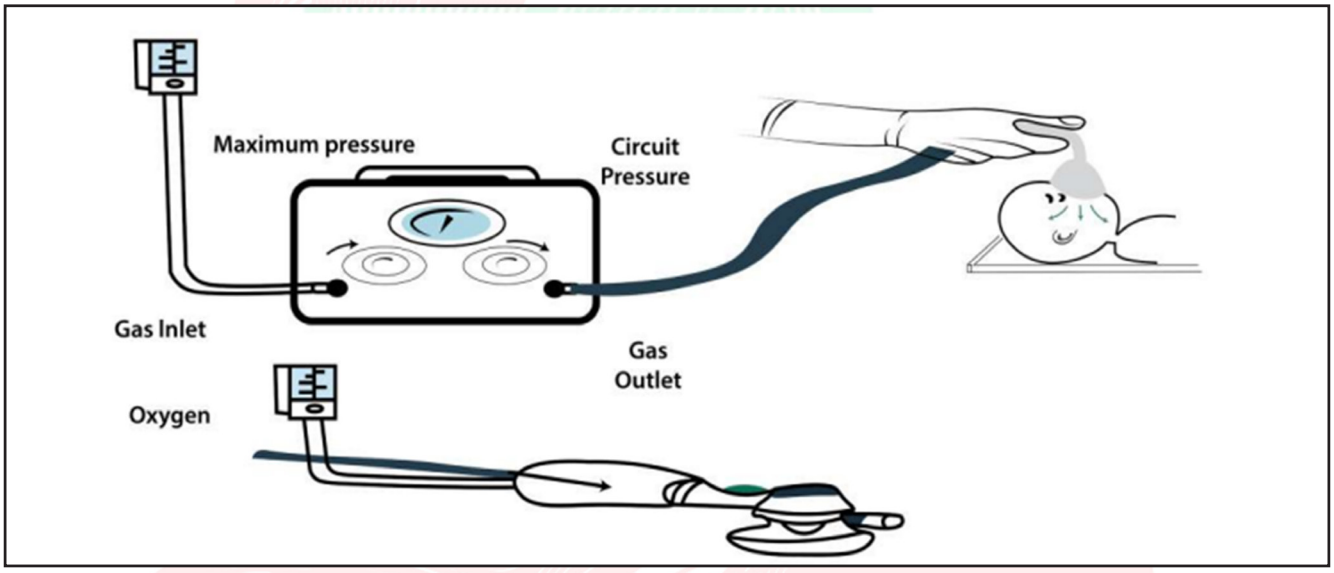
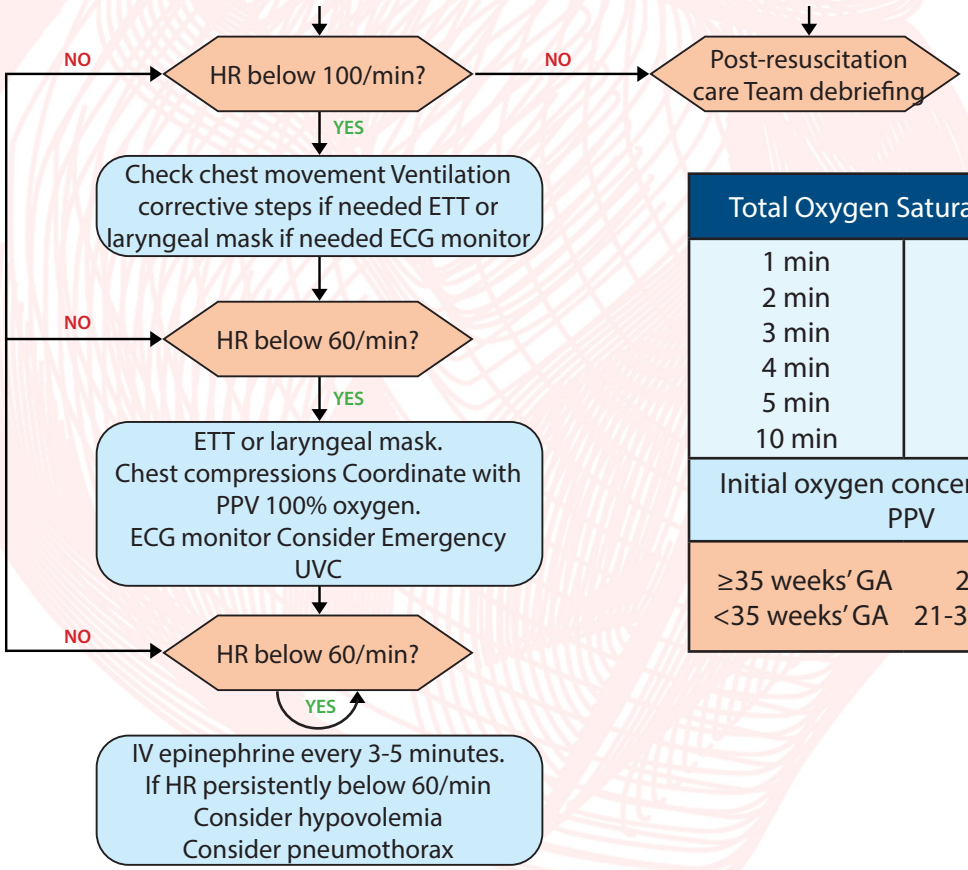


Figure 17.6: T-piece resuscitator system

Indications of Effective Positive

Pressure Ventilation Is your technique effective? If Your Ventilation Technique Is Effective, three signs are observed:

1. An increase in heart rate
2. Chest is moving.
3. Increase in Oxygenation.



Total Oxygen Saturation Table	
1 min	60-65 %
2 min	65-70 %
3 min	70-75 %
4 min	75-80 %
5 min	80-85 %
10 min	85-95 %
Initial oxygen concentration for PPV	
≥35 weeks' GA	21% oxygen
<35 weeks' GA	21-30 % oxygen

- The infant's heart rate ought to exceed 100 beats per minute within 30 seconds of the commencement of PPV.
- Continue PPV if the baby's heart rate starts to rise after the first 15 seconds. Following 30 seconds of PPV, you will verify the response once more.
- After the first 15 seconds, if the baby's heart rate does not rise, ask your helper if the baby's chest is moving.

If the baby's heart rate does not increase and the chest does not move, you will need to make a sequence of changes known as the ventilation corrective steps. Leaks surrounding the mask, airway obstructions, and low ventilation pressure are the most likely causes of poor mask ventilation. These typical issues are addressed by the ventilation remedial steps, which are presented in the table.

Table 17.4: The corrective steps (MRSOPA)

Corrective Step	Actions
M: Mask adjustment	Reapply the mask, then forward the jaw. Think about the two-hand hold
R: Reposition thr head and neck	Place head neutral or slightly extended
Give 5 breaths, then assess chest movement. Do the following if is no chest movement	
S: Suction the mouth and nose.	Use a suction catheter or bulb syringe
O: Open the mouth.	To softly open the mouth, use a finger.
Give 5 breaths and assess chest movement. If no chest movement, do the next step.	
P: Pressure increases.	Increase pressure in 5-10 cm H_2O steps. 40 cm H_2O maximum term and 30 cm H_2O maximum preterm.
Take 5 breaths, then assess chest movement. if no chest movement, do the next step.	
A: Alternative airway.	Insert an endotracheal tube or laryngeal mask.
Examine chest movement and breath sounds during PPV.	

What should you do after 30 seconds of lung-ventilation positive-pressure ventilation?

You will recheck the infant's heart rate response after 30 seconds of PPV that ventilates the lungs, as indicated by increasing heart rate or chest movement.

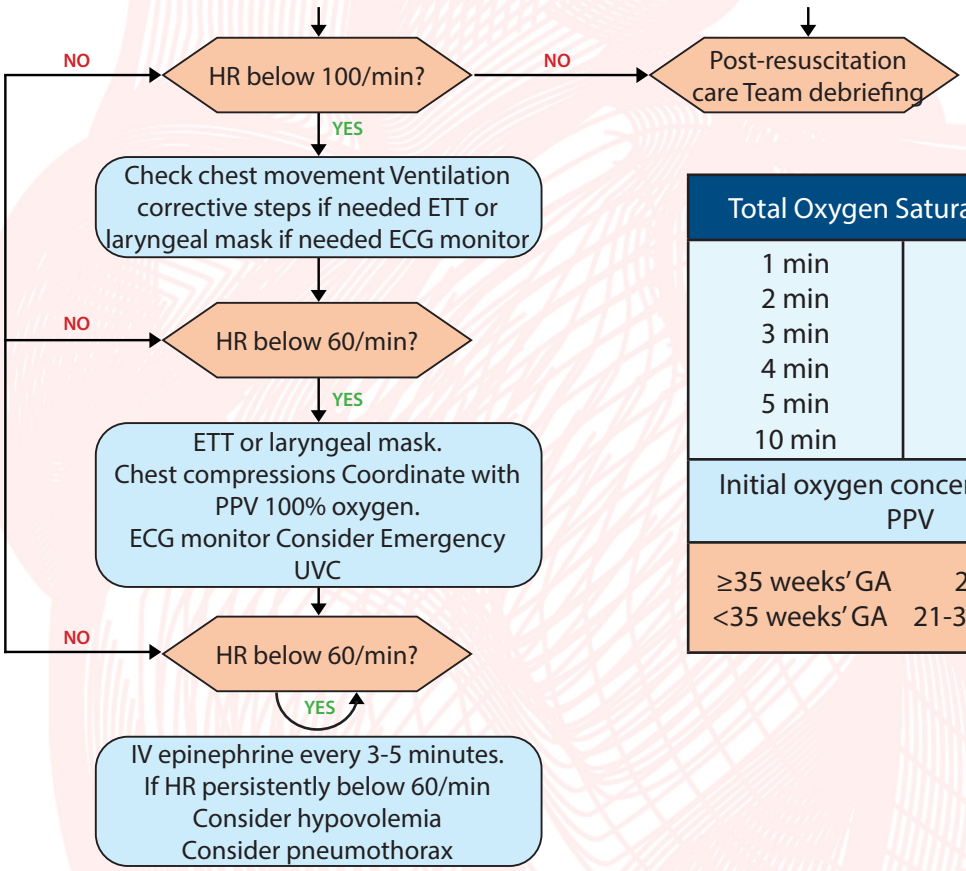
- Assisted ventilation has been successful if the heart rate is greater than or equal to 100 beats per minute. Continue taking 40–60 breaths per minute of ventilation. Keep an eye on the infant's breathing effort, heart rate, and chest movement.
- The heartbeat is at least 60 beats per minute, but not more than 100.
- As long as the infant is steadily improving and the heart rate is increasing, keep giving PPV. In

order to achieve the goal saturation range, monitor the oxygen saturation and modify the FIO2 as necessary. If the heart rate does not Increase, immediately review your ventilation strategy.

- We have to make sure that all above steps do not exceed 2 minutes to start chest compression if the infant's heart rate is still less than 60 BPM after at least 30 seconds of PPV that moves the chest, ideally through a different airway, increase the FiO2 to 100% and begin chest compressions.

Chest Compression

Only when the heart rate is still under 60 beats per minute after 30 seconds of efficient ventilation, preferably using a laryngeal mask or an endotracheal tube, are chest compressions necessary. Before beginning chest compressions, make sure that the chest rise during PPV indicates effective ventilation. If not, use the necessary corrective ventilation procedures (MR-SOPA) to establish successful ventilation.



Total Oxygen Saturation Table	
1 min	60-65 %
2 min	65-70 %
3 min	70-75 %
4 min	75-80 %
5 min	80-85 %
10 min	85-95 %
Initial oxygen concentration for PPV	
≥35 weeks' GA	21% oxygen
<35 weeks' GA	21-30 % oxygen

Use the thumbs technique to support the baby's back during compressions by placing your thumbs at the bottom third of the sternum, right below the intermammillary line.

Figure 17.7: Compression hands placement

During compressions, move only your thumbs to depress the sternum to about one-third of the anterior-posterior (AP) diameter of the chest , followed by a complete release of the compression to allow for the refilling of the heart, coronary perfusion, and giving the chance for the lungs to expand. Each cycle (3 compressions and 1 ventilation) lasts for 2 seconds. The rate of compression is 90 per minute, coordinated with ventilation, with a ventilation to compression ratio of 1/3.

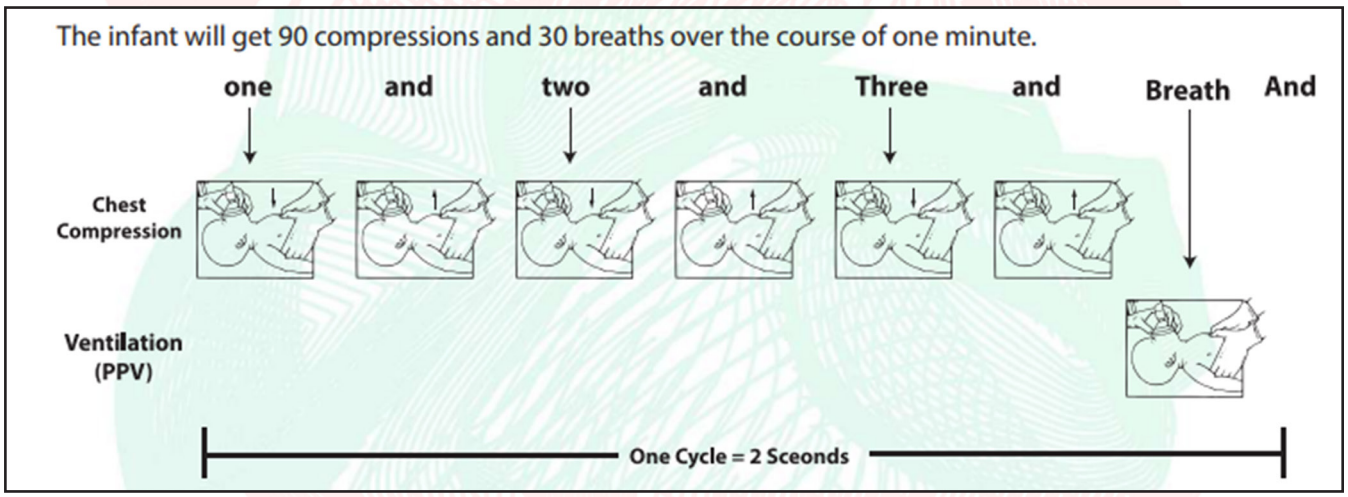


Figure 17.8: Comparison and ventilation

After 60 seconds of PPV-coordinated chest compressions, check the heart rate. If the heart rate increases to more than 60 beats per minute, stop doing chest compressions and adjust FiO2 to the desired oxygen saturation level. Increase the PPV rate to 40–60 beats per minute once the chest compressions have been stopped.

if, after 60 seconds of PPV-coordinated chest compressions, the heart rate is still below 60:

- check to see if you are administering an effective PPV with chest rise, that FiO2 is 100%, that the

chest is compressed deeply enough,

- and that the rate of chest compression is 90/min.

Resume chest compression, insert an umbilical venous catheter and inject epinephrine if the heart rate is still less than 60 bpm.

Figure 17.9: Epinephrine administration through UVC

Medication and fluids

Epinephrine: Indication: If the infant's heart rate stays below 60 beats per minute (bpm) following:

A. At least 30 seconds of PPV that causes the lungs to expand as shown by chest movement; and

B. Another 60 seconds of chest compressions timed to 100% oxygen utilizing PPV.

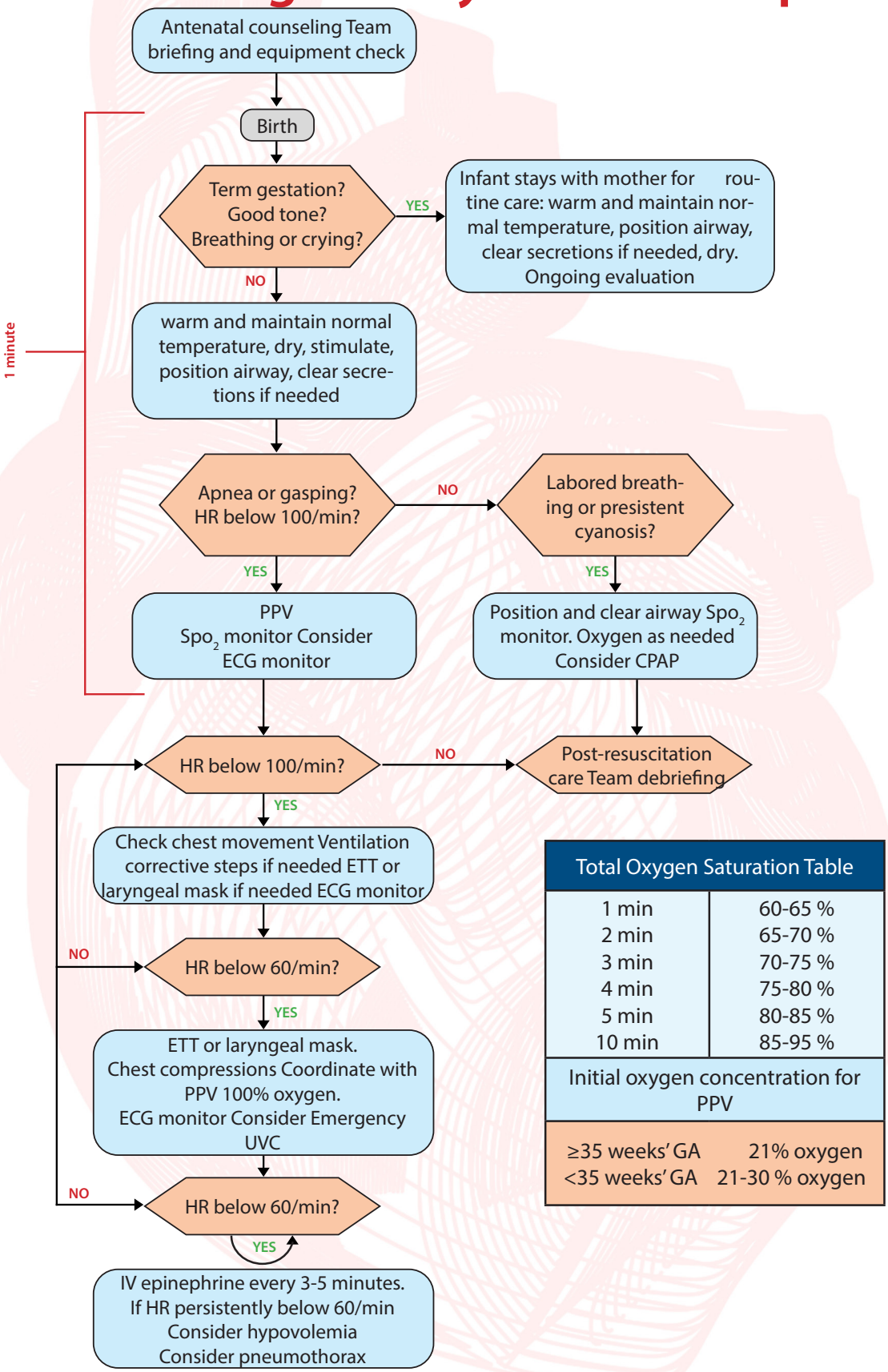
- The concentration is 1 mg/10 mL at 0.1 mg/mL
- Route: Intravenous or intraosseous (preferred)
- While vascular access is being established, one endotracheal dose may be taken into consideration.
- Dose: 0.02 mg/kg (equivalent to 0.2 mL/kg) every 3- 5 minutes IV/IO; the range is 0.1 to 0.3 mL/kg, or 0.01 to 0.03 mg/kg.

Volume Expanders:

If the infant is not responding to the steps of resuscitation and there are indicators of shock or a history of severe blood loss, a volume expander is recommended.

- Solution: type O Rh-negative blood or normal saline (NS).
- Intravenous or intraosseous route
- Syringe with a 30- to 60-mL capacity (labeled NS or O- blood) D. Dose: 10 mL/kg.
- Rate: More than five to ten minutes

At all stages: do you need help?



Total Oxygen Saturation Table	
1 min	60-65 %
2 min	65-70 %
3 min	70-75 %
4 min	75-80 %
5 min	80-85 %
10 min	85-95 %
Initial oxygen concentration for PPV	
≥35 weeks' GA	21% oxygen
<35 weeks' GA	21-30 % oxygen

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