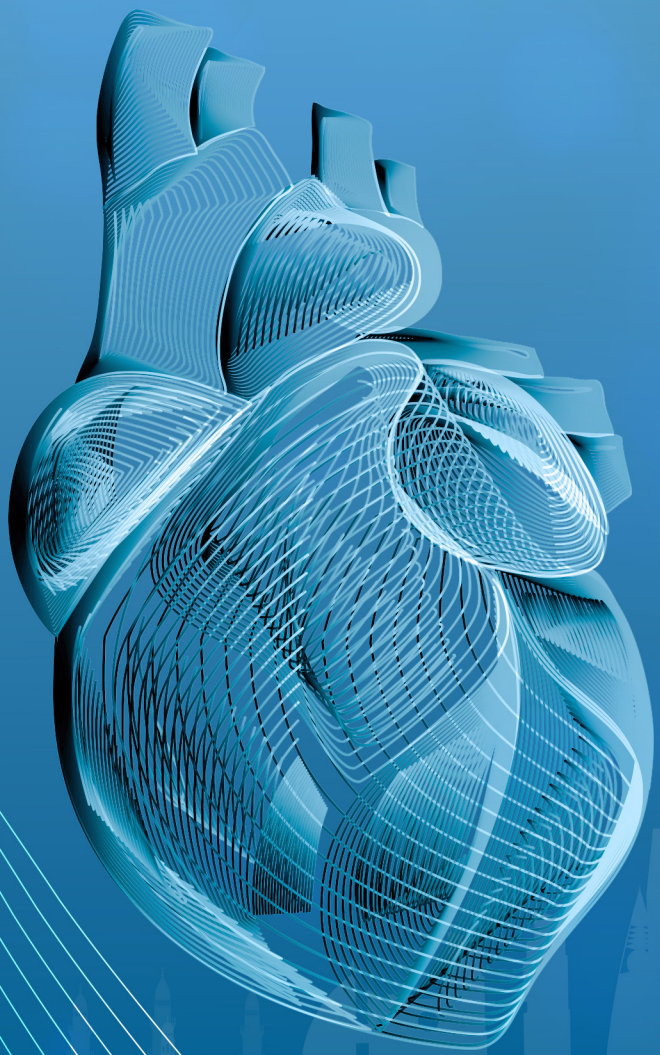
جمعية القلب السعودية
Saudi Heart Association
National Life Support Committee

SBLSO

SBLSO

The Saudi Basic Life Support in Obstetric

Provider Course Manual 2026



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The Saudi Basic Life Support in Obstetrics (SBLSO) Provider Manual 2026

Preface

The Saudi Basic Life Support in Obstetrics (SBLSO) Provider Manual introduces a foundational, evidence-based, and highly practical program designed to significantly reduce maternal and neonatal morbidity and mortality.

This course is particularly crucial for obstetrical and non- obstetrical healthcare providers such as EMTs and emergency department staff who may encounter childbirth emergencies in diverse or resource-limited settings. Adapted from the more advanced SALSO course, SBLSO's core pur pose is to standardize skills for the emergent management of common obstetric complications, including shoulder dystocia and postpartum hemorrhage.

The primary objective of SBLSO is to improve patient safety and maternal outcomes by promoting a consistent, team-based approach to maternity care. A critical emphasis throughout the course is placed on effective teamwork and communication as fundamental pillars of patient safety, fostering collaboration among all staff in direct and indirect care, including physicians, residents, nurse midwives, and registered nurses.

This manual serves as the foundation for the SBLSO course content. It is structured into sixteen chapters, each clearly outlining its learning objectives and summarizing the most significant evidence-based findings from current literature. A comprehensive list of references is provided in the final chapter for participants seeking more in-depth information.

Acknowledgements

The Saudi Heart Association wishes to express its gratitude to the Clinical Skills and Simulation Center (CSSC) at King Saud University Medical City and its dedicated staff. Their cooperation and support were invaluable during the development of this manual's content, significantly enhancing the simulation technologies and teaching methods integrated into this course.

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Course Overview

Course Description

The Saudi Basic Life Support in Obstetric (SBLSO) course is meticulously developed for all healthcare professionals who may be engaged in the management of maternal cardiopulmonary arrest and analogous emergencies. This extensive scope includes, yet is not confined to, obstetricians/gynecologists (OB/GYNs), personnel operating within the Emergency Room, specialists, Nurses,midwives, anesthesia providers, Paramedic personnel.

The SBLSO course has two main areas of application: Inside-Hospital (IH) and Outside-of-Hospital (OH).

- Inside-Hospital (IH): This guidance is intended for providers who deliver care to pregnant patients across a range of clinical environments, including clinics, urgent care centers, emergency departments (EDs), and inpatient hospital settings.
- Outside-of-Hospital (OH): The training for EMS providers is structured into two distinct levels.
  - Advanced OH SBLSO : This is recommended for Emergency Medical Services (EMS) providers whose roles mandate holding the Saudi Advanced Cardiac Life Support (SACLS) certification.
  - Basic OH SBLSO : The standard level for other EMS providers.

This course provides providers with the essential knowledge and practical skills for assessing and managing maternal emergencies. A primary focus is placed on enhancing maternal-fetal outcomes, particularly following a maternal cardiac arrest (MCA).

Course Objectives

The SBLSO program aims to equip learners with the following essential competencies:

1. Understand the changes associated with pregnancy to effectively execute Basic and Supportive Advanced Life Support) during Maternal Cardiopulmonary Arrest (MCA).
2. Recognize and prevent impending arrest.
3. Demonstrate expert application of SBLSO (Supportive Basic Life Support in Obstetrics), prioritizing high-quality chest compressions, immediate Left Uterine Displacement (LUD), and appropriate use of an Automated External Defibrillator (AED).
4. Incorporate pregnancy-specific changes into the SACLS algorithm.
5. Apply specific adaptations to the standard primary survey When managing trauma in a patient of reproductive age.
6. Utilize the Different briefing approach to demonstrate clear and effective communication within the team.
7. Improve communication with both the healthcare team and patient families, particularly following poor patient outcomes.
8. Identify, recognize, and treat the underlying causes.
9. Effectively manage various critical obstetric (OB) emergencies, including but not limited to hypertension, bleeding, shoulder dystocia, and fetal malpresentation.
10. Deliver immediate and vital care, including resuscitation, to newborns in need.

Pre-Course Requirement: Online Pretest

Prior to attending the in-person training, all participants are required to successfully complete an online Pretest. The minimum passing score is 80%, with unlimited attempts allowed.

Post-Course Assessment and Certification

The required online post-course test consists of 25 multiple-choice questions. Participants must achieve a passing score of 80% and are permitted to use course resources during the test.

Each participant is allowed two attempts to pass the test. If a participant fails the first attempt, they have 48 hours to complete the second attempt.

Upon successfully passing the online test, the participant will be prompted to complete the course evaluation. Completion of the evaluation is mandatory before the participant can receive their certification card.

Course Prerequisites

To enroll in the SBLSO course, learners are required to be proficient in SBLS skills. While a basic understanding of SACLS is helpful, it is not a mandatory prerequisite.

Please note that the SBLSO course does not include a review of SACLS pharmacology or instruction on interpreting cardiac rhythms. Learners wishing to enhance these specific skills can find relevant resources by visiting the Saudi Heart Association website at www.shacpr.org.sa.

CHAPTER ONE

Safety in Maternity Care

Learning Objectives

The learner will be able to:

1. Discuss the significance of patient safety and the adoption of a team-based approach in maternity care.
2. Explain how to apply the elements of an effective high-performance team to enhance safety.
3. Identify the most frequent challenges in maternity care and propose potential mitigation strategies.

Introduction: The Imperative of Patient Safety

Patient safety is crucial for improving outcomes and saving lives, achieved through fostering collaboration, effective communication, and developing robust systems. The Institute of Medicine defines it as “the prevention of harm to patients.”

It’s super important to tackle this goal, especially considering the troubling direction maternal health is heading. For instance, the US has seen a seriously worrying jump in its maternal mortality rate, which shot up from 17.4 per 100,000 live births in 2018 to a jarring 32.9 per 100,000 live births in 2021. The CDC says this alarming increase translates to 1,205 mothers who died during or shortly after giving birth (within 42 days).

Compounding this crisis, the incidence of severe maternal morbidity—including complications such as major blood transfusions, eclampsia, hysterectomy, and heart failure—has also increased. These severe, non-fatal consequences are fifty times more common than pregnancy-related death. Addressing this global challenge is a priority for the United Nations, which established a Sustainable Development Goal to reduce the world’s maternal death rate from 216 per 100,000 live births in 2015 to less than 70 per 100,000 births by 2030.

Effective perinatal safety programs have been shown to reduce adverse events and liability claims across various healthcare systems and state collaboratives. These comprehensive programs integrate several key elements: an interdisciplinary perinatal practice committee, continuous audit and feedback, team training, education on safety principles, fetal monitoring training, and strict compliance with evidence-based clinical practices.

Teamwork: A Safety Mandate

Multidisciplinary team training is mandatory for all hospital staff, as required by The Joint Commission since 2003. This educational mandate aligns with the National Patient Safety Goals, which necessitate the implementation of such methods to improve patient care.

Maternity care inherently involves many clinicians, meaning patient care teams are rarely composed of the exact same individuals consistently.Even the most skilled specialist cannot perform optimally without a formidable team. Since consistent team composition is rare, teaching all healthcare staff uniform communication methods is vital, ensuring every clinician can contribute effectively to the various teams they encounter.

Patient Safety Bundles: A Systemic Approach

Patient safety bundles are evidence-based sets of best practices developed by multidisciplinary experts to address specific clinical challenges in expectant and new mothers. They are considered a crucial initial step in reducing avoidable maternal death, morbidity, and health inequalities. Safety bundles provide a systematic framework for improving both patient outcomes and care processes.

California, with the longest history of implementing safety bundles through large-scale collaborative improvement, has demonstrated success in reducing maternal morbidity and mortality. This strategy has also yielded improved results in other health systems. While historically focused on inpatient emergencies like hemorrhage and hypertensive crisis, bundles now cover a broader spectrum of maternal health care.

All safety bundles share fundamental principles: standardization of preparedness, recognition, response, and reporting to enhance care. Each bundle includes a minimal set of recommendations and links to practical resources. However, like checklists, successful implementation depends not only on institutional support but also on a strong safety culture, interprofessional integration, effective communication techniques, and cultural humility.

Core Components of Patient Safety Bundles

Readiness

Health systems are required to accurately capture and ensure the availability of self-identified race, ethnicity, and native language data within the electronic medical record. Key actions to achieve this are:

- Informing all employees (inpatient, outpatient, and community-based) about the healthcare system's interpreter resources.
- Conducting staff-wide education on prenatal racial and ethnic disparities and their underlying causes.
- Implementing optimal procedures for group decision-making.
- Involving diverse patient, family, and community advocates on leadership teams focused on quality and safety to represent significant community partnerships.

Recognition

All personnel, including families and patients, should be supported by:

- Educating staff members about unconscious bias.
- Providing the mother/patient with prompt, easy, and low-cost access to health records (paper or electronic) in an understandable format that summarizes data essential to prenatal care and well-being.
- Establishing a mechanism for staff, relatives, and patients to report instances of disrespect, poor communication, or unequal treatment.

Response

During every clinical interaction, the following should be ensured:

- Implement best practices for shared decision-making in patient care.
- Ensure prompt and personalized responses to all complaints regarding disrespect or unequal treatment.
- Integrate discussions about contraceptive options and reproductive life planning into regular care throughout a woman's reproductive years, rather than limiting them to during or immediately following pregnancy.
- Establish effective discharge navigation and coordination systems post-delivery to guarantee women receive appropriate follow-up and clear instructions on when to return for medical appointments.
- Providing discharge instructions that cover actions to take if a question or concern arises, contact information, and warning signs to monitor. These documents must consider the patient's linguistic, cultural, and health literacy needs.

Reporting & Systems Learning

Establish a just and equitable environment within all healthcare units, incorporating mechanisms for clear reporting, responsive action, and continuous learning. These mechanisms must actively support ongoing safety culture initiatives:

- Implement a Health Equity Data Dashboard: Create a dashboard to track key process and outcome metrics, segmented by race and ethnicity, and ensure this data is regularly accessible to all staff and leadership.
- Launch Targeted Quality-Improvement Projects: Develop and execute initiatives specifically designed to address and reduce inequities in healthcare access, treatment, and outcomes.
- Integrate Social Determinants into Clinical Review: During multidisciplinary reviews of significant clinical events (e.g., severe maternal morbidity, mortality), actively consider the influence of social and economic factors on health, including race, ethnicity, language, poverty, literacy, and the impact of systemic and interpersonal racism.

A crucial part of the review process is using a checklist to determine: Was the morbidity influenced by language barriers, racial/ethnic bias (implicit prejudice), or socioeconomic determinants of health (yes/no/maybe)? If so, what system modifications could be implemented to impact the outcome?

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

AIM-supported initiatives focus on specific high-risk areas:

Core Patient Safety Bundles for Maternity Care:

The following essential safety bundles are focused on improving outcomes for mothers and newborns:

1. Maternal Mental Health: Addressing Depression and Anxiety.
2. Maternal Venous Thromboembolism (VTE) Prevention.

3. Obstetric Care for Women with Opioid Use Disorder (OUD).
4. Obstetric Hemorrhage Management.
5. Postpartum Care Fundamentals:
    - From Birth to the Comprehensive Postpartum Visit.
    - Transitioning from Maternity to Well-Woman Care.
6. Prevention of Retained Vaginal Sponges Post-delivery.
7. Reduction of Peripartum Racial/Ethnic Disparities.
8. Safe Reduction of Primary Cesarean Birth Rates.
9. Severe Hypertension in Pregnancy Management.

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: Core Elements of High PerformanceLeadership

In an efficient team, any member capable of managing a given circumstance to the best of their ability can assume the leadership role. A skilled team leader organizes the group, clarifies aims, ensures inclusive decision-making, empowers members to voice concerns, actively encourages productive collaboration, and manages disagreements effectively.

Situation Monitoring and Mutual Support

Situation Monitoring:

This is the continuous practice of observing and evaluating one's surroundings to maintain awareness of the current situation. (STEOP) is a mnemonic used to structure this: Status (Patient), Team members, Environment, and Objective Progress. Situation awareness is "knowing what is going on around you" and recognizing the factors influencing the job. For shared mental models, every team member must have situation awareness and share relevant information, ensuring everyone is "on the same page."

Mutual Support - Task Aid:

Task aid is a form of mutual support where team members:

- Guard against excessive workload.
- Prioritize patient safety when offering or requesting assistance.
- Cultivate an environment where actively seeking and providing help is the expectation.

Cross-monitoring:

A technique to reduce errors by observing the actions of other team members, serving as a safety net within the group. This ensures errors or oversights are immediately identified, effectively "watching each other's back."

DESCR Program (Conflict Resolution):

A methodical strategy for providing constructive criticism and handling disagreement, which involves:

- Describing the specific situation.
- Expressing concerns about the events.
- Suggesting alternative actions.
- Stating the Consequences.
- Reaching consensus and agreement for moving forward.

Communication: Clarity and Structure

Effective communication must be prompt, thorough, concise, and clear.

Structured Communication Tools

SBARQ (Handoff and Condition Change):

SBARQ is a critical method for rapidly conveying essential information that requires immediate attention, especially during a patient handoff or when reporting a change in condition:

- Situation: What is the patient's current condition?
- Background: Could you provide the context or the patient's history?
- Assessment: What is my belief regarding the issue?
- Suggestion and Recommendation: How should the issue be addressed?
- Questions and Inquiries: An opportunity to ask and answer any follow-up questions.

Using SBARQ helps the listener focus on the key points and prepares them for the subsequent details. It also keeps the presenter brief, requiring them to provide their opinion and recommendation. Regular use of the SBARQ format increases the speed and predictability of communication. It can be helpful to initially plan out the key points for each SBARQ section before initiating the conversation. Consistent practice enhances efficiency, reduces planning effort, improves team communication, and ultimately leads to better patient treatment by "bringing other team members up to speed."

Callout:

A technique for clearly and loudly announcing critical information during an emergency or when urgent help is needed.

Checkback (Closed-Loop Communication):

A closed-loop communication technique involving multiple parties to confirm and validate shared information. The recipient of the information restates their understanding of the message, allowing

the original informant to clarify or confirm. If the recipient's restatement is misinterpreted, the original informant must clarify and repeat the checkback procedure until correct confirmation is received.

Two Challenge Rule (Raising Issues):

An approach for voicing a concern at least twice, particularly if the initial attempt was met with resistance or silence. It is recommended to frame the first "challenge" as a clarifying question to raise awareness, and the second "challenge" as a definitive statement to reinforce the concern. If necessary, a more forceful strategy should be adopted, involving the supervisor or chain of command. The two-challenge rule empowers all team members to "stop the line" if they observe a critical safety lapse.

Power Words:

The use of specific, predetermined language that clearly conveys danger, caution, and warning. These words are designed to grab the attention of medical professionals and, when integrated into a safety culture, are typically linked to prearranged actions. Examples include "concerned," "uncomfortable," and "safety issue." They are used to express an increasing degree of worry about a subject. For instance:

- Using the term "concerned" (e.g., "I am concerned about...") is a team member's way of alerting the team or provider.
- Stating "I am uncomfortable because..." suggests that a previous expression of "concern" may have been overlooked, and the situation is now heightened and potentially hazardous.
- Raising a "safety issue" mandates that the current course of activity must halt and be re-evaluated before proceeding.

Event Management

Briefs (Pre-Event Planning):

A loosely structured discussion among team members to enhance patient care by creating a strategy and ensuring agreement before any action. This brief planning meeting focuses on team formation, assigning key responsibilities, setting the tone and expectations, and projecting possible outcomes and backup plans.

Huddles (Dynamic Adjustment):

A spontaneous gathering of team members in response to evolving conditions to reorganize and establish a shared mental model for plan modifications.

Debriefs (Post-Event Analysis):

A semi-structured discussion among team members immediately after an event to analyze performance with the goal of planning future improvements and reinforcing desired actions. Crucial questions to consider are:

- What worked successfully, and why?
- What could have been done better, and why?
- What actions should be changed in the future?

Malpractice Risk and Prevention

A positive side effect of reducing unfavorable practices is a decrease in damages for care providers and facilities. Risk management strategies reduce the probability of lawsuits, limit the size of damages in a claim, and help prevent patient harm. One such strategy is early case reporting, often combined with an apology and patient negotiation as a case-finding strategy.

The Five C's of Risk Management

The Five C's framework can lower the likelihood of a malpractice lawsuit by promoting better patient care:

- **Compassion:** Patient dissatisfaction frequently precedes legal action. It is challenging for patients to sue someone they like and who shows genuine concern.
- **Communication:** Building a better rapport with patients can lead to fewer legal disputes. Patients value adequate explanations of their symptoms and test results. Simply sitting down and talking with patients improves their perception of the healthcare provider's communication skills. Effective communication tactics include:
  - Encouraging patients to ask questions.
  - Limiting the amount of information provided at one time.
  - Using "teach-back" or "show-me" approaches to confirm understanding.
  - Speaking slowly and using non-medical language.
  - Providing written resources to support verbal explanations.
- **Competence:** The provider must be qualified and experienced to deliver the appropriate care. Consultations or referrals should be made when necessary.
- **Charting:** Insufficient medical record evidence is the main reason why many claims are unsuccessful. The medical record serves as the primary witness in a court of law. Documents must be fully completed, dated, and timed, and errors should be correctly fixed.
- **Confession:** A suspected cover-up is often a stronger motivation for suit filings than the error itself. A provider's honest admission of a mistake can soften the patient's opinion.

Simulations for Improved Maternity Care

Simulation exercises can take place in maternity care units or dedicated simulation labs. In-unit simulations more accurately replicate patient care and system problems. These exercises are also effective for practicing cooperation and communication concepts. Regular drills are particularly beneficial in resource-constrained environments.

CHAPTER TWO

Anatomic and Physiologic Changes during Pregnancy

Learning Objectives

The learner will be able to:

- Identify the anatomical and physiological changes that occur during pregnancy.
- Analyze the maternal vulnerabilities arising from alterations in the cardiovascular, respiratory, hematologic, gastrointestinal, genitourinary, endocrinologic, and immunologic systems.

Pregnancy induces extensive and complex anatomical and physiological changes across virtually all maternal organ systems to support fetal development and prepare the body for labor and delivery. These adaptations are primarily driven by the increasing levels of hormones.

Cardiovascular System

Increased Cardiac Output: Cardiac output rises by 30% to 50% from baseline, peaking around 20-24 weeks and remaining high until delivery. This is initially due to increased stroke volume and later maintained by a higher heart rate (up to 15-20 beats/minute increase).

Table 2.1 Alterations in Cardiovascular Physiology and Anatomy During Gestation

PARAMETER	VALUES IN PREGNANCY
Heart rate (HR)	↑ 20%
Stroke volume (SV)	↑ 30%
Cardiac output (CO)	↑ by more than 40%; can result in normal grade 1-2 systolic ejection murmur
Systemic vascular resistance (SVR)	↓ by more than 30%, nadir at 32 weeks
Oncotic pressure	↓ due to hemodilution and decreased serum albumin
Uterus	Palpable at the maternal umbilicus (generally corresponding to 20 weeks gestation with a single fetus), can ↓ preload and cardiac output
Breast tissue	Can be dense and enlarged, causing difficulty with hand placement and pad placement, and ↓ effectiveness of chest compressions

Blood Volume and Composition: The total blood volume experiences an increase of 40% to 50%. This expansion is resulting in the “physiologic anemia” associated with pregnancy.

Vascular Changes: A notable decrease in systemic vascular resistance is observed, primarily due to the vasodilatory properties of progesterone and nitric oxide, which consequently leads to a reduction in blood pressure, especially evident during the second trimester.

Hypercoagulability: During gestation, the blood transitions into a hypercoagulable state characterized by elevated levels of most clotting factors (e.g., fibrinogen, factors VII, VIII, X) to mitigate the risk of excessive hemorrhage during parturition. This physiological adaptation, however, concomitantly increases the susceptibility to thromboembolic events.

Anatomical Shift: The enlarging uterus displaces the heart superiorly and to the left. Furthermore, compression of the inferior vena cava (IVC) in the supine position may precipitate supine hypotensive syndrome, thereby necessitating lateral positioning in late gestation.

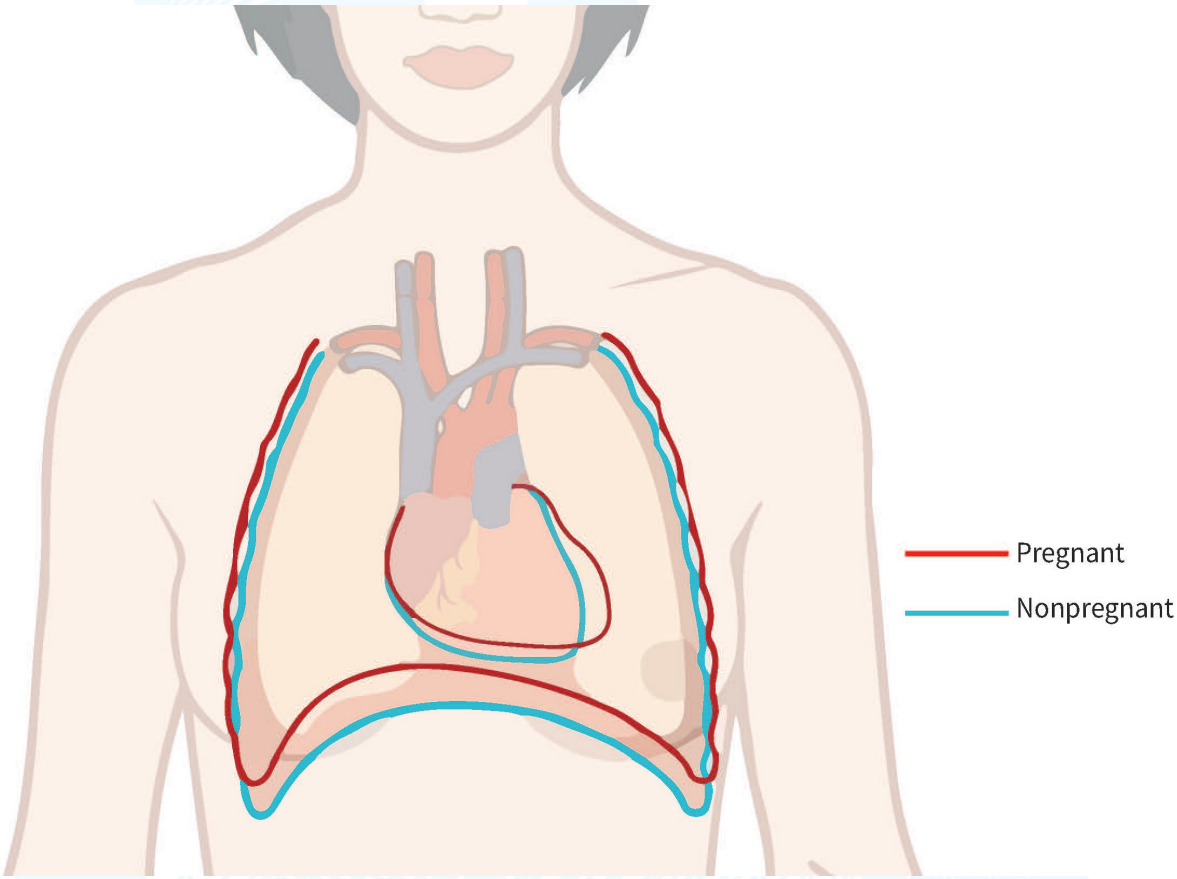


Figure 2.1: Heart and Diaphragm Displacement During Pregnancy

The primary reason pregnancy affects Cardiopulmonary Resuscitation (CPR) is the additional anatomic changes that impact the cardiovascular system. Specifically, the enlarging uterus causes aortocaval compression, which significantly hinders blood flow by directly pressing on the great vessels, namely the inferior vena cava and the aorta.

Key Effects of Aortocaval Compression:

- Upon the fundal height reaching the level of the umbilicus (typically observed at approximately 20 weeks of gestation in a singleton pregnancy), the gravid uterus is capable of inducing sufficient compression to diminish cardiac output by as much as 25% when the patient is positioned supine.
- The compression occurs at the level of the umbilicus because this anatomical site represents the bifurcation of the great vessels. Consequently, the location of the fundal height relative to the umbilicus, rather than strictly the gestational age, constitutes the critical determinant.
- In multifetal pregnancies (e.g., twins), the fundal height may reach or exceed the umbilicus prior to 20 weeks of gestation.
- This effect typically becomes more pronounced or manifests more rapidly as the pregnancy progresses.

Clinical Considerations for CPR:

- Compression of the inferior vena cava may impede the heart's absorption of fluids and medications. Consequently, establishing intravenous (IV) access superior to the diaphragm is advised.
- Expansion of maternal breast tissue frequently occurs, potentially hindering appropriate hand placement during chest compressions.

Respiratory System

Hormonal Effects on the Respiratory System During Pregnancy

Physiological alterations in the respiratory system during gestation are substantially mediated by hormones.

Influence of Estrogen and Progesterone:

Elevated estrogen levels during pregnancy are associated with an increased number and heightened sensitivity of central progesterone receptors in the hypothalamus and medulla. Estrogen also potentiates the effects of progesterone, which typically reaches peak concentrations around 37 weeks of gestation. This hormone exerts multiple influences on the respiratory system:

- It enhances the respiratory center's chemosensitivity to carbon dioxide.
- It induces bronchodilation through the relaxation of airway smooth muscle tone.

Furthermore, it augments the vascularity and edema of mucosal surfaces, which subsequently leads to exacerbated nasal congestion and a reduction in the internal tracheal diameter. These collective consequences diminish nasal patency and can elevate the Mallampati score.

The Mallampati Score and Airway Difficulty:

The Mallampati classification system is a clinical instrument employed by medical professionals to predict the potential challenges associated with laryngoscopy. This scoring system comprises four distinct classes, progressing from Class I (characterized by complete visualization of the oropharynx, indicating minimal predicted difficulty) to Class IV (defined by the absence of soft palate visualization, suggesting a substantial anticipated difficulty). Research indicates that over 30% of patients attain a Mallampati score of Class IV by the time they reach term. Moreover, the physiological changes during labor, particularly increased airway edema, can exacerbate the Mallampati score, thereby complicating airway management.

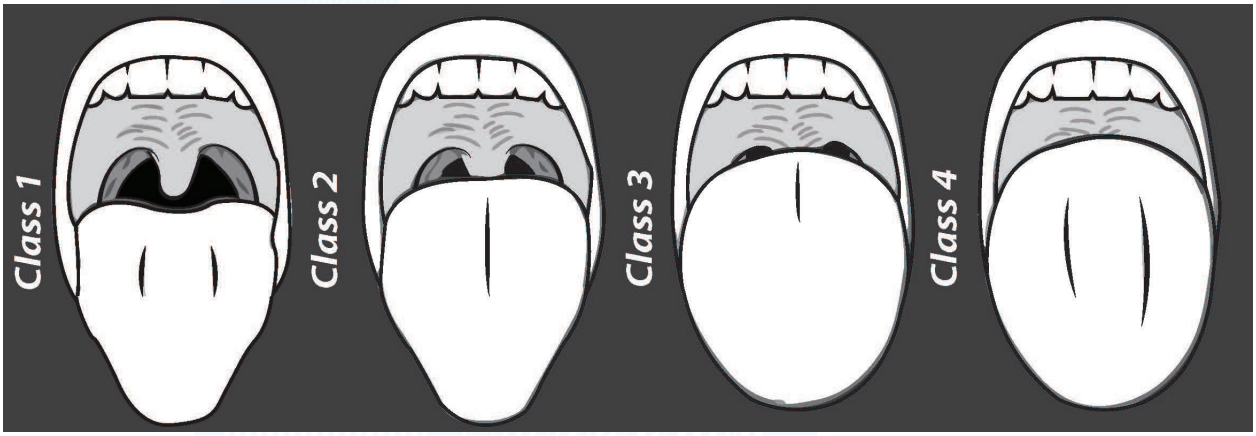


Figure 2.2: The Mallampati classification system.

The Role of Prostaglandins:

Prostaglandins are present throughout all trimesters of pregnancy, with concentrations increasing during labor. Prostaglandin F2 alpha elevates airway resistance by inducing bronchial smooth muscle constriction. Conversely, prostaglandins E1 and E2 exhibit bronchodilatory effects. Due to its constrictive action, carboprost tromethamine, a synthetic analogue of prostaglandin F2 alpha frequently employed in the management of postpartum hemorrhage, is contraindicated in patients with asthma, as it possesses the potential to exacerbate the condition through heightened airway resistance.

Pregnancy leads to significant respiratory changes due to both anatomical and hormonal factors. As the growing uterus elevates the diaphragm combined with the significant increase in oxygen demand during normal pregnancy, results in a lower overall oxygen reserve.

Pregnant individuals face a significantly higher risk of rapid oxygen desaturation compared to nonpregnant adults. The time to desaturation is markedly reduced during pregnancy, typically lasting only about 3 minutes, in contrast to approximately 9 minutes for nonpregnant adults.

Maternal blood gas analysis typically reveals a mild respiratory alkalosis, characterized by a pH of 7.4, which is slightly elevated compared to the nonpregnant reference range (pH 7.35–7.45). Concurrently, a minor decrease in maternal PaCO2 (28–32 mm Hg) is observed when contrasted with nonpregnant values (35–45 mm Hg). Figure 2.2 and Table 2.2 delineate the cumulative effects of these hormonal and anatomical alterations.

Table 2.2 Changes During Pregnancy

PARAMETER	VALUES IN PREGNANCY
Functional reserve capacity (FRC)	↓ by 20%
Expiratory reserve volume (ERV)	↓ by 15%–20%
Residual volume (RV)	↓ by 20%–25%
Tidal volume (TV)	↑ by 30%–40%
Minute ventilation	↑ by 50%
Diaphragm	Elevated by gravid uterus resulting in ↓ FRC, ERV, RV, and total lung capacity
Progesterone	↑ sensitivity of the respiratory center to carbon dioxide, relaxes airway smooth muscle tone (resulting in a bronchodilatory effect), and mediates hyperemia and edema of mucosal surfaces ↓ nasal patency

Renal/Urinary System Alterations

Pregnancy induces significant changes in the female urinary system and renal function.

Urinary Stasis and Anatomic Changes

The enlarging uterus and fetus exert direct pressure on the bladder, contributing to an increase in urinary stasis. Simultaneously, anatomic changes within the urinary tract further compound this effect. The kidneys enlarge, the renal pelvis dilates, and the ureters become elongated. This leads to an increased overall volume capacity within the urinary system, which in turn results in a higher post-void residual urine volume and, consequently, greater stasis.

Altered Renal Function

Renal function undergoes substantial modification during gestation. The glomerular filtration rate (GFR) increases by approximately 50%, a change driven by hormonal modulation and expanded plasma volume. Concurrently, levels of renin, angiotensin, and aldosterone are all elevated. Despite the increased GFR, the overall daily urinary output volume remains similar to prepregnancy levels, though patients often report an increase in the frequency of urination. Interestingly, the functional capacity of the bladder itself is also augmented, capable of reaching about 1.5 L.

Filtration and Fluid Balance

Aldosterone's elevated activity facilitates sodium resorption, thereby promoting fluid resorption and helping to sustain intravascular fluid balance. The enhanced renal filtration results in greater creatinine clearance, leading to corresponding decreases in serum creatinine and blood urea nitrogen (BUN) levels. Furthermore, sporadic glucosuria is a frequent finding during pregnancy, potentially attributable to the elevated glomerular filtration.

Gastrointestinal Changes During Pregnancy

Gastrointestinal (GI) symptoms are among the most common complaints reported during pregnancy. While early pregnancy is often characterized by nausea and vomiting, later stages frequently involve complaints of early satiety and constipation.

Several physiological changes in the GI tract contribute to these symptoms:

- Decreased Motility and Reflux: Overall GI motility decreases, resulting in slower gastric emptying and increased transit time through the large intestine. The combination of slower emptying and relaxation of the terminal esophageal sphincter often leads to an increase in gastroesophageal reflux symptoms. This reflux can be worsened in late pregnancy as the growing uterus pushes the stomach upward.
- Oral Health: Reports of gingival hypertrophy and the worsening of pre-existing gingival disease are also noted. Preliminary research, though inconclusive, has suggested a possible correlation between periodontal disease and an increased risk of preterm labor.

Alterations in the Blood System

Pregnancy induces characteristic changes in a patient's blood profile, stemming partly from an increase in intravascular volume. This volume expansion leads to a rise in red blood cell volume, consequently heightening the body's iron requirement. Insufficient iron intake, whether from diet or supplements, frequently results in iron deficiency anemia in pregnant patients, identifiable by typical alterations in red cell indices, specifically a reduction in both mean corpuscular volume and mean corpuscular hemoglobin content.

Additionally, a physiological increase in blood leukocytes (white blood cells) is a standard change during gestation. White blood cell counts steadily climb throughout the pregnancy, reaching their peak during labor. This elevated count can complicate the accurate diagnosis of an infection.

CHAPTER THREE

Cardiac Arrest in Pregnancy

Learning Objectives

The learner will be able to:

- Compare the pregnancy-related mortality ratio in the Kingdom of Saudi Arabia with the global maternal mortality ratio, and identify the principal causes of maternal complications (MCA) and subsequent mortality.
- Explain the relationship between severe maternal morbidity (SMM) and maternal death, and enumerate the primary demographic risk factors associated with MCA and mortality.
- Delineate and analyze the current strategies implemented to prevent MCA and maternal mortality.

Maternal Cardiac Arrest (MCA) and Mortality in Saudi Arabia

Maternal Cardiac Arrest (MCA) is a rare but critical emergency in obstetrics. Saudi Arabia has achieved substantial improvements in maternal healthcare, reflected in a declining Maternal Mortality Ratio (MMR). Recent data from the Ministry of Health indicates an MMR of 11.9 per 100,000 live births in 2018, a rate comparable to or even better than those in many developed nations.Epidemiology and Context in Saudi Arabia

The issue of maternal mortality is a key public health focus in Saudi Arabia. Sources suggest the MMR has fallen dramatically, from an estimated 46 per 100,000 live births in 1990 to as low as 7.00 per 100,000 in 2023, signifying considerable progress in healthcare quality and accessibility.

Despite this decline in overall maternal mortality, the actual incidence of cardiac arrest during the peripartum or pregnancy period remains low globally, with estimates ranging from 1 in 12,000 to 1 in 55,000 births. The specific national incidence of MCA in Saudi Arabia is not yet widely documented in national surveys, with most available data stemming from studies conducted in individual hospitals.

Key risk factors identified in Saudi studies that contribute to maternal mortality include:

- Advanced maternal age and grand multiparity.
- Absence of antenatal care (referred to as “unbooked patients”).
- Lower socioeconomic status and educational attainment.
- The presence of pre-existing chronic conditions prevalent in the region, such as hypertension and diabetes.

Table 3.1: Reported Complications of Pregnancy and Childbirth at MOH Hospitals, 2024

Total Cases	Complications of Pregnancy and Childbirth
12,543	Pregnancy-Related Anemia
10,549	Diabetes Mellitus Developed During Gestation
8,547	Urinary Tract Infection (UTI) in Pregnancy
7,996	Antepartum Vaginal Bleeding
7,138	Pre-Gestationally Diagnosed Diabetes Mellitus
6,227	Pre-existing Hypertension (Diagnosed prior to pregnancy)
4,113	Preeclampsia (Gestational Hypertension)
3,867	Bronchial Asthma in Pregnancy
3,383	Postpartum Vaginal Bleeding
693	Intrapartum Vaginal Bleeding
510	Pregnancy in the Context of Heart Disease
509	Pregnancy-Related Venous Disorders
428	Eclampsia (Gestational Hypertension)

Maternal deaths in Saudi Arabian hospitals are significantly attributed to obstetric hemorrhage, with postpartum hemorrhage (PPH) being a primary concern.In the Kingdom, the growing occurrence of PPH has been recognized as a primary contributor to both maternal morbidity and mortality (Asiri et al., 2022).

Maternal mortality presents a serious health challenge, with several key factors contributing to adverse outcomes. Hospitals are actively responding to this through comprehensive training programs for healthcare providers. These programs emphasize the early identification and effective management of obstetric emergencies, including the appropriate use of blood products and necessary surgical interventions (Asiri et al., 2022; Abousada et al., 2021).

Significant hemorrhage resulting from complications like placenta previa and placenta accreta is another major cause of maternal mortality. These conditions demand meticulous management, frequently involving cesarean delivery and, in severe instances, a hysterectomy (Abduljabbar et al., 2016; Kassem & Alzahrani, 2013).

Furthermore, maternal mortality is indirectly influenced by pre-existing chronic conditions, such as diabetes and hypertension, and other comorbidities. Socioeconomic factors—including limited access to quality healthcare and education among certain demographics—often exacerbate these indirect causes

(Hazzazi et al., 2021; Alanazy & Brown, 2020).

In response, the Saudi government is prioritizing both the quality and accessibility of antenatal care services. Key initiatives include public health campaigns designed to increase awareness about the importance of consistent antenatal visits and the proper management of chronic illnesses during pregnancy (Alanazy & Brown, 2020; Al-Hindi et al., 2020).

the Chain of Survival

The successful resuscitation from maternal cardiac arrest (MCA) involves critical steps applicable to both pre-hospital and in-hospital settings. Despite the high risk of maternal mortality following cardiac arrest, pregnant patients experiencing in-hospital cardiac arrest demonstrate a higher survival rate to hospital discharge compared to non-obstetric populations.

This improved outcome may stem from differences in clinical risk factors, variations in patient monitoring across hospital units, or simply the reversibility of many arrests, underscoring the potential for optimizing survival through enhanced institutional preparation and collaborative provider training. EMS personnel play a vital role, especially since a patient's condition can rapidly deteriorate during transport. It is also significant to note that the majority of postpartum deaths happen more than seven days after delivery, typically following the patient's discharge from the hospital.

Managing rare, high-risk events such as Major Obstetric Hemorrhage (MCA) is difficult and requires coordinated interventions, strong teamwork, clear communication, and provider confidence.

Simulation training is effective in improving adherence to SACLS protocols, resulting in faster initiation of CPR and RCD. It also enhances critical skills like airway management and LUD, and helps practitioners identify the causes of arrest. Moreover, simulation offers a safe space for professionals to identify local barriers, receive feedback, and correct errors.

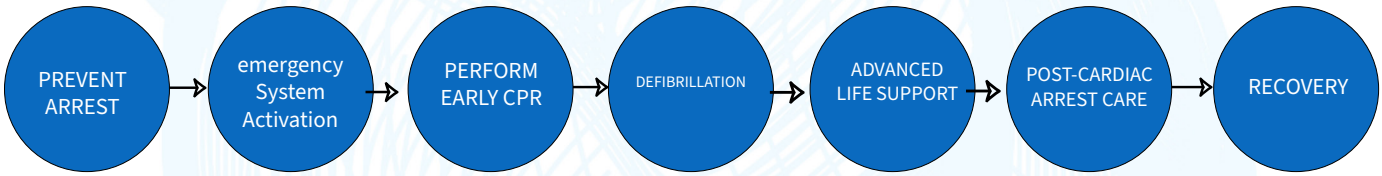


Figure 3.1 In & Out of Hospital Chain of Survival

Maternal Cardiac Arrest Prevention

Managing cardiac arrest in a pregnant patient is a significant challenge because the care team must simultaneously manage two patients: the mother and the fetus. While many resuscitation protocols align with standard adult care, unique considerations are necessary. Effective management requires an understanding of maternal mortality, defined as a woman's death during pregnancy, delivery, or within 42 days postpartum due to pregnancy-related causes or management complications.

Etiology of Maternal Cardiac Arrest (MCA)

The primary causes of maternal cardiac arrest (MCA) most frequently documented include maternal

obstetric hemorrhage, cardiovascular issues (excluding stroke), venous thromboembolism, and amniotic fluid embolism.

A range of other significant etiologies also contribute to MCA:

- Hypertensive disorders of pregnancy
- Sepsis
- Stroke
- Complications related to anesthesia
- Trauma
- Medication and illicit drug use
- Anaphylaxis
- Respiratory failure stemming from conditions like status asthmaticus.

The global variation in the prevalence of these complications is largely determined by the quality of maternal care available to women during and after pregnancy.

Figure 3.2 Urgent Maternal Warning Signs

Early Warning Scores (EWS): Detecting Clinical Deterioration

Early Warning Scores (EWS) are essential clinical tools used to assess the severity of a patient's illness. They rely on routine physiological measurements to monitor a patient's condition and identify early signs of deterioration. Critically, a higher EWS indicates greater illness severity and necessitates a more urgent clinical response.

EWS systems operate by assigning a point value to each of a patient's vital signs based on how far they deviate from normal physiological ranges. These individual scores are summed up to generate a single, overall score. This final score then triggers a specific protocol for increased monitoring and escalation of care, adhering to the core principle that physiological decline typically precedes severe adverse events like cardiac arrest.

Key Parameters

The vital signs typically incorporated into EWS calculations include:

- Respiratory rate
- Oxygen saturation
- Systolic blood pressure
- Heart rate
    - Level of consciousness (often evaluated using the AVPU scale: Alert, Voice, Pain, Unresponsive)
- Body temperature

Early Warning Score (EWS) systems

Standardized tools known as Early Warning Score (EWS) systems are designed to help clinicians promptly identify patient deterioration. These systems are customized for diverse clinical environments and patient populations.

Specific EWS Systems:

- **MEWT** The Maternal Early Warning Tool (MEWT) is an effective instrument designed to decrease maternal morbidity in the U.S. It achieves this by concentrating on the four primary causes of poor outcomes: obstetric hemorrhage, infection, cardiac and respiratory disorders, and high BP. Key features of the MEWT include explicit criteria for vital sign assessment and associated management recommendations. The tool also incorporates "maternal triggers," such as altered mental status, changes in vital signs, and fetal tachycardia.

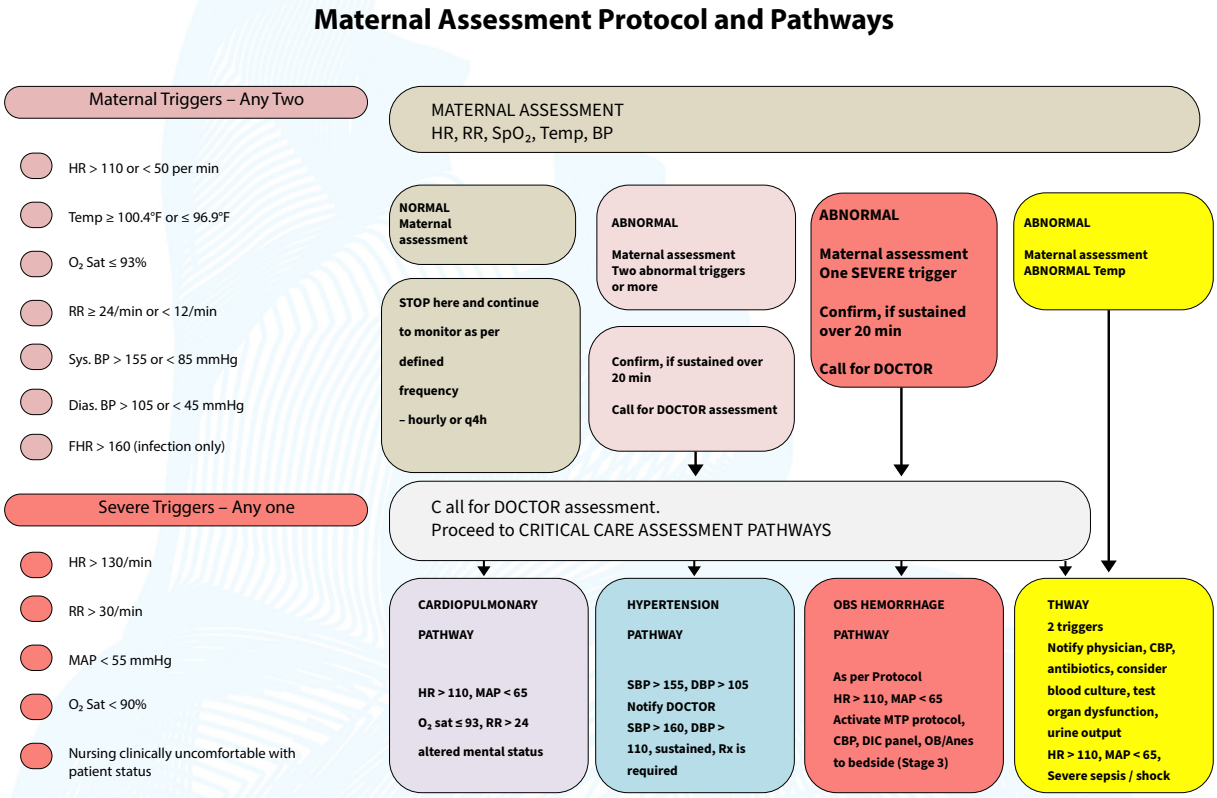


Figure 3.3 Maternal Assessment Protocol and Pathways

- **Modified** Early Warning System (MEWS): Maternal Early Warning Systems (MEWS) are clinical assessment protocols designed to enable healthcare providers to quickly identify and respond to the initial signs of a decline in the health of a pregnant or recently pregnant woman. The core objective of MEWS is to prevent severe complications (maternal morbidity) and fatalities by ensuring rapid evaluation and subsequent treatment.

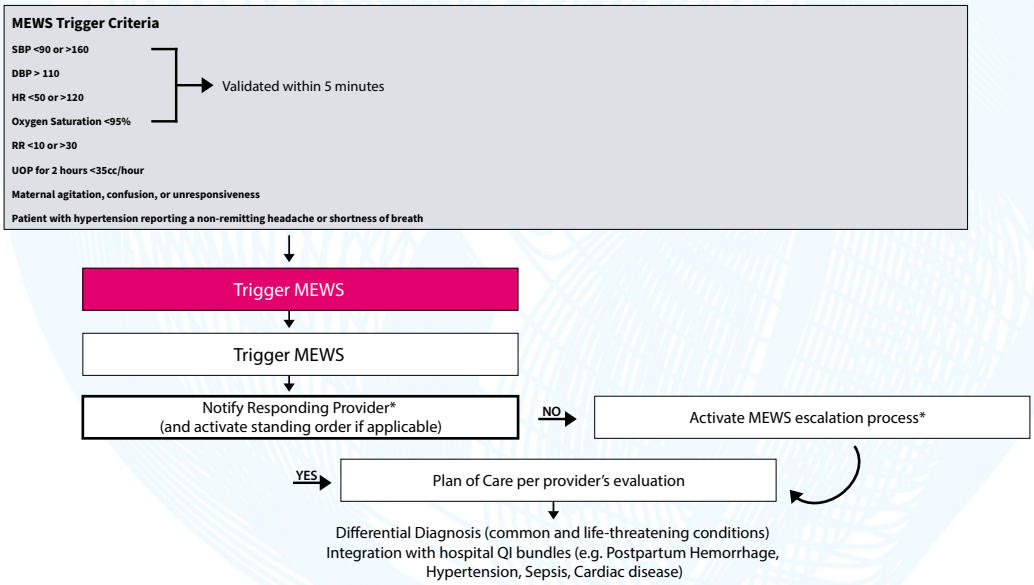


Figure 3.4 MEWS Trigger Criteria

- **Obstetric** Early Warning Systems: These are emerging systems developed for maternal-fetal medicine. Their goal is to identify and monitor high-risk conditions during pregnancy and postpartum, such as preeclampsia and hemorrhage.

Primary Etiologies of Maternal Cardiac Arrest

1- Maternal Bleeding

Maternal hemorrhage constitutes the principal global etiology of maternal morbidity and mortality. Postpartum hemorrhage (PPH), which is clinically defined as blood loss within the initial 24 hours following parturition, accounts for approximately 75% of these incidents. Significantly, more than half of maternal fatalities attributable to PPH transpire during this critical 24-hour post-delivery interval. Hemorrhage that manifests subsequent to the first 24 hours is designated as delayed PPH, specifically defined as bleeding occurring later than 24 hours but preceding the 6-week postpartum mark.

Table 3.1 Major Causes of Maternal Hemorrhage

Time period	Major causes of hemorrhage
Antepartum	• Placental abnormalities (abruption, previa, accreta spectrum) • Trauma • Uterine rupture • Coagulation defects (inherited, acquired)
Intrapartum or immediate postpartum (within 24 hours of delivery)	• Uterine atony • Uterine inversion • Vaginal/cervical lacerations • Episiotomy • Retained conception products or retained placenta, placental abnormalities (abruption, previa, accreta spectrum) • Amniotic Fluid Embolism (AFE) • Uterine rupture • Bleeding surgical sites/pedicles
Delayed postpartum (>24 hours after delivery, <6 weeks postpartum)	• Retained products of conception/placenta • Infection

2- Emergency Hypertension /Eclampsia

Preeclampsia is a condition typically diagnosed after 20 weeks of gestation, characterized by a set of signs and symptoms. Common symptoms of the condition include headache, swelling (edema), a general feeling of unwellness (malaise), pain in the right upper abdomen, nausea, and vomiting.

Key signs for diagnosis are:

- Hypertension: Defined as a Systolic Blood Pressure (SBP) of 140 mmHg or a Diastolic Blood Pressure (DBP) of 90 mmHg, or a significant worsening of blood pressure in individuals with pre-existing hypertension.
- Other Physical Findings: These include edema, proteinuria, and, in rare instances, jaundice. Associated laboratory abnormalities include hemoconcentration, thrombocytopenia, elevated liver enzymes, elevated serum creatinine, and hemolysis.
- The acute management of preeclampsia with severe features necessitates a dual focus: the prevention of eclamptic seizures, typically achieved through continuous intravenous (IV) magnesium sulfate administration, and the timely control of severe hypertension, defined as systolic blood pressure (SBP) 160 mmHg or diastolic blood pressure (DBP) 110 mmHg, which should be addressed within 15–30 minutes. Preferred first-line antihypertensive agents include IV/intramuscular (IM) Hydralazine, IV Labetalol (with caution or avoidance in patients with asthma), and immediate-release oral Nifedipine (particularly suited for conscious patients lacking immediate IV access).

Management of Eclamptic Seizures

Eclamptic seizures are typically brief and self-resolving, but they require prompt and aggressive intervention, beginning with magnesium sulfate to prevent recurrence.Initial Treatment with Magnesium Sulfate

Table 3.2 Management of Eclamptic Seizures

Patient Scenario	Action
Not currently receiving Magnesium Sulfate	Establish IV access and administer a **6-g bolus** of MgSO4 over 15-20 minutes, followed by a **2 g/hour maintenance infusion**.
On Magnesium Sulfate, experiencing a second seizure	Give another **2-g bolus** of magnesium sulfate over a period of 15-20 minutes, and then continue with the 2 g/hour infusion.

Refractory Seizures (Following Second Magnesium Bolus)

Should a further seizure occur (i.e., not controlled by the two doses of magnesium sulfate), switch to an alternative anticonvulsant agent:

- Benzodiazepines: IV lorazepam (2–4 mg) or midazolam (2.5–5 mg).

Alternative Routes for Administration

If intravenous (IV) access is unavailable, it can be via the intramuscular or intraosseous.

- IM Magnesium: The standard dose is 10 g, divided into two 5-g injections (one into each gluteal muscle).
- IO Dosing: Follow the same dosage regimen as for IV administration.

Refractory Seizures (Status Epilepticus)

A seizure lasting longer than 5 minutes without a return to the patient's baseline neurological function constitutes status epilepticus. This mandates:

1. Immediate administration of benzodiazepines.
2. Securing the airway.
3. Consultation with neurology or activation of a Code Stroke protocol.
4. Prehospital Option: For adults weighing over 40 kg, midazolam 10 mg IM is an option.

Evaluation for Structural Lesions

Eclamptic seizures are typically generalized. If the presentation involves a focal seizure semiology (e.g., unilateral jerking, forced gaze deviation), it suggests a possible underlying structural lesion (e.g., intracerebral hemorrhage). This requires:

- Immediate Code Stroke activation.
- Urgent brain imaging.

3 - Maternal Sepsis: Recognition, Challenges, and Management

Sepsis is accounting for about 12.4% of maternal deaths. Typical clinical indicators include temperature dysregulation, tachycardia (>120 bpm), WBC count abnormalities, and hypotension (systolic BP <90 mmHg, MAP <60–65 mmHg).

Identifying sepsis in pregnant individuals is challenging because normal physiological changes—such as the absence of fever in some severe cases, naturally elevated WBC counts, and a transient drop in blood pressure—can mask or mimic these signs. Infections can be of obstetric (e.g., chorioamnionitis) or nonobstetric (e.g., UTIs, pneumonia) origin, and the source may be occult.

Management guidelines, adapted from the Surviving Sepsis Campaign for non-pregnant adults due to limited pregnancy-specific data, advocate for rapid intervention within 1 hour of suspicion. This includes obtaining blood cultures and lactate, administering broad-spectrum antibiotics, fluid resuscitation with balanced crystalloids, initiating vasopressors for refractory hypotension, and prioritizing source control.

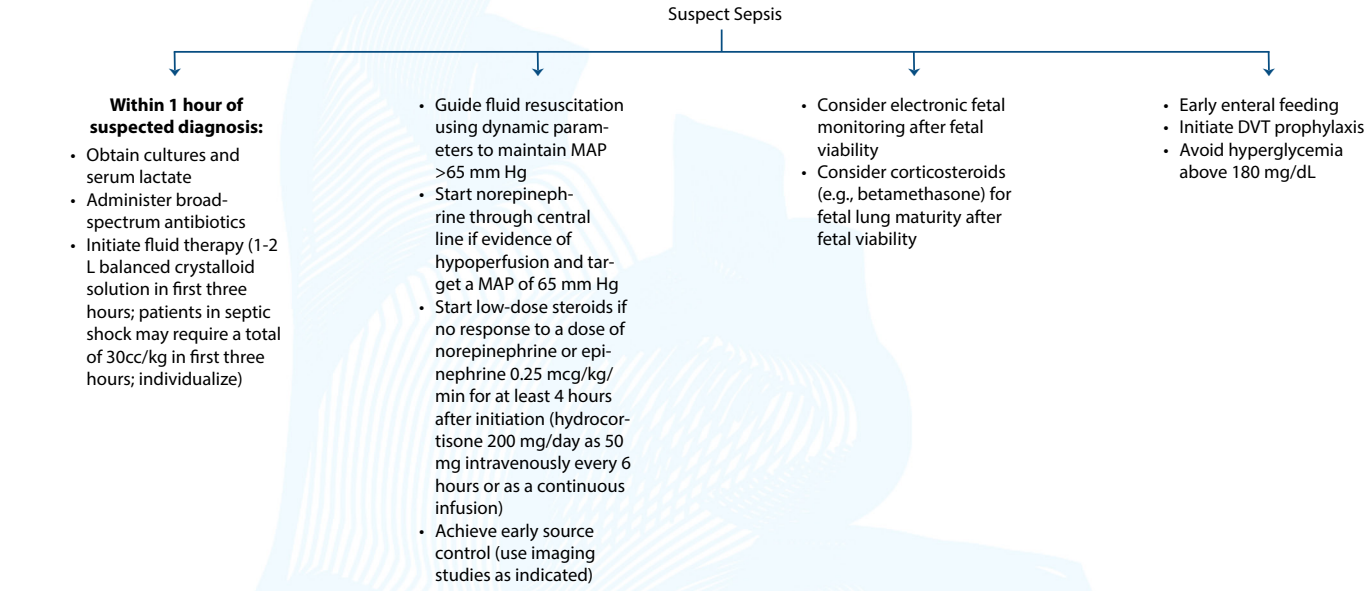


Figure 3.5 Initial Sepsis Management in Pregnancy (Adapted from SMFM).

4- Amniotic Fluid Embolism

It is a rare, immune-mediated reaction caused by amniotic fluid entering the maternal bloodstream, typically occurring during or immediately after labor, but also potentially due to trauma or prolonged rupture of membranes. Clinically, it presents as sudden cardiovascular collapse, often requiring immediate high-quality Cardiopulmonary Resuscitation (CPR). AFE progresses through two stages: the initial Respiratory Arrest Phase, followed rapidly by the Hemorrhagic Phase, which leads to Disseminated Intravascular Coagulation (DIC).

5- Clot/Cerebrovascular/ Pulmonary Embolism

The provided text discusses pulmonary embolism (PE) in the context of pregnancy, emphasizing its seriousness and the increased risk due to vascular injury, venous stasis, and hypercoagulability.

PE typically presents with sudden shortness of breath, tachycardia, and/or chest pain, necessitating an initial ECG and chest X-ray. The diagnostic workflow assesses for clinical DVT signs. If present, a lower extremity ultrasound is performed; a positive result leads to therapeutic anticoagulation. If negative, a D-dimer test is performed.

If clinical suspicion for PE remains high, empiric therapeutic anticoagulation should be initiated immediately while pursuing confirmatory imaging (CTPA or ventilation-perfusion scan), noting that a shielded abdomen is required for CTPA in pregnant patients to minimize fetal radiation exposure.

6- Cerebrovascular (Stroke)

Stroke, though it's a rare cause of sudden cardiac death. Strokes are classified as either ischemic (blockage) or hemorrhagic (rupture). Due to similar symptoms, a rapid head CT scan is necessary to rule out hemorrhage ("Time Is Brain").

Stroke can happen at any time during pregnancy, but it is most frequently observed in the first two weeks following childbirth (postpartum). The effects of a stroke are grave, with the potential for death directly resulting from cerebral edema (brain swelling) or indirectly from secondary complications such as pulmonary embolism or aspiration.

7- Trauma

Trauma, encompassing both unintentional (like falls, motor vehicle collisions) and intentional (like intimate partner violence) causes, is defined as a physical injury from an external force. This review focuses on both types of trauma during pregnancy and associated severe consequences, such as tension pneumothorax and cardiac tamponade, leading to major complications (MCA).

Blunt Abdominal Trauma and Placental Abruption

Placental abruption, which is the premature separation of the placenta from the uterine wall, is a significant risk associated with blunt abdominal trauma, often resulting from falls and motor vehicle collisions. This risk is particularly elevated after 12 weeks of gestation, as the uterus is no longer shielded within the pelvis.

Trauma causes shearing forces between the elastic uterine wall and the inelastic placenta, leading to separation and potential catastrophic bleeding, hypovolemic shock, Fetal Death, and Disseminated Intravascular Coagulation (DIC).

Clinical signs include abdominal pain, uterine contractions, and vaginal bleeding, though concealed abruptions may lack visible bleeding. Insidious presentations can rapidly progress to hemodynamic instability.

Management prioritizes prompt maternal evaluation and treatment, which must not be delayed by pregnancy. Significant trauma requires evaluation using trauma protocols. Minor trauma necessitates fetal and contraction monitoring post-event:

- Low Risk: Patients with no signs of abruption and a clear ultrasound should be monitored for at least 6 hours.
- High Risk: Patients with abdominal pain, vaginal bleeding, four or more contractions per hour, significant trauma, or an ultrasound suggestive of abruption require immediate evaluation and consideration for a minimum of 24-hour monitoring.

8- Cardiovascular

A major cause of maternal mortality, focusing specifically on peripartum cardiomyopathy (PPCM) and acute coronary syndrome.

Cardiovascular Red Flags that require immediate medical attention, hospitalization, and cardiology/ maternal-fetal medicine consultation. These include a HR 120 bpm, SBP 160 mm Hg, oxygen saturation 94%, RR 30, and shortness of breath or orthopnea at rest.

Peripartum Cardiomyopathy (PPCM) is the most common cardiomyopathy during pregnancy. This idiopathic heart failure typically onsets in the last month of pregnancy or up to five months postpartum.

Clinical Presentation involves symptoms of heart failure such as dyspnea on exertion, dyspnea at rest, and orthopnea, along with potential excessive weight gain and peripheral edema.

Diagnosis is supported by physical findings like tachycardia, hypertension, hypoxia, crackles, and JVD, as well as an echocardiogram showing a decreased ejection fraction and a BNP 100 pg/mL.

Management requires prompt and aggressive treatment, noting that while recovery is common, some patients suffer irreversible damage, and there is a significant risk of recurrence in future pregnancies.

9- Overdose

Overdoses as a cause of Maternal Cardiac Arrest (MCA), focusing on two primary areas: Magnesium Toxicity and Opioid Overdose, with a brief mention of electrolyte imbalances (Glucose/K+).

Magnesium Toxicity (Overdose):

- Magnesium sulfate serves a dual role: it is administered for seizure prevention in cases of preeclampsia or eclampsia, and it is also utilized for fetal neuroprotection.
- Toxicity is caused by administration errors or reduced clearance (especially with renal insufficiency).
- **Clinical Signs:** Loss of deep tendon reflexes (DTRs) and decreased respiratory rate.
- **Management:** Immediately discontinue infusion, obtain STAT serum level, administer calcium gluconate for significant toxicity, and intubate for respiratory depression. Levels >25 mEq/L are extremely dangerous.
- **Monitoring:** Patients require regular monitoring. The therapeutic range is typically 4–6 mEq/L. Specific action levels are provided (8 mEq/L: stop infusion; >10 mEq/L: give calcium gluconate and consider intubation).

Electrolyte Imbalances (GLUCOSE, K+):

- Acidosis is a rare cause, but pregestational diabetes can lead to severe hypoglycemia, potentially progressing to cardiac arrest.
- **Action:** POC of sugar level for any patient in cardiac arrest.
- **Treatment for Severe Hypoglycemia:** IV bolus of 50% glucose or IM/Subcutaneous injection of glucagon.

Opioid Overdose:

- Opioid abuse and overdose deaths are increasing in pregnant and postpartum women.
- Signs/Symptoms: Respiratory depression, pinpoint pupils, clammy skin, unresponsiveness.
- Treatment (Naloxone): The standard and safe treatment during pregnancy/postpartum.
- Dosing: 2 mg intranasal OR 0.4 mg intramuscularly. A second dose may be given after 4 minutes if the initial dose is ineffective.

11- Acute Respiratory Distress/Acute Lung Injury

It is triggered by various factors, including lung infection, sepsis, aspiration, and trauma.

Patients typically show SOB, decreased sat., and decreased lung sounds. Diagnosis is confirmed through CX-ray/CT scan, which should not be delayed in pregnant patients. Immediate evaluation for intubation is necessary for pregnant patients with respiratory distress and hypoxemia (O2 sat < 90%) alongside

hypercapnia.

12- Anesthesia

Maternal deaths can result from complications associated with both regional and general anesthesia used during delivery. Airway management issues are often compounded by pre-existing maternal conditions, such as severe obesity or preeclampsia. It is critical for healthcare providers to be vigilant for and immediately treat anesthetic complications like high spinal or lidocaine toxicity, as these represent immediately reversible causes of maternal cardiac arrest.

The two major complications associated with anesthesia in a pregnant patient: High Spinal Complication and Acute Local Anesthetic Systemic Toxicity (LAST).

- **High Spinal Complication** is characterized by anxiety, difficulty breathing, nausea, arm numbness/weakness, hypotension, and bradycardia, potentially progressing to LOC and RA. Treatment involves immediate supportive care, including 100% oxygen, IVF, possible ETT, RRT activation, administration of lipid emulsion, and use of peripheral vasoconstrictors (like phenylephrine or ephedrine) and atropine.
- **Acute Local Anesthetic Systemic Toxicity (LAST)** can occur during epidural placement or perineal laceration repair. Symptoms in a pregnant person may include circumoral numbness, facial tingling, restlessness, vertigo, tinnitus, slurred speech, tonic-clonic seizures, and cardiac arrest.

CHAPTER FOUR

Basic and Advanced Life Support for Pregnant Patients

Learning Objectives

The learner will be able to:

Learning Objectives:

- Examine current CPR guidelines for both pregnant and non-pregnant individuals.
- Outline the critical steps for responding to a Maternal Cardiopulmonary Arrest (MCA) to maximize resuscitation effectiveness in pregnant patients.
- Review the latest Advanced Resuscitation guidelines specifically tailored for the pregnant individual.

Basic Life Support (SBLS) for healthcare providers (HCPs), focusing on an evidence-based method for assessing unconscious or unstable adult patients. If an unresponsive adult patient is found to lack a pulse or breathing, HCPs must immediately activate the emergency response system, retrieve an Automated External Defibrillator (AED), and begin high-quality chest compressions.

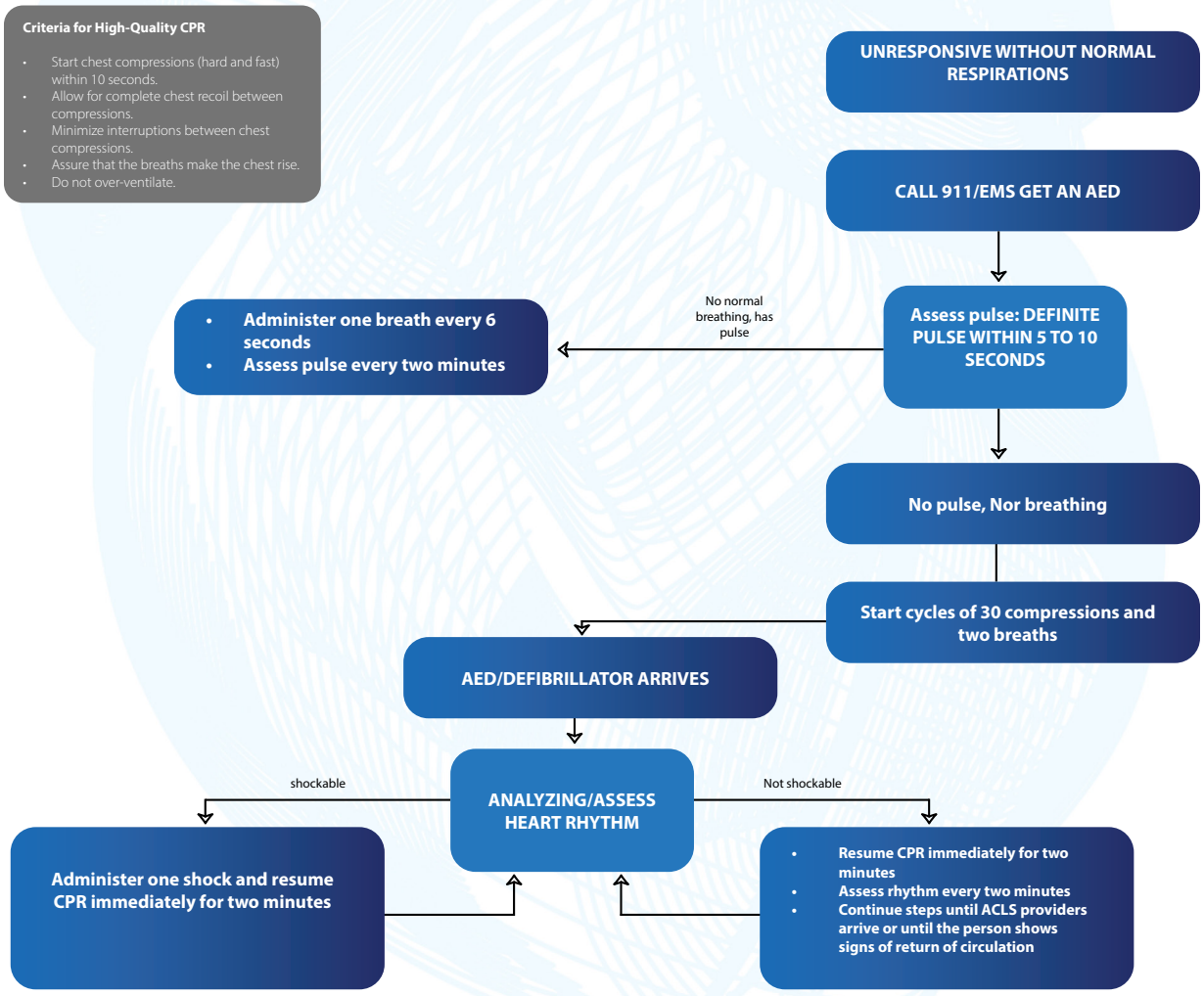


Figure 4.1: Review of Adult SBLS Algorithm

CPR Modifications in Pregnancy

The initiation of a Basic Life Support survey for both pregnant and nonpregnant individuals mandates the same essential initial steps: immediate activation of emergency services and commencement of high-quality chest compressions. These two interventions are crucial determinants of favorable patient outcomes. When activating the emergency response system, it is imperative to clearly communicate the patient's pregnant status, as a minimum of three responders is necessary to execute all required basic modifications simultaneously.

chest compressions and ventilation for pregnant adults, which largely follow the standard techniques for nonpregnant adults.

- **Compression Technique:** Hand placement is in the middle of the sternum, with a rate of 100–120 compressions per minute, and a depth of at least 2 inches (5 cm), ensuring full chest recoil.
- **Ratio:** The standard 30 compression to 2 ventilation is used, or continuous compressions with ventilations every 6 seconds if an advanced airway is in place.

Addressing Obstruction: If large breasts interfere with effective compressions, the rescuer should maintain the heel of the hand centrally on the sternum and slightly rotate the hand so the fingers point toward the patient's shoulder. This adjustment ensures the hand lies flat to apply maximum force.(as illustrated in Figure 3.2).

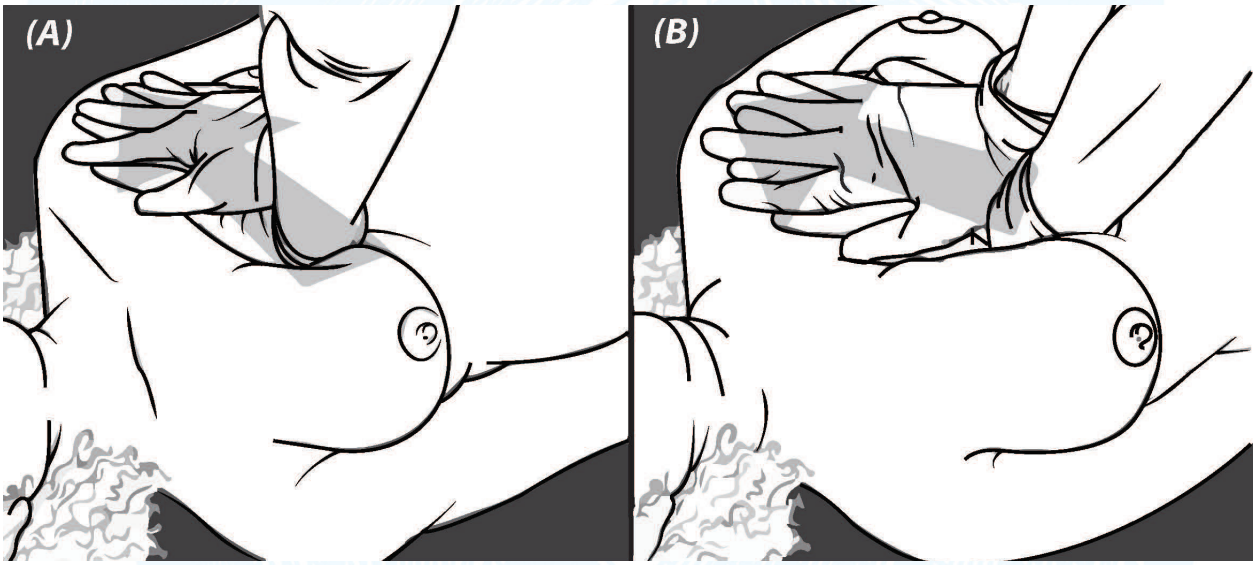


Figure 4.2 correct hand placement.

- Standard Placement: Position hands as shown in (A) for proper delivery of downward force.
- Adjustment for Breast Tissue: Should the area be obstructed by large, pendulous breasts, a slight rotation of the hand toward the patient's shoulder (B) is necessary to ensure the downward force is applied accurately.

Defibrillation

Defibrillation is a crucial step in the resuscitation of a pregnant patient with a shockable rhythm and must be administered promptly.

Defibrillation Procedure:

Defibrillation Procedure

- **Device:** Utilize a manual defibrillator or an Automated External Defibrillator (AED).
- **Electrode Pad Placement:** Make sure the electrode pads are placed either on the front and side (anterolateral) or the front and back (anteroposterior)—check out Figure 5.3. And, crucially, always follow the specific instructions for the device you're using.
- **Precaution for Suspected Spinal Cord Injury:** In cases where a spinal cord injury is suspected, the anterolateral pad placement is the preferred choice to minimize patient movement and mitigate the risk of exacerbating the injury.
- **Anterolateral Pad Placement Tip:** When setting up the anterolateral pad, you'll need to gently lift and move any loose left breast tissue toward the middle. Make sure the lateral pad is placed underneath the breast and slightly to the side, taking care that the pad doesn't actually touch the breast tissue itself.
- **Energy Doses:** The required energy doses remain consistent with those administered to non-pregnant patients; adherence to the specific recommendations provided by the device manufacturer is mandatory.

Additional Safety Measure:

- **Fetal Monitors:** Before using a defibrillator on a pregnant patient, remove any fetal monitors. While leaving them on isn't a major safety risk, removing them allows the rescuer to focus entirely on the mother and eliminates the small possibility of an electrical arc between the defibrillator pads and the monitors.

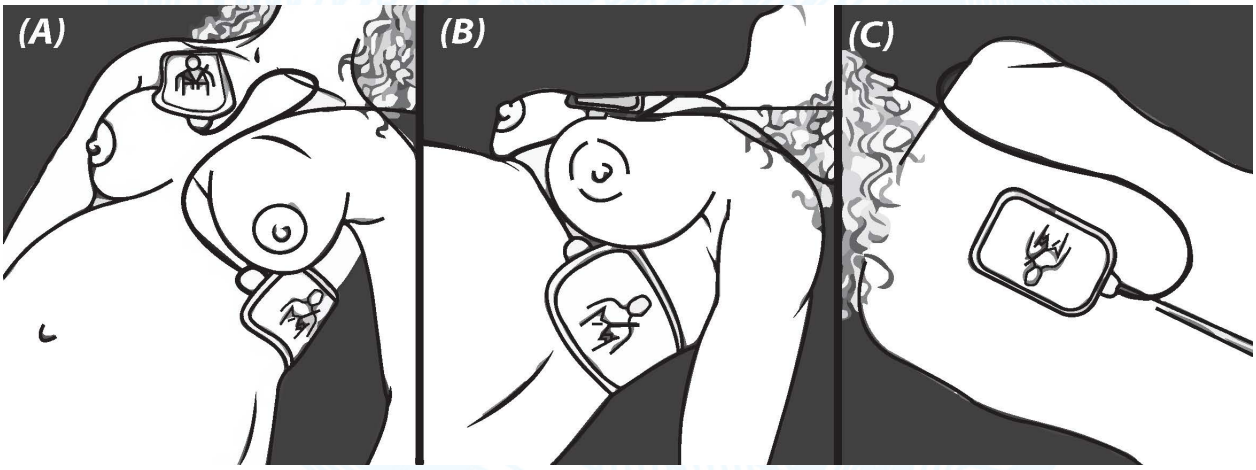


Figure 4.3 AED placements : (A) Front right, (B) Front left side, and (C) On the back.

Left Uterine Displacement

If a pregnant patient experiences cardiac arrest and her uterus is enlarged (at or above the level of the belly button), performing Lateral Uterine Displacement (LUD) is mandatory.

A full-term uterus can significantly impede blood flow returning to the heart, potentially blocking 25-30% of the venous return. In a cardiac arrest scenario, this greatly compromises the effectiveness of CPR. LUD is crucial because it shifts the uterus, thereby improving blood circulation back to the heart.

This can be accomplished from either side of the patient:

1. From the Right Side: Kneel on the patient's right side and push the uterus toward the left and slightly cephalad (upwards).
2. From the Left Side: Kneel on the patient's left side and use both hands to pull the uterus toward the left and slightly cephalad (upwards).

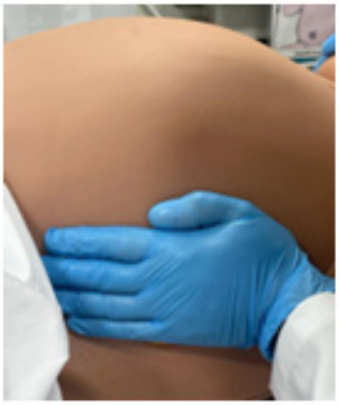


Figure 4.4 One Handed Technique.

Figure 4.5 Two Handed Technique.

Advanced Cardiac Life Support (SACLS) Survey Overview

The SACLS survey builds upon the foundational principles of the Basic survey by focusing on prioritizing a patient's circulation and ventilation. It employs the systematic ABCDE approach for patient assessment, which covers Airway, Breathing, Circulation, Disability, and Exposure. Core elements of the SACLS survey involve the accurate interpretation of the ECG rhythm and the subsequent administration of appropriate pharmacological interventions for various cardiac dysrhythmias.

Table 4.1 Primary Assessment (ABCDE)

ASSESSMENT	MANAGEMENT
AIRWAY	
Check for patency • Observe any audible abnormal breath sounds that might indicate an airway obstruction. • Can the patient keep his airway open? • Is there an indication of an advanced airway?	• Position the head properly to open the airway by using head tilt and chin lift or jaw thrust. • Suction for no more than 10 seconds if indicated. • Use airway adjuncts if indicated • Insert advanced airway if indicated
BREATHING	
Is oxygenation and ventilation adequate? • Connect the patient to a pulse oximeter • Assess respiratory rate (RR) • Chest rise • Lung sounds	• Provide supplemental oxygen • Perform Bag mask ventilation
DISABILITY	
Check central and peripheral pulses. Attach to monitor and Analyze rhythm with pulse rate. Measure the blood pressure. Check capillary refill time.	Obtain IV/IO cannulation Administer volume resuscitation if indicated. Administer blood volume if indicated. Draw labs (blood sample). Give appropriate medication if indicated. Start compressions if indicated
EXPOSURE	
Expose to check for signs of Trauma Bleeding Burn Previous surgeries Medical bracelets Medications patches Needle use Skin rashes Assess Temperature	Manage any abnormal findings

Airway Management During Resuscitation

- Maintain high-quality chest compressions without interruption.
- If BMV is effective, the advanced airway can be deferred until the patient does not respond to initial CPR and defibrillation, or until the return of spontaneous circulation (ROSC)
- Airway management in pregnant patients is anatomically and physiologically challenging.
- Intubation attempts in pregnant patients should ideally be performed by an experienced provider.

Post-Placement Airway Confirmation and Monitoring:

- Once an advanced airway is placed, confirm its correct position using a physical examination and continuous quantitative waveform capnography.
- Secure the airway carefully to prevent accidental dislodgement.
- Adequate ventilation and oxygenation are assessed by observing chest rise, checking for cyanosis, measuring SaO2, and monitoring quantitative waveform capnography (end-tidal CO2 [ETCO2]).

Actionable Insight: If quantitative waveform shows an ETCO2 of less than 10 mm Hg, efforts must be focused on improving the quality of chest compressions.

Shockable Rhythms: Ventricular Fibrillation (VF) and Pulseless Ventricular Tachycardia (PVT)

Pulseless Ventricular Tachycardia: Pulseless ventricular tachycardia, also known as VT without a pulse, is a shockable cardiac arrest rhythm characterized by a rapid but regular ventricular rhythm.

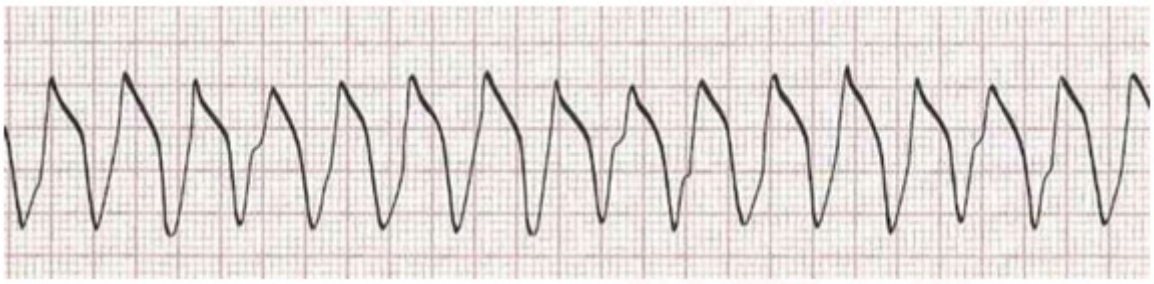


Figure 4.6 Pulseless Ventricular Tachycardia.

Ventricular Fibrillation: Is a shockable cardiac arrest rhythm characterized by rapid, irregular, and chaotic electrical activity in the ventricles.

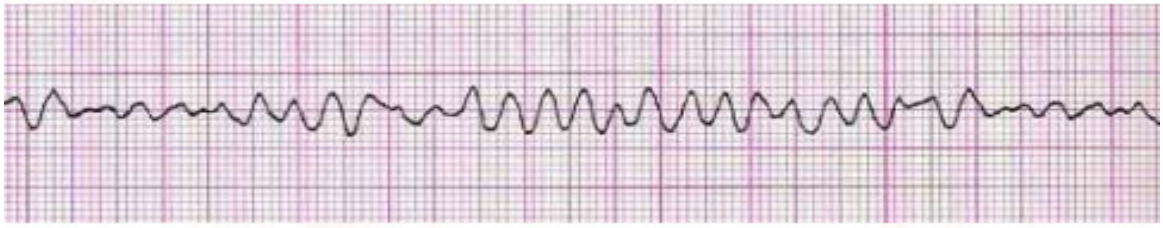


Figure 4.7 Ventricular Fibrillation.

NON-SHOCKABLE RHYTHMS: PEA AND ASYSTOLE

Pulseless Electrical Activity (PEA) means the heart monitor shows an organized rhythm, but you can't feel a pulse. Since PEA isn't a shockable rhythm, the main focus is excellent CPR and getting IV or IO access.

Asystole is also non-shockable, so high-quality CPR and giving epinephrine are the top priorities. PEA often turns into asystole. However, before declaring true asystole, clinicians must double-check for technical problems like loose leads, power issues, or if it's actually something else, like Ventricular Fibrillation (VF). Asystole is often the very last rhythm before death for all cardiac issues, even those that started as VF or Ventricular Tachycardia (VT).

What is Asystole? It's when the heart has absolutely no electrical activity. This means the heart muscles aren't contracting or moving at all, leading to a complete stop of blood flow throughout the body.

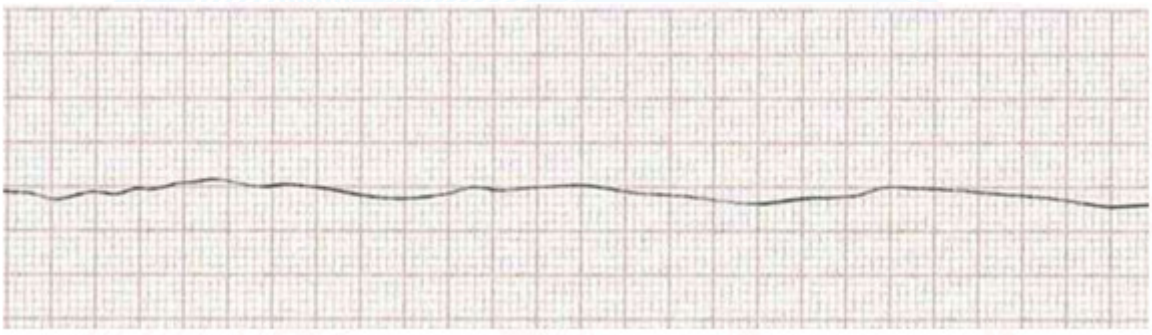


Figure 4.7 Asystole Rhythm.

Pulseless Electrical Activity: This is a condition in which the heart's electrical activity is present on an electrocardiogram (ECG), but there is no detectable pulse or blood flow. This phenomenon occurs when the electrical signals in the heart are not strong enough to produce a contraction of the heart muscle, leading to the absence of a pulse. Could be identified with any electrical activity that was supposed to generate a pulse, but it failed except pulseless ventricular tachycardia (PVT).

Figure 4.9 Pulseless electrical activity.

Management Protocol

Team Preparedness: In addition to LUD, the resuscitation team must be prepared for the following contingencies:

- Immediate performance of a Resuscitative Cesarean Delivery.
- The requirement for baby resuscitation.
- The potential for a difficult airway.
- All intravenous (IV) access lines must be established above the diaphragm.
- Consideration of Extracorporeal Cardiopulmonary Resuscitation (ECPR).

Defibrillation Protocol

- Equipment: Utilize a manual defibrillator or an Automated External Defibrillator (AED).
- Pad Placement: following the manufacturer's guide.
- Spinal Immobilization Precaution: If a spinal cord injury is suspected, the anterolateral placement is preferred to minimize patient movement and prevent exacerbation of the injury.
- Anterolateral Specifics: When employing the anterolateral position, gently elevate and displace any large left breast tissue medially. The apical pad should be positioned inferior and lateral to the breast tissue, ensuring it is not directly on the breast.
- Energy Settings: The energy dose selection remains the same as for the non-pregnant population; follow the manufacturer's recommendations.

Establishing Intravenous Access

In pregnant patients, establishing intravenous access above the diaphragm is strongly recommended. This approach mitigates the risk of aortocaval compression by the gravid uterus, ensuring the rapid and effective delivery of fluids and medications to the central circulation.

If peripheral IV access proves difficult (e.g., due to severe increase in BP, long-standing diabetes, or renal impairment), an intraosseous (IO) line serves as an acceptable alternative. Placement is recommended in the proximal humerus (a site above the diaphragm). The IO route is reliable, rapidly placed, and provides drug delivery comparable to a central line.

Potential drawbacks of IO access include pain upon insertion, occasional difficulty in aspirating bone marrow, and mechanical issues such as bent needles. A rare but serious complication is compartment syndrome (incidence <1%), which can result from fluid extravasation at the insertion site.

Once the patient is stabilized, the IO device should be replaced with a long-term intravenous line.

Anti-Arrhythmic Medications

The dosages and administration routes for anti-arrhythmic medications in pregnant patients experiencing cardiac arrest remain unchanged from standard protocols. Administer anti-arrhythmics, if indicated, at the same as for a non-pregnant individual. It is crucial to utilize an IV or IO line placed above the diaphragm to optimize drug and fluid delivery.

Fetal Monitoring

To maintain team focus on the mother, fetal monitors should not be placed. Any existing monitors must be immediately removed upon recognition of MCA.

This practice ensures the focus remains on the mother and clears the abdomen for the potential need for immediate Resuscitative Cesarean Delivery (RCD). Furthermore, removal of monitors eliminates the slight risk of electrical arcing during defibrillation. If Return of Spontaneous Circulation (ROSC) is achieved prior to RCD, then fetal monitoring may be initiated, taking into consideration the gestational age.

Resuscitative Cesarean Delivery (RCD) in Maternal Cardiac Arrest (MCA)

RCD is indicated for pregnant patients at or beyond 20 weeks gestation (or with a uterine fundus at or above the umbilicus) who experience MCA without achieving ROSC within the first 5 minutes.

Rationale for RCD:

- It alleviates pressure on the inferior vena cava, thereby increasing venous return to the heart.
- Post-delivery uterine contraction functions as an internal autotransfusion mechanism.

Timing and Location of RCD:

- RCD must be performed as soon as possible following MCA. Expedited action is correlated with improved outcomes for both mother and neonate; therefore, do not strictly adhere to the 5-minute time frame.
- The procedure should be executed immediately where the patient is located (in-hospital) or immediately upon arrival in the Emergency Department (ED) (if brought in by Emergency Medical Services).
- Seriously, don't waste time trying to move the patient to Labor and Delivery or an OR. Just get the procedure started.
- For out-of-hospital arrests, be prepared to initiate RCD immediately upon ED arrival.
- Some guidelines advocate for immediate RCD for nonshockable rhythms occurring during labor.

Preparation and Procedure:

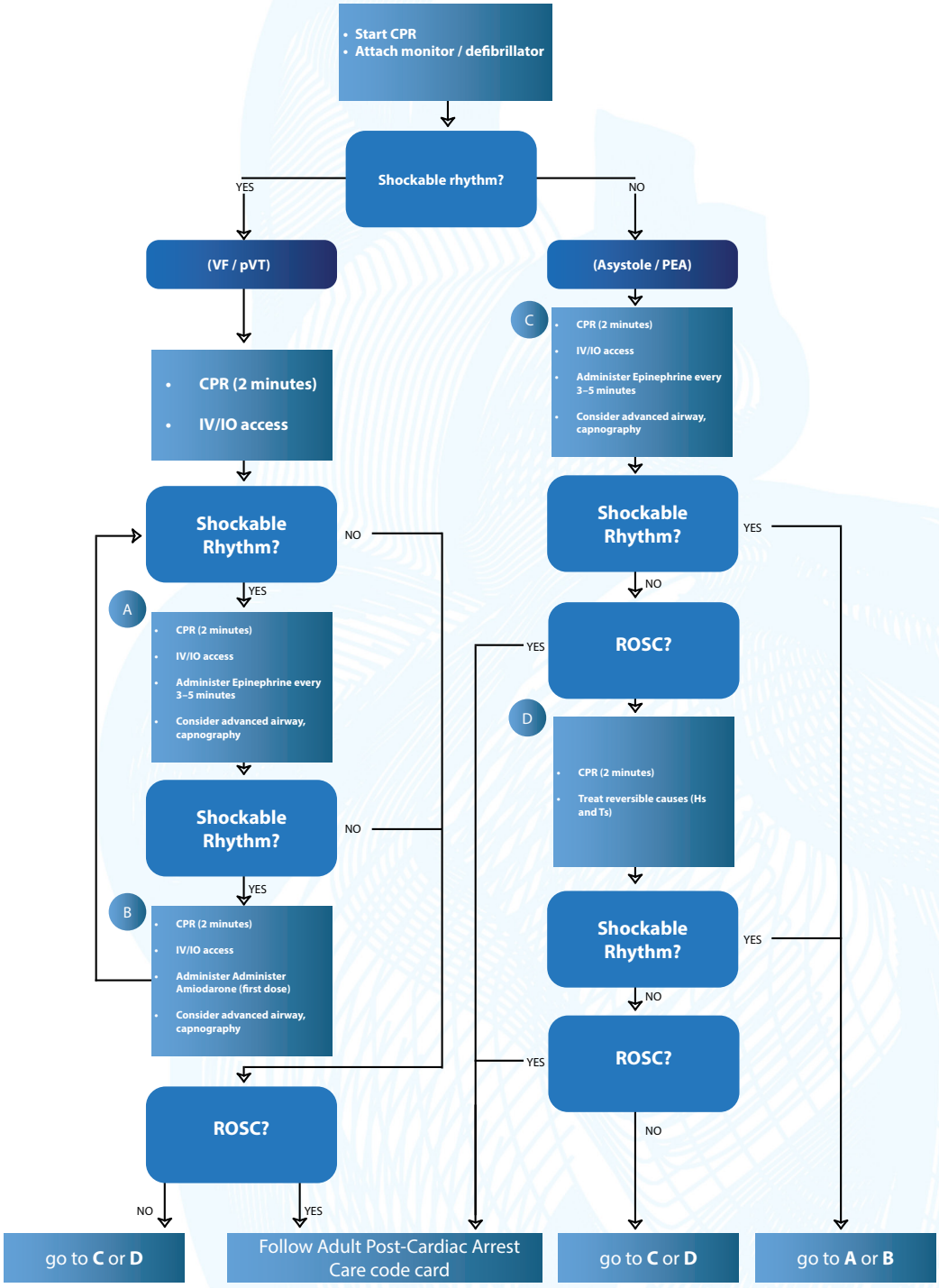
- If a patient needs to be transferred, make sure to call the hospital ahead of time so the RCD teams are ready to go when they arrive.
- Incision: Use a vertical midline skin incision for optimal exposure, bleeding control, and potential abdominal exploration (trauma/unknown arrest etiology). Avoid the horizontal (Pfannenstiel) incision.
- Personnel: If an Obstetrician-Gynecologist is unavailable, a general surgeon, trauma surgeon, or emergency physician should perform the procedure.
- Delivery: Following the vertical skin incision, make a vertical incision on the uterus, deliver the infant, and immediately transfer the neonate to the NICU/pediatric team. Remove the placenta.

Post-Delivery Management

- **Surgical Closure:**
  - The uterus can be temporarily managed by packing with surgical sponges and clamping, OR closed immediately with a continuous, locked suture utilizing a delayed absorbable material (e.g., 0-polyglactin or 0-poliglecaprone).
  - The abdomen may also be temporarily packed and covered with a sterile towel, with final closure deferred until maternal resuscitation is complete.
- **Post-ROSC Stabilization:**
  - Once ROSC is achieved, initiate an oxytocin infusion (an IV bolus must be avoided due to the risk of rearrest) and administer prophylactic antibiotics (e.g., Cefazolin 2g IV, unless contraindicated).
  - Be prepared for significant hemorrhage by ensuring adequate supplies, blood products, and/or activation of the massive transfusion protocol.
  - Consider transferring the patient to an operating room once stable (ROSC achieved) to complete the surgical procedure under better lighting and with enhanced resources.

Point-of-Care Ultrasound (POC-US) during maternal resuscitation.

- Initial Use: POC-US should be used by trained personnel to confirm pregnancy when the patient's status is unclear (e.g., due to obesity).
- Usage Guidelines: POC-US must not interfere with chest compressions, the primary focus remains effective maternal resuscitation, and it should not be used to determine the FHR.
- Actions Based on Findings:
  - If pregnancy is confirmed and the fundus is palpable at or above the umbilicus, immediately perform Left Uterine Displacement (LUD).
  - If its difficult to palpate the fundus, POC-US can be used to estimate gestational age by measuring fetal femur length (FL) or biparietal diameter (BPD).



Defibrillation Energy Doses
Obtain cultures 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 IV/IO bolus every 3 to 5 min

Amiodarone: First dose: 300 mg IV/IO bolus; Second dose: 150 mg aafter 5th shock

Lidocaine: First dose: 1 to 1.5 mg/kg IV/IO; 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 of 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 ETCO2, arterial blood pressure (if available)

What Is ROSC?
Sudden and sustained increase in ETCO2

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

Figure 4.10 Cardiac Arrest Algorithm

ECMO CPR (Extracorporeal Membrane Oxygenation): ECMO CPR serves as a critical rescue therapy for stabilizing critically ill obstetric patients experiencing cardiac arrest due to cardiovascular complications. While there are few absolute contraindications in obstetrics, careful consideration is necessary for patients with significant hemorrhage or disseminated intravascular coagulopathy (DIC), as extracorporeal circulation may worsen thrombosis or coagulopathy by activating clotting factors. It is recommended that obstetric patients at high risk for cardiopulmonary decompensation receive care at facilities with ECMO capability.

Maternal Team	• OB • Labor and delivery nurses • Critical care or emergency physicians and nurses • Respiratory therapy or equivalent • Anesthesia (obstetric anesthesiologist if available), staff • anesthesiologist, anesthesia assistant or Certified Registered • Nurse Anesthetists (CRNAs) • Consider trauma/general surgery, pharmacy representative,and internal medicine or family physician, if no critical care providers available
Neonatal Resuscitation Team	• Neonatal physician or pediatrician or family physician • Neonatal or pediatric nurse • Neonatal respiratory therapist or equivalent
ECPR Team	• Adult ECMO physician • Adult ECMO specialist (nurse or respiratory therapist) • Advanced technology specialist
Stroke Team	• Neurologist • Neuro-intensive care unit RN

Table 4.2 CPR team members

Teamwork and Preparedness

Effective management of high-stakes, low-frequency events like maternal cardiac arrest requires meticulous team preparedness. Obstetricians, anesthesiologists, neonatologists, and labor and delivery nurses must routinely practice response plans and mobilization through both didactic learning and simulated drills. Evidence suggests that simulated training can decrease the time required to initiate cardiopulmonary resuscitation (CPR) and perform a resuscitative hysterotomy.

Crucial elements of successful teamwork include:

- Effective Leadership: The code leader is responsible for directing and maintaining team structure amidst the crisis, overseeing task completion, and guiding diagnosis and treatment upon the arrival of additional support.
- Closed-Loop Communication: Team members must acknowledge and complete assigned tasks and should be encouraged to offer suggestions for improvement.

Post-Resuscitation Care (ROSC)

Once Spontaneous Circulation is Restored (ROSC), standard post-resuscitation protocols must be implemented. This includes:

- Surgical and Hemostasis Management: Patients may require additional surgery to repair or seal the resuscitative hysterotomy. Achieving proper hemostasis is vital.
- Infection and Intensive Care: Appropriate antibiotic therapy and adherence to intensive care unit (ICU) protocols are essential.
- Temperature Management: Controlled hypothermia may be used when suitable, though clinicians must note that inducing hypothermia in the mother could exacerbate coagulopathy.
- Comfort Care: Patients who regain consciousness must receive suitable pain management and sedation.

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 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 Back
- 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 10mm HE

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

Figure 4.11 Maternal Cardiac Arrest Pathway

CHAPTER FIVE

Normal Labor

Learning Objectives

The learner will be able to:

- Define labor as uterine contractions that lead to progressive cervical changes.
- Initiate the assessment of labor by confirming the gestational age.

Labor and Delivery: Background

Labor and delivery is the climax of the prenatal period, a phase marked by the greatest likelihood for both intense happiness and considerable worry.

Prelabor Events

Before the onset of true labor, a predictable sequence of physiological changes marks the body's preparation for childbirth:

- Braxton Hicks Contractions: Beginning 4–8 weeks prior to delivery, the patient may experience mild, irregular, and non-sustained uterine contractions. These are typically associated with only minor discomfort and do not induce measurable cervical change.
- Lightening: Approximately two weeks before the onset of labor, the fetal head commonly descends and engages within the pelvic inlet. This "dropping" of the fetus, termed lightening, can result in a quantifiable decrease in fundal height. Patients may report an alleviation of symptoms related to generalized intra-abdominal pressure but may experience an intensification of symptoms associated with fetal pressure within the pelvis.
- Cervical Changes: Commencing days to weeks before parturition, the cervix initiates a preparatory process of softening, which may incorporate a degree of effacement (thinning) and dilation. Dilation up to 3 cm may occur during this phase, often more pronounced in multiparous women. The Bishop score is a standardized metric frequently employed to evaluate the cervical condition, particularly when assessing suitability for labor induction.

Table 20.1 Bishop scale cervical scoring

Indicator	Score			
	0	1	2	3
Dilation (cm)	0	1-2	3-4	5-6
Effacement (%)	0-30	40-50	60-80	80-100
Fetal station	-3	-2	-1/0	≥ +1
Consistency	Firm	Medium	Soft	
Cervical position	Posterior	Mid	Anterior	

- Bloody Show: As the cervix effaces and dilates, the cervical mucus plug, which has sealed the os throughout pregnancy, is expelled. This expulsion is sometimes accompanied by a small amount of blood, known as "bloody show." The loss of the mucus plug and the presence of bloody show are general indicators that labor is imminent.

The Stages of Labor

Labor is conventionally delineated into three distinct stages. The duration of each stage is highly variable and typically diminishes in subsequent pregnancies.

- First Stage: Commences with the onset of regular uterine contractions and terminates when the cervix achieves complete dilation and effacement.
  - Latent Phase: The initial segment of the first stage, characterized by protracted and often irregular cervical changes. Patients are generally considered to be in this phase until cervical dilation approximates 6 cm.
  - Active Phase: Initiates upon reaching a cervical dilation of approximately 6 cm and persists until full dilation is attained.
- Second Stage: Begins with complete cervical dilation and culminates with the delivery of the neonate.
- Third Stage: Commences immediately following the infant's delivery and concludes upon the expulsion of the placenta.

Assessment

The assessment of a patient presenting with possible labor begins with a targeted history and comprehensive physical examination.

History

A concise yet critical history must be obtained, focusing on the following parameters:

- **Accurate Gestational Dating:** This information is essential for appropriate management; uncertain dating necessitates management as if preterm labor were a potentiality.
- **Prenatal Course Review:** Including any documented complications, pre-existing medical conditions, and known allergies.
- Contraction Characteristics.
- **Key Symptoms:** Specific inquiry regarding vaginal bleeding or documented rupture of membranes.
- **Fetal Activity:** Confirmation of satisfactory fetal movement.

Physical Examination

The physical examination should encompass the following elements:

- **Vital Signs**
- **Abdominal Assessment:** Including the performance of Leopold's maneuvers and a clinical estimation of fetal size.
- **Manual Cervical Examination:** Conducted to determine the "four Ps": Dilation, Effacement, Station, and Presentation.
  - **Dilation:** Quantified in centimeters (ranging from 0 cm, closed, to 10 cm, complete). Complete dilation (10 cm) is roughly equivalent to the span of fully separated index and middle fingers or

the inability to palpate cervical tissue.

- **Effacement:** Represents the progressive thinning of the cervix over the presenting fetal part, described in percentages (0% for no change to 100% for complete thinning/absence of appreciable thickness). Dilation and effacement may occur independently or concurrently.
- **Station:** Describes the position of the fetal head within the birth canal relative to the ischial spines, which serve as the reference point (defined as zero station). Positions superior to the spines are denoted by negative values, and positions inferior are positive values. Measurement may be subdivided into thirds (e.g., +1, +2, +3 at the pelvic outlet) or in centimeters from the spines (a -6 to +6 scale). It is imperative to measure the fetal head itself, not the fetal caput, due to the potential for molding.
- **Presentation:** The presenting fetal body part must be meticulously examined and confirmed. If a cephalic (head-first) presentation cannot be confirmed manually, an ultrasound examination is warranted.

Laboratory Studies

Prior prenatal laboratory results should be systematically reviewed, and any absent critical values should be promptly ordered, specifically noting hemoglobin, platelet count, and infection status (e.g., Group B Streptococcus screening). Additional laboratory assessments may be mandated for patients presenting with specific complications.

Management

First Stage Management

Management during the first stage is generally expectant:

- **Admission:** Patients should be admitted, ideally as late in the first stage as is clinically feasible.
- **Monitoring:** Maternal blood pressure should be assessed every 2–4 hours. The fetal heart rate should be monitored every 30 minutes unless abnormalities necessitate more frequent surveillance.
- **Activity and Intake:** Ambulation may be permitted, but oral intake should be restricted.
- **Pain Management:** Adequate analgesia/anesthesia should be provided upon the patient's request, with recent evidence supporting the utilization of early anesthesia if desired.

Second Stage Management

This stage is characterized by the descent of the fetal head through the birth canal, typically adhering to the sequence: engagement, flexion, descent, internal rotation, extension, external rotation, and expulsion.

- **Delivery:** Delivery often proceeds without direct provider assistance. Gentle counterpressure can be applied to the fetal head at the moment of delivery to regulate the process and minimize the potential for perineal trauma.
- **Shoulder Delivery:** The anterior shoulder is delivered with gentle downward traction, followed by the posterior shoulder using an upward motion.
- **Immediate Post-Head Delivery:** After the delivery of the head, a rapid check for a nuchal cord (umbilical cord encircling the neck) is performed. Bulb suctioning of the infant's nose and mouth

should follow this check, with the mother advised to breathe rather than push during this brief intervention.

- **Post-Body Delivery:** Once the body is fully delivered, the infant should be placed onto the maternal abdomen, dried, and stimulated. Umbilical cord clamping should be delayed by 30–60 seconds unless the neonate or the mother requires immediate medical intervention.

Third Stage Management (Placenta Delivery)

The expulsion of the placenta typically requires minimal provider assistance under normal circumstances.

- **Assistance:** Gentle traction on the umbilical cord may facilitate release, but excessive traction carries the risk of uterine inversion, cord rupture, or increased postpartum hemorrhage.
- **Signs of Separation:** The provider must remain vigilant for the classic signs indicative of placental separation: fundal elevation, visible cord prolongation, and a sudden gush of blood.

CHAPTER SIX

Intrapartum Fetal Surveillance and Using Partograph

Learning Objectives

The learner will be able to:

1. Explain the methods used for fetal surveillance.
2. Analyze and understand electronic fetal heart rate monitoring results.
3. Examine and discuss the potential complications associated with abnormal fetal heart rate patterns.

Introduction

Intrapartum fetal surveillance involves either intermittent auscultation or Electronic Fetal Monitoring (EFM). Intermittent auscultation is the preferred method for low-risk pregnancies, assuming adequate staffing and expertise are available.

EFM is linked to a high incidence of cesarean sections and has poor predictive accuracy. To potentially enhance communication and improve patient outcomes, adopting standardized definitions, mnemonics, category classifications, and corresponding actions is advisable.

Table 6.1 The DR C BRADO Framework for Structured Intermittent Auscultation

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

Electronic Fetal Monitoring (EFM), also referred to as cardiotocography (CTG), must be assessed in conjunction with overall feto-maternal well-being, associated risk factors, and the progression of labor. Using tools like DR C BRAVADO can assist in identifying risks and interpreting CTG results. Furthermore, ensuring staff certification in CTG training is crucial for improving communication and facilitating timely intervention.

Table 6.2 Utilizing the DR C BRAVADO Mnemonic for Interpreting Electronic Fetal Monitoring (EFM) Tracings

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

Definitions

Electronic Fetal Monitoring (EFM) / Cardiotocography (CTG): The recording of a fetus's heart activity alongside a mother's uterine contractions.

Fetal Heart Rate (FHR) Baseline Definitions

- **Baseline Rate:** This is the average FHR, rounded to the nearest 5 beats per minute (BPM), determined over a 10-minute span. To calculate this, periods of acceleration, deceleration, and significant FHR variability (greater than 25 BPM) are excluded. A minimum of two minutes of measurable baseline (which do not need to be continuous) must be present in the 10-minute window. If this criterion is not met, the baseline is considered indeterminate, and the rate from the preceding 10-minute period may be used.
- **Bradycardia:** A baseline rate sustained below 110 BPM for a duration of 10 minutes or longer.
- **Tachycardia:** A baseline rate sustained above 160 BPM for a duration of 10 minutes or longer.

Baseline Fetal Heart Rate (FHR) Variability

Baseline Variability refers to the irregular fluctuations in the FHR's baseline, measured within a 10-minute period (excluding accelerations and decelerations). It is visually quantified as the amplitude of the peak-to-trough, expressed in beats per minute (BPM).

Table 6.3 Baseline Fetal Heart Rate (FHR) Variability

Category	Amplitude Range
Absent	Undetectable
Minimal	Detectable but equal or less than 5 BPM
Moderate	6 to 25 BPM
Marked	> 25 BPM

Fetal Heart Rate (FHR) Acceleration

Definition: An abrupt, visually apparent increase in Fetal Heart Rate (FHR), with the time from onset to peak being less than 30 seconds.

Table 6.4 Criteria for Standard Acceleration

Gestational Age	Peak (above baseline)	Duration (from onset to return)
32 weeks	15 beats per minute (BPM)	15 seconds
< 32 weeks	10 BPM	10 seconds

Prolonged Acceleration:

An acceleration that lasts 2 minutes but < 10 minutes.

Baseline Change: An acceleration lasting 10 minutes is classified as a change in the FHR baseline.

Deceleration

- **Early Deceleration:**
  - A gradual and typically symmetrical decrease and return of the Fetal Heart Rate (FHR) that is visually apparent and associated with a uterine contraction (onset to nadir is 30 seconds).
  - The lowest point (nadir) of the deceleration generally aligns with the peak of the uterine contraction.
  - The beginning, lowest point, and recovery of the FHR change are usually synchronous with the start, peak, and end of the contraction, respectively.
- **Late Deceleration:**
  - A gradual and typically symmetrical decrease and return of the FHR that is visually apparent and associated with a uterine contraction (onset to FHR 30 seconds).
  - The nadir of the deceleration occurs after the peak of the uterine contraction.

Fetal Heart Rate (FHR) Decelerations and Uterine Activity

FHR Decelerations

The five types of fetal heart rate (FHR) decelerations:

1. Late Deceleration: A decrease in FHR that is delayed, with the nadir occurring after the peak of the uterine contraction.
2. Variable Deceleration: An abrupt (onset to nadir < 30 seconds) decrease in FHR of at least 15 BPM, lasting at least 15 seconds, but less than 2 minutes. These can be associated with or occur without contractions and can vary with successive contractions.
3. Prolonged Deceleration: A decrease in FHR of at least 15 BPM, lasting between 2 minutes and 10

minutes. A deceleration lasting 10 minutes or more is considered a baseline change.

4. Recurrent Decelerations: Occur with 50% or more of uterine contractions within a 20-minute period.
5. Intermittent Decelerations: Occur with less than 50% of uterine contractions within a 20-minute period.

FHR Patterns

- **Sinusoidal Pattern:** A smooth, sine wave-like undulating FHR baseline with a frequency of 3–5 cycles per minute, lasting for 20 minutes or more.
- **Pseudo-sinusoidal Pattern:** A pattern that resembles sinusoidal but is more jagged ("saw-tooth"), rarely lasts over 30 minutes, and is preceded and followed by normal patterns.

Uterine Activity:

- **Normal Uterine Activity:** Up to 5 contractions per 10 minutes, averaged over a 30-minute period.
- **Tachysystole:** More than 5 contractions per 10 minutes, averaged over a 30-minute period.

Fetal Monitoring: Shared Decision-Making and Continuous Care

The key principles for Informed Decision-Making and Ongoing Risk Assessment related to fetal monitoring during labour.

Informed Decision-Making requires discussing fetal monitoring options during antenatal care and documenting the woman's choice. Throughout labour, providers must communicate clearly about the recommended method and its rationale, respect the woman's final decision (involving her birthing companion if she wishes), and fully document all discussions and decisions. If expert consultation is sought, the woman must be kept informed.

Ongoing Risk Assessment emphasizes that fetal monitoring risk assessment is continuous, and the advised monitoring method may need to change as labour progresses.

Intermittent Auscultation for Fetal Heart Rate Monitoring in Low-Risk Labour

For women with a low risk of complications, fetal heart rate (FHR) monitoring using intermittent auscultation is recommended during established first-stage labour.

The procedure for Intermittent Fetal Heart Rate (FHR) Auscultation during labour.

Key components of the procedure include:

- **Equipment:** Pinard stethoscope or Doppler ultrasound.
- **Technique:**
  - Maternal Pulse Differentiation: Palpate the maternal pulse (MHR) simultaneously to ensure the FHR is correctly distinguished. MHR is recorded hourly in the first stage.
  - Duration: Listen for a minimum of 1 minute during each auscultation.
- **Timing:**

- First Stage of Labour: Auscultate immediately after a contraction, repeating at least every 15 minutes.
- Second Stage of Labour: Auscultate immediately after a contraction, repeating at least every 5 minutes.

- **Documentation:** Record the FHR as a single rate on the partogram and in the notes, noting any accelerations or decelerations.

The recommendations for Structured Intermittent Auscultation (SIA) in low-risk women during labor.

The provided guidelines detail the procedure and frequency for Fetal Heart Rate (FHR) auscultation during labor. FHR must be checked every 30 minutes in the active first stage and every 15 minutes in the active second stage.

The auscultation procedure involves determining fetal presentation, positioning the Doppler over the point of maximum sound intensity (typically the fetal back), differentiating FHR from Maternal Heart Rate (MHR), and concurrently palpating contractions.

The baseline FHR is determined by counting for 15-60 seconds between contractions when the fetus is quiet. Fetal response to contractions is assessed by counting the FHR for 30-60 seconds immediately following a contraction.

Managing Concerns/Abnormal Fetal Findings:

- **Absent Fetal Heartbeat:** If a fetal heartbeat cannot be detected, immediately offer a real-time ultrasound to assess the fetus's viability.
- **Changes in Fetal Heart Rate (First Stage of Labor):** If intermittent auscultation reveals a deceleration or the plotted FHR increases by 20 beats per minute or more compared to the start of labor, the following steps should be taken:
  - Increase the frequency of intermittent auscultation (e.g., after every three consecutive contractions).
  - Conduct a comprehensive clinical review. This review must take into account the complete clinical picture: existing and new intrapartum risk factors, maternal observations, contraction frequency (including any hypertonus), antenatal history, and the overall progress of labor.

Table 6.5 Summary of Advantages and Disadvantages of Systematic Intermittent Auscultation

	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), in- creased amniotic fluid, and with uterine contractions • Requires 1:1 nurse-to-patient ratio
If fetal heart rate concerns are confirmed: If fetal heart rate concerns are confirmed.	Requesting immediate assistance. **Recommending continuous Cardiotocography (CTG) monitoring**, accompanied by a comprehensive explanation to the woman and her support person(s) regarding the recommendation and its potential impact on available care options. **Facilitating the transfer of care from a midwifery-led model to an obstetric-led model**, provided this is deemed safe and appropriate. **Reverting to intermittent auscultation** if continuous CTG monitoring was initiated following concerns raised by intermittent auscultation, but the subsequent CTG trace is determined to be normal after a period of 20 minutes, unless the woman expresses a preference to continue with continuous monitoring.

Table 6.6 Implementation Strategies for Successful 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) / Cardiotocography (CTG) - Criteria for Use

Continuous Cardiotocography (CTG) is vital for fetal assessment, recommended when any risk factor for fetal compromise is present, pre- or intra-labour.

I. Indications for Continuous CTG: In Labour (Antenatal Risk Factors)

CTG is indicated for women in labour with established antenatal risk factors, including:

- **Prior Uterine Surgery:** Previous Caesarean section or full-thickness uterine scar.
- **Maternal Health:** Hypertensive disorders requiring medication, pre-existing or gestational diabetes requiring medication, suspected maternal sepsis, chorioamnionitis, or advanced gestational age (≥42+0 weeks at established labour onset).
- **Fetal Status/Presentation:** Non-cephalic presentation, Fetal Growth Restriction (EFW <3rd centile), Small for Gestational Age (EFW <10th centile) with other high-risk features (e.g., abnormal Doppler, reduced liquor), polyhydramnios, anhydramnios, or reduced fetal movements in the 24 hours before contractions.
- **Obstetric Concerns:** Prolonged ruptured membranes (unless already in established labour 24 hours post-rupture without other concerns), or vaginal bleeding other than a 'show.'
- **Clinical Judgment:** Consider CTG for other complex antenatal/obstetric factors (e.g., multiple pregnancies) following clinical and multidisciplinary review.

II. Indications for Continuous CTG: Intrapartum Risk Factors

CTG should be offered to women who develop new risk factors during labour, including:

- **Uterine/Fetal Environment:** Uterine hyperactivity (contractions >2 min or 5 in 10 min), meconium presence (mandates full risk assessment and discussion), suspected sepsis, or chorioamnionitis.
- **Maternal Vitals/Symptoms:** Maternal Pyrexia (single 38°C or two 37.5°C one hour apart), new vaginal bleeding, blood-stained liquor (not from examination), Maternal Tachycardia (>120 bpm recorded twice 30 min apart), or atypical pain.
- **Hypertensive/Pre-eclampsia:** Severe Hypertension (SBP 160 or DBP 110 mmHg single reading), Non-Severe Hypertension (SBP 140 or DBP 90 mmHg twice 30 min apart), or Pre-eclampsia Indicators (2+ protein + elevated BP).
- **Labour/Intervention:** Confirmed delay in the first or second stage of labour, or intervention

requiring regional analgesia (e.g., epidural) or oxytocin use.

- **Clinical Judgment:** Consider CTG for other intrapartum factors, not explicitly listed, that may increase the risk of fetal compromise, following assessment and multidisciplinary review.

Electronic Fetal Monitoring (EFM) – Features and Interpretation

Review and Assessment

Hourly, review previous EFM/CTG results and antenatal/intrapartum risk factors for changes in baseline FHR, variability, or decelerations. If the fetal heart rate pattern changes, review risk factors for hypoxia.

When reviewing a CTG, assess and document: Contractions, Baseline FHR, Variability, Decelerations (type/characteristics), and Accelerations.

Interpretation and Clinical Context

Interpret the baby's ability to cope with labor by considering maternal, fetal, and labor factors alongside CTG changes. Care advice is based on an assessment of multiple factors, including the woman's preferences, her condition, the baby's condition, and CTG findings. EFM is a guidance tool, not a standalone diagnostic; findings must be considered within the developing clinical picture. Initial assessment must be followed by ongoing assessment of risks, feto-maternal well-being, and EFM changes.

Ongoing Risk Assessment

Perform a full assessment of the woman and baby every hour, including a review of maternal, fetal, and new intrapartum risk factors for fetal compromise.

Hourly Clinical Assessment and Review:

Systematically assess and document the condition of the woman and baby hourly, or more often if concerns arise. Ensure all hourly CTG assessments are reviewed in-person by a second clinician ("fresh eyes") before the next assessment is due.

Staffing and Communication:

Maintain continuous one-to-one support with a midwife present throughout labor. Inform the woman if the midwife leaves or staff changes.

CTG Trace Classification:

Classify the overall CTG by systematically categorizing features (Contractions, Baseline FHR, Variability, Decelerations, Accelerations).

- **Category I CTG:** Baby is coping well.
- **Non-Category I or Changing CTG:** Less certainty about the baby's condition. Maintain continuous CTG and comprehensive assessment, checking for new risk factors (meconium, sepsis, slow progress).
- **Responding to Changes:** Consider any CTG change alongside risk factors for hypoxia. Discuss the change and implications with the woman, incorporating her preferences into the plan.

Defining CTG Features:

- **Contractions:** Record frequency and length with a tocodynamometer.
- **Decelerations:** Transient FHR drops >15 bpm below baseline, lasting 15 seconds (may be 'shallow' with reduced variability).

Assessing Deceleration Significance:

Evaluate decelerations based on: timing (early, variable, late) relative to contractions, duration, return to baseline, total time present, repetitiveness (>50% of contractions), presence/absence of "shouldering," and variability within the deceleration.

Concerning Characteristics of Variable Decelerations:

Duration >60 seconds, reduced variability within the deceleration, slow/absent return to baseline FHR, or loss of 'shouldering.'

CTG Interpretation and Categorization:

Explicitly describe decelerations as 'early,' 'variable,' or 'late.' Categorization is vital for rapid communication but must be used with antenatal/intrapartum risk factors to evaluate changes over time.

Special Considerations for CTG Traces in the Second Stage of Labour:

Interpretation is more complex; maintain a low threshold for seeking assistance. Differentiate FHR from maternal heart rate every 5 minutes. If differentiation is difficult, consider a fetal scalp electrode or expedite birth.

- In the second stage, FHR accelerations likely represent maternal pulse.
- If FHR decelerations occur, actively seek other hypoxia signs (rising baseline FHR, reduced variability).
- Hypoxia onset is more common and rapid in the active second stage. A baseline FHR increase of 20 bpm (from the start of labor or last hour) is a red flag.

Management of CTG Concerns in the Active Second Stage of Labour:

Immediately obtain obstetric review. Unless birth is imminent, consider discouraging pushing and stopping oxytocin to facilitate fetal recovery. Document a clear plan with specific time limits.

Differentiating Maternal and Fetal Heartbeats:

Differentiate between maternal and fetal heartbeats hourly, or more often if concerned. If uncertain, discuss and support the woman's choice of methods: Pinard, bedside ultrasound, continuous maternal heart rate monitoring (pulse oximeter/CTG), fetal scalp electrode (must be used with maternal monitoring), or simultaneous pulse palpation.

Confirming FHR is critical in the second stage. If differentiation remains difficult or no fetal heart is heard, obtain an urgent review by an obstetrician or senior midwife, and ensure the CTG trace is of high quality (reposition transducer/tocodynamometer, use FSE).

Systematic CTG Review and Management

A systematic approach to Cardiotocography (CTG) interpretation is essential:

1. Evaluate & Document: Continuously assess and document changes in the trace over time.
2. Integrate Risk Factors: Interpret changes within the context of intrapartum risk factors.
3. Determine Cause & Plan: Identify potential reasons for changes and integrate them into the ongoing care plan.

Fetal Monitoring Management Decisions

Care decisions must be comprehensive:

1. Comprehensive Assessment (Hourly): Thoroughly assess fetal well-being every hour by integrating CTG interpretation with antenatal/intrapartum risk factors, maternal observations, contraction frequency, and labor progress. The final labor management decision must reflect the complete clinical picture.
2. Communication & Support: Discuss the situation and plan with the woman and her companion(s), supporting her preferences and decisions.

Table 6.7 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 under- lying 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 attention 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 encepha- lopathy, cerebral palsy, and neonatal acidosis. managements may include, when appropriate:**	- Providing oxygen, - Providing an Intravenous fluid, - Change the woman p osition, - Halting uterine stimulants, - Management of persistent non-reassuring fetal heart rate tracings (Category III) requires a systematic approach, including: Intrauterine Resuscitation: Initial efforts involve corrective maneuvers, such as managing a decrease in blood pressure. Preparation for Delivery: Concurrently, preparation for delivery is crucial, including establishing a delivery timeline and readying the necessary resources for an operative delivery. Decision to Delivery: If the tracing does not improve with appropriate corrective measures, prompt delivery of the fetus is indicated. The interval from decision-to-incision should be individualized to best integrate maternal and fetal risks and benefits. While the 30-minute standard is often cited, evidence does not conclusively show that it reduces adverse neonatal outcomes. Furthermore, immediate delivery of a fetus with an unverified duration of a Category III tracing may not improve outcomes if prior hypoxic injury has already occurred.

The recommended action is to continue CTG monitoring and usual care, with an exception allowing discontinuation if the CTG was started only due to intermittent auscultation concerns and there are no other antenatal or intrapartum risk factors. Documentation requires a full risk assessment to be performed and recorded at least hourly.

Category II CTG Trace:

- **No Other Concerning Risk Factors:** Requires a full risk assessment, consideration of underlying reasons, and conservative measures. The presence of accelerations suggests fetal acidosis is unlikely.
- **Additional Intrapartum Risk Factors:** Requires the same initial steps plus an urgent review by a senior clinician, and consideration of fetal scalp stimulation or expediting birth.

Category III CTG Trace:

- Requires an urgent review, immediate exclusion of acute events (e.g., cord prolapse), a full risk assessment, and implementation of conservative measures.

Persistent Pathological CTG after Conservative Measures:

- Requires a further urgent review, evaluation of the whole clinical picture, and maintaining a low threshold for intervention, with consideration for expediting birth if risk factors for fetal compromise are evolving.

All actions require full documentation of findings.

Table 6.8 Acute Events Requiring Immediate Intervention

Event	Action
Acute Bradycardia OR **Single prolonged deceleration for 3 minutes or more**	Urgently seek obstetric review.
Acute Event (e.g., cord prolapse, suspected placental abruption, suspected uterine rupture)	Expedite the birth.

Conservative Management:

1. Maternal Positioning: Encourage non-supine positions to optimize blood flow/alleviate cord compression.
2. Addressing Hypotension: give IV fluids, position left lateral, and request an anesthetic consultation.
3. Managing Excessive Contractions: Reduce/stop oxytocin, or consider a tocolytic (e.g., subcutaneous terbutaline 0.25 mg).
4. Oxygen Therapy: Not routine for FHR; use only for maternal conditions (e.g., hypoxia) or preoxygenation for anesthesia.

Fetal Assessment:

- **Fetal Scalp Stimulation (FSS):** Consider for suspicious Cardiotocography (CTG) with risk factors. A positive response (acceleration/sustained CTG improvement) permits continued monitoring. Absence of acceleration is serious, suggesting the need for expedited delivery.
- **Fetal Blood Sampling (FBS):** Conduct in the left lateral position. Document results.
  - Indications: Persistent pathological CTG despite conservative measures (if no acute compromise and delivery cannot be quickly expedited) or prioritizing multiple cases.
  - Contraindication: Clear acute compromise (e.g., deceleration >3 minutes).
  - Interpret pH results with prior pH, labour progression, and maternal/fetal status.
  - Note: High-quality RCTs on CTG with/without FBS effect on outcomes/interventions are lacking.

Table 6.9 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

Fetal Blood Sampling (FBS) Protocol

A third FBS may be deferred if initial and second CTG/FBS results are stable, unless CTG worsens. Account for FBS time when scheduling repeats. A consultant must approve a third FBS. If FBS is technically unsuccessful, but scalp stimulation causes acceleration on the CTG, significant fetal acidosis is unlikely.

FBS is prohibited with maternal infections (e.g., HIV, hepatitis, herpes), fetal bleeding disorders (e.g., haemophilia), or prematurity (<34 weeks).

Records must detail FHR parameters/classification, uterine activity (including resting tone), interventions/responses, and other maternal observations.

CEFM Record Keeping:

- **Technical Setup/Labeling:** Verify accurate date/time, ensure 1 cm/min recording speed, and sufficient paper. Label each trace with patient's full name, DOB, ID number, maternal pulse (at start), and CTG date.
- **Intrapartum Events:** Standardized recording of events (e.g., VEs, epidural) in notes or directly on the CTG trace is required.
- **Storage/Retrieval:** Store CTG traces for a minimum of 25 years (electronic preferred). Photocopy non-electronic traces and store indefinitely if fetal brain injury is suspected. Robust tracing systems are mandatory, especially if stored separately, to ensure all records can be accurately located, even if temporarily removed.

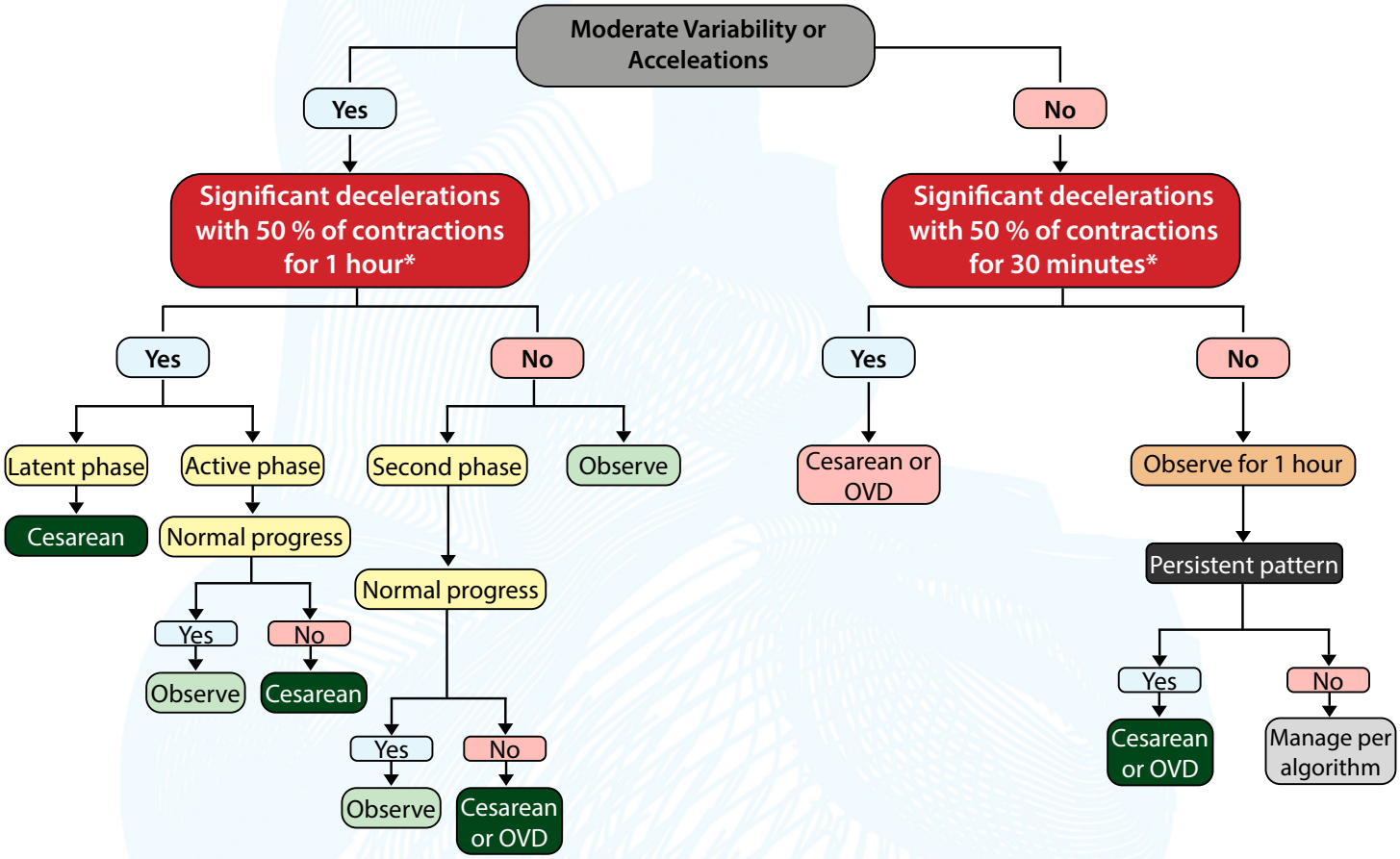
Table 6.10 Category of the Fetal Heart Rate Tracings

Category	Features
Category I Fetal Heart Rate Tracings	Category I tracings, highly indicative of normal fetal acid-base status, must include: • Baseline rate of 110–160 bpm. • Moderate baseline variability. • Absence of variable or late decelerations. • Early decelerations may be absent or present. • Accelerations (provoked or spontaneous) may be present or absent.
Category II Fetal Heart Rate Tracings	Category II Fetal Heart Rate (FHR) tracings are those that do not meet the criteria for Category I or Category III and are frequently seen in clinical practice. They are characterized by a range of features in three main areas: 1. Baseline Rate and Variability: Includes increased or decreased heart rate without absent variability, minimal or marked baseline variability, or lack of variability not associated with recurrent decelerations. 2. Accelerations: Involves the lack of induced accelerations following fetal stimulation. 3. Periodic or Episodic Decelerations: Encompasses frequent decelerations (with low/average variability, or late with average variability), prolonged decelerations (2 to 10 minutes), or variable decelerations with specific features like 'overshoots' or 'shoulders.'
Category III Fetal Heart Rate Tracings	Category III Fetal Heart Rate (FHR) tracings are strongly indicative of abnormal fetal acid-base status and require immediate evaluation and rapid intervention. They are defined by either a sinusoidal pattern or the absence of baseline FHR variability accompanied by recurrent late decelerations, recurrent variable decelerations, or bradycardia.

Table 6.11 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 underly- ing 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 compro- mise. 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 trac- ings 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.

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.**

Using Partograph

The Partograph is a standardized graphical tool for monitoring labor progression, centralizing key information to aid in the early identification of failure to progress. It records cervical dilatation, FHR, uterine contractions, maternal vital signs, medications, amniotic fluid status, and moulding.

The Partograph should be started only once the woman is in the active phase of labor (typically 3 cm to 10 cm dilatation, with strong, frequent contractions), excluding the latent phase. Critical decision-making is guided by the Alert Line (indicating unsatisfactory progress) and the Action Line (signaling the need for immediate intervention, drawn 4 hours after the Alert Line).

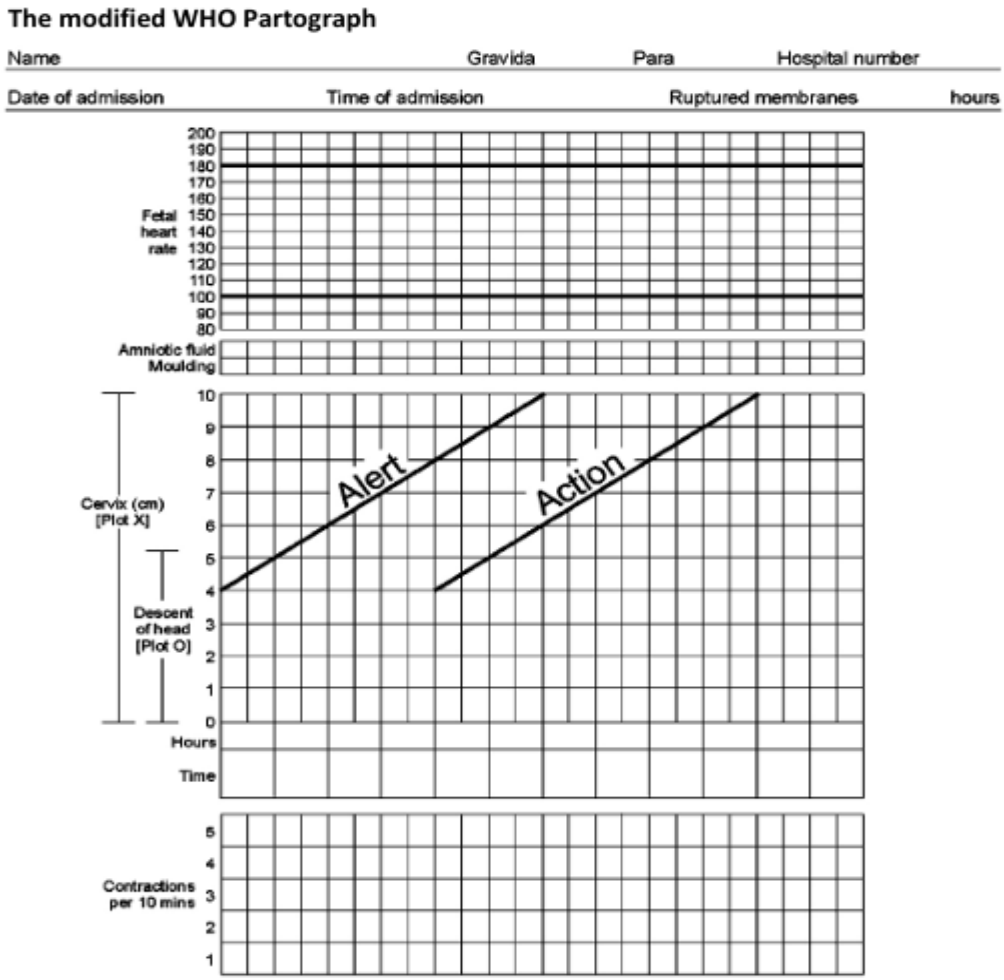


Figure 6.2 The Modified WHO Partograph

1. Alert Line: Starts at 4 cm cervical dilatation, projects to full dilatation at 1 cm/hour.
2. Action Line: Drawn parallel to, and 4 hours to the right of, the Alert Line.
3. Descent (Fetal Head Assessment):
    - Assessed by abdominal palpation and recorded as O at each vaginal exam.
    - Measures the portion of the head (in fifths) palpable above the symphysis pubis.
    - 0/5 means the sinciput (S) is level with the symphysis pubis.

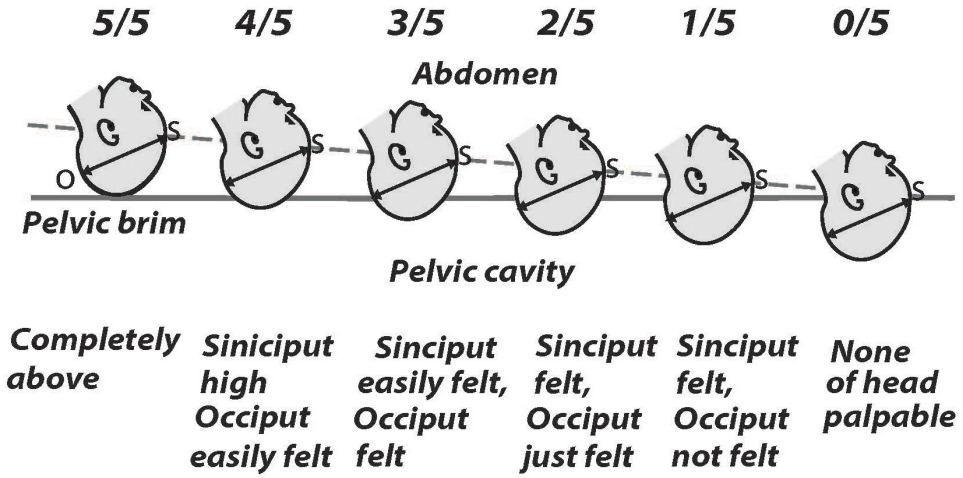


Figure 6.3 The position of the fetal head, measured in fifths, relative to the symphysis pubis.

Table 6.12 Additional Information for the Partograph:

Parameter	Recording Frequency	Marking	Details
Hours	Not Applicable	Not Applicable	The duration represents the time elapsed since the commencement of the active stage of labor (either directly observed or estimated).
Time	As required	Not Applicable	Document the precise time of the observation or intervention.
Contractions	Every 30 minutes	Not Applicable	Chart and quantify the number of contractions occurring within a 10-minute interval, simultaneously noting and categorizing their duration in seconds.
			- Less than 20 seconds
			- Between 20 and 40 seconds
			- Greater than 40 seconds
Oxytocin	Every 30 minutes (if administered)	Not Applicable	Record the quantity of oxytocin and the intravenous fluid volume in drops per minute.

Drugs Given	As required	Not Applicable	Document all other pharmaceutical agents administered.
Pulse	Every 30 minutes	Dot (.)	Indicate with a dot (.).
Blood Pressure	Every 4 hours	Arrows	Indicate with arrows.
Temperature	Every 2 hours	Not Applicable	Not Applicable
Urine (Protein, Acetone, Volume)	Upon each instance of micturition	Not Applicable	Record Protein, Acetone, and Volume measurements.

Latent Phase: Re-evaluate women remaining in the latent phase for over 8 hours. Confirm true labor and support, possibly keeping them in the ANC area until confirmed.

Active Phase: Spans 4 cm to 10 cm cervical dilatation, with a minimum expected rate of 1 cm per hour.

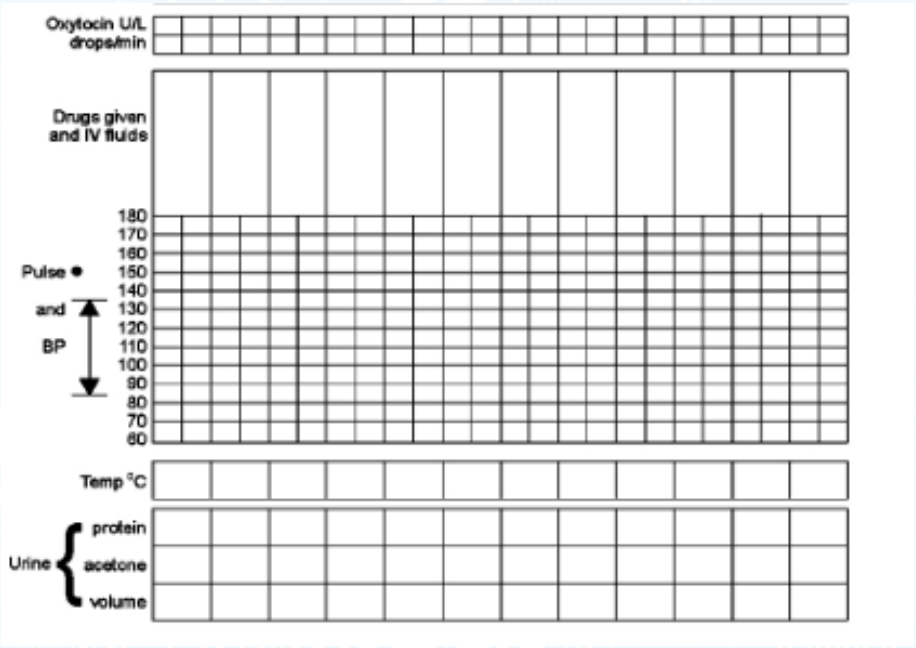


Figure 6.4 Partograph

Labor progress is defined as normal when the graph used to plot cervical dilatation remains to the left of the alert line.

Failure to progress in labor is a critical issue that demands prompt identification of its underlying cause to ensure appropriate management. The possible causes are typically categorized into problems with one of three factors:

1. **Powers:** Inadequate uterine contractions, leading to what is known as dysfunctional labor.
2. **Passage:** The pelvis is too small for the baby (cephalopelvic disproportion) or the labor is obstructed.
3. **Passenger:** Obstructed labor is a severe complication of childbirth primarily caused by a size

mismatch between the baby and the mother's pelvis, known as cephalopelvic disproportion (CPD), or by an abnormal fetal presentation or position (malposition). Specific malpositions that can cause obstruction include occipitoposterior, brow or face presentation, and shoulder presentation (transverse lie). Both CPD and malposition prevent normal labor progression, leading to prolonged, ineffective contractions, and increasing risks of fetal distress and maternal injury, often requiring assisted delivery or a Cesarean section. Therefore, the main mechanical causes are disproportionate fetal size and non-optimal fetal alignment.

Accurately determining which of these three contributing factors is responsible for the failure to progress is essential for selecting the correct course of action.

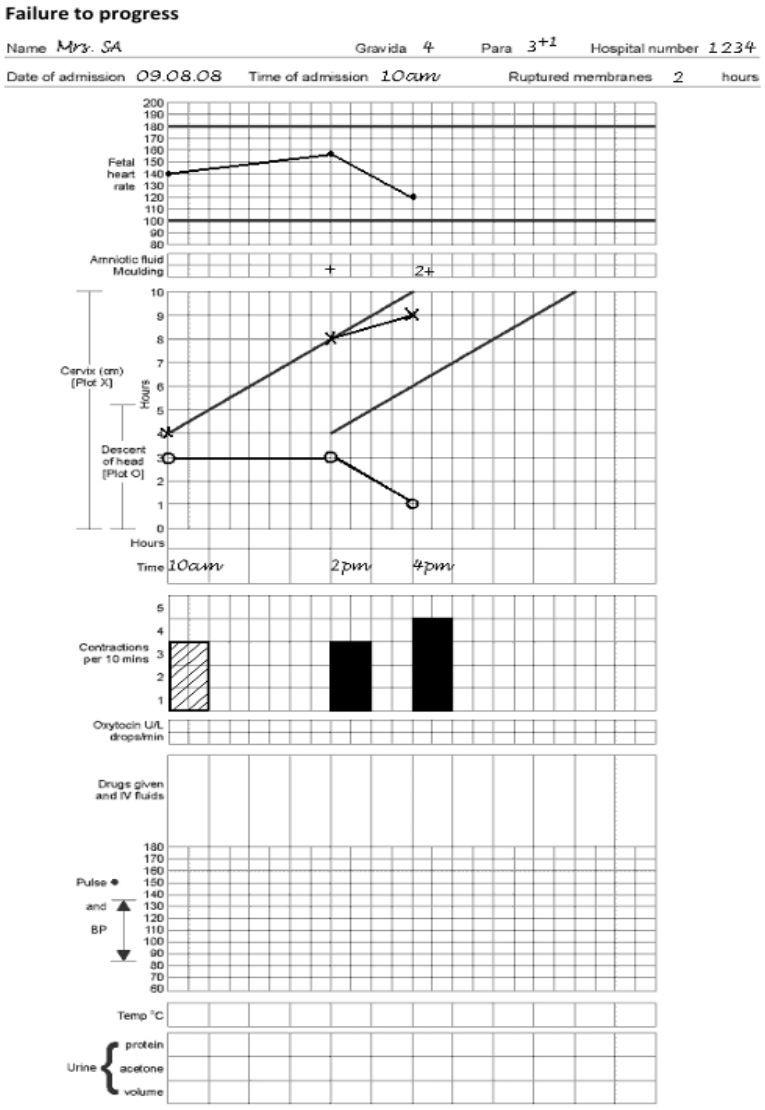
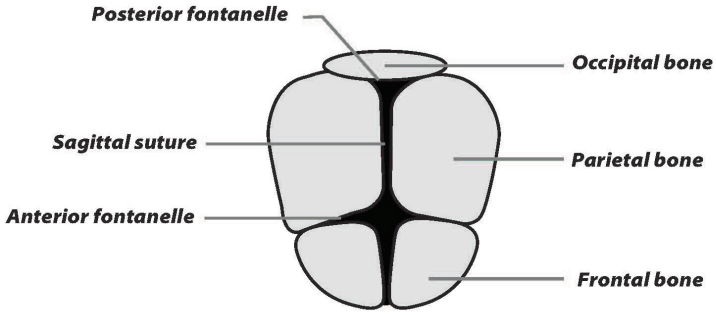
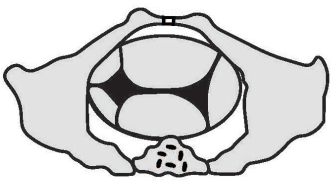
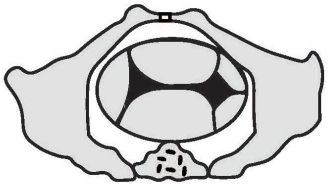


Illustration of position of fetal head





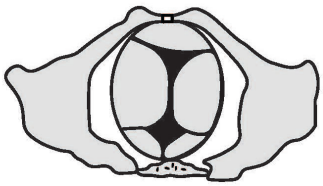
Left occiput transverse



Right occiput transverse

Left anterior occiput

Right occiput anterior



Occiput Anterior

CHAPTER SEVEN

Pre-labour Preterm Rupture of Membrane

Learning Objectives

The learner will be able to:

1. Define prelabour rupture of membranes (PROM) and discuss its potential causes.
2. Explain the diagnostic process for PROM.
3. Outline the management strategies for PROM based on gestational age, including post-delivery care and considerations for subsequent pregnancies.

Introduction

Pre-labour preterm rupture of membranes (PPROM) is defined as the rupture of membranes occurring between 24+0 and 36+6 weeks of gestation. PPROM is a complication in up to 3% of pregnancies and is associated with 30-40% of preterm births.

Risk Factors

Key risk factors for PPROM include:

- History of PPROM in a previous pregnancy.
- Ascending genital infections, which are often subclinical until fluid loss occurs.
- Recurrent antepartum haemorrhage.
- Cervical incompetence.
- Maternal smoking.

Complications

PPROM carries significant risks for the neonate and the mother:

1. **Neonatal Morbidity and Mortality:** Primarily due to:

- Prematurity
- Sepsis
- Cord prolapse
- Pulmonary hypoplasia
- Fetal death

2. **Associated Maternal Risks:**

- Chorioamnionitis
- Placental abruption

Diagnosis

The diagnosis of PPROM relies on maternal history followed by a sterile speculum examination.

- **Gold Standard:** The pooling of amniotic fluid observed during a speculum examination.
- **Atypical Presentation:** If no pooling is observed, clinicians should consider testing vaginal fluid for insulin-like growth factor-binding protein 1 (IGFBP 1) or placental alpha microglobulin 1 (PAMG 1) to guide further management.
- **Ultrasound:** The role of ultrasound assessment of amniotic fluid volume is currently unclear.

Assessment for Chorioamnionitis

A combination of clinical assessment and maternal blood tests, not used in isolation, should be employed to diagnose chorioamnionitis in women with PPROM.

Diagnosis of Clinical Infection:

1. Clinical Parameters: Monitoring maternal pulse, blood pressure, temperature, and symptoms.
    - Symptoms: 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 Monitoring: Fetal heart rate assessment using cardiotocography.
4. Caution: Digital pelvic examination should be avoided.

Management

1. Antibiotics

- Erythromycin should be administered for 10 days or until the woman is in established labour (whichever comes first).
- Penicillin may be used as an alternative for women who cannot tolerate erythromycin.

2. Antenatal Corticosteroids

- In women with PPROM from 24+0 weeks:
- Offer: Between 24+0 and 33+6 weeks of gestation.
- Consider: Between 34+0 and 35+6 weeks.

3. Magnesium Sulfate (Neuroprotection)

- Intravenous magnesium sulfate should be:
- Offered: Between 24+0 and 29+6 weeks if the woman is in established labour or having a planned preterm birth within 24 hours.

- Considered: When preterm birth is anticipated between 30+0 and 33+6 weeks. The neuroprotective benefit is greatest before 30 weeks of gestation.

4. Tocolysis

- Tocolysis is not recommended for patients with PPROM.

5. Neonatologist Consultation

- The neonatologist should be informed once PPROM is confirmed and delivery is anticipated to ensure the neonatal unit is adequately staffed and equipped.
- Women with PPROM and their partners should be offered an opportunity to meet with a neonatologist antenatally to discuss the baby's care.

6. Monitoring and Setting of Care

- In-patient care is necessary if delivery appears imminent, allowing for the administration of steroids and intravenous magnesium sulfate.
- The decision for safe out-patient management, following an initial period of in-patient care, should be individualised based on multiple factors:
- Past obstetric history
- Support available at home
- Distance from the hospital
- The woman's preference

7. Fetal Monitoring

- Fetal growth assessed by ultrasound every two weeks.
- Amniotic fluid volume and umbilical artery Doppler assessed weekly.

8. Amnioinfusion

- Amnioinfusion is not recommended as part of routine clinical practice in PPROM.
    - A Cochrane review suggests amnioinfusion is associated with:
    - Improved fetal umbilical artery pH at delivery
    - Reduced variable decelerations in labour
    - But also linked to neonatal death, neonatal sepsis, pulmonary hypoplasia, and puerperal sepsis.
- Further evidence is needed before routine recommendation.

Timing of Birth: Early Delivery vs. Expectant Management

1. For women with PPROM and no contraindications, expectant management with careful monitoring is associated with better outcomes for the mother and baby.
2. The timing of birth should be determined on an individual basis, carefully considering patient

preference and ongoing clinical assessment.

3. There is no difference in neonatal sepsis or infection rates between early birth and expectant management.
4. Early delivery is associated with:
   - Increased incidence of respiratory distress syndrome.
   - A higher rate of caesarean section.
   - A higher rate of neonatal death and need for ventilation.
5. There were no differences in overall perinatal mortality or intrauterine deaths when comparing early delivery with planned treatment.

Late PPROM (34+0 to 36+6 weeks)

- The benefits of expectant management are less clear for women with PPROM at this late gestation.

Debriefing

1. Patients and their families must be informed of all potential benefits and risks associated with PPROM to facilitate an informed decision-making process.
2. Women with PPROM and their partners should be offered additional emotional support both during pregnancy and postnatally.

CHAPTER EIGHT

Hypertension in Pregnancy

Learning Objectives

The learner will be able to:

1. Describe the common causes, signs, and symptoms associated with Hypertension in Pregnancy.
2. Know how to diagnose Hypertension in Pregnancy.
3. Understand the approach to managing Hypertension in Pregnancy.

Background: Hypertensive Disorders in Pregnancy

Hypertension can complicate pregnancy, presenting either as a pre-existing condition (chronic hypertension) or as a new diagnosis during gestation. Both scenarios carry significant risks for both the mother and the fetus, necessitating careful management.

Chronic hypertension is defined as blood pressure (BP) readings of systolic 140 mmHg or diastolic 90 mmHg that existed before pregnancy or were first diagnosed before 20 weeks' gestation. Obstetrical complications associated with chronic hypertension include an increased risk for:

- Pre-eclampsia (discussed below)
- Abruptio placentae
- Premature delivery
- Intrauterine Growth Restriction (IUGR)
- Fetal demise and fetal stress

Pregnancy itself may exacerbate existing hypertensive renal disease. The majority of these complications occur in women with diastolic BPs exceeding 110 mmHg, though they can occur at lower pressures.Pre-eclampsia

Pre-eclampsia is a significant obstetrical risk, affecting approximately 5% of pregnancies. It is a multisystem disorder characterized by pregnancy-induced hypertension (occurring after 20 weeks' gestation) coupled with evidence of end-organ involvement. While proteinuria has traditionally been considered a hallmark, it is not essential for diagnosis. Evidence of end-organ involvement may include:

- Proteinuria
- Thrombocytopenia
- Visual complaints
- Pulmonary edema
- Impaired hepatic function

The exact cause is unknown, but the multisystem complications are well-described physiologically, marked by increased vascular resistance, platelet aggregation, and endothelial dysfunction. Clinically, pre-eclampsia can manifest as:

- Hypertension (after 20 weeks' gestation)
- Proteinuria
- HELLP syndrome (hemolysis, elevated liver enzymes, low platelets)
- Seizures (eclampsia)

Pre-eclampsia shares many obstetrical risks with chronic hypertension and may lead to:

Maternal Complications:

- HELLP syndrome (10–20%)
- Abruptio placentae (1–4%)
- Eclampsia (< 1%)
- Rarely, maternal stroke or death
- Long-term cardiovascular morbidity

Neonatal Complications:

- IUGR (10–25%)
- Preterm delivery (15–67%)
- Perinatal death (1–2%)
- Long-term cardiovascular morbidity
- Diagnosis

Diagnostic Criteria for Hypertension in Pregnancy

The diagnostic criteria for hypertension in pregnant patients are similar to those for nonpregnant patients. Hypertension is diagnosed based on at least two BP readings of systolic >140mmHg or diastolic >90 mmHg, separated by a minimum of 4 hours but no more than 7 days.

Diagnosis and Classification of Pre-eclampsia

Pre-eclampsia is generally diagnosed by the presence of hypertension (first diagnosed after 20 weeks' gestation) combined with proteinuria (defined as 300 mg per 24 hours or 1+ dipstick protein in two random urine samples separated by at least 4 hours).

Diagnosis Without Proteinuria:

Pre-eclampsia can be diagnosed in the absence of proteinuria if any of the following severe criteria are present:

1. Severe Hypertension: Systolic BP >160 mmHg or Diastolic BP >110 mmHg.
2. Associated Multiorgan Dysfunction: Hypertension accompanied by any of the following:
    - Neurological: Headache, visual changes, or altered mental status.
    - Hepatic Dysfunction: Elevated liver enzymes (>2 times the upper limit of normal transaminase) or persistent right upper quadrant pain.

- Renal Dysfunction: Creatinine >1.1 mg/dL or twice the baseline level, or oliguria (<500 cc/day).
- Pulmonary Edema.
- Hematological: Decreased platelet count (Thrombocytopenia <100,000).

Note on Atypical Presentations:

It is important to note that up to 10% of patients who develop HELLP syndrome and up to 33% of patients who develop eclampsia may not present with the traditional combination of both hypertension and proteinuria.

Severe Pre-eclampsiaSevere pre-eclampsia is diagnosed if any one of the three primary diagnostic features (hypertension, proteinuria, or multiorgan involvement) meets the severe criteria:

- Severe Hypertension: Systolic BP >160 mmHg and/or Diastolic BP >110 mmHg.
- Severe Proteinuria: Levels of 5 grams per day.
- Multiorgan Involvement: Demonstrated by the presence of any of the following:
  - Pulmonary edema.
  - Seizures or altered mental status.
  - Headaches or visual disturbance.
  - Persistent right upper quadrant pain with elevated liver enzymes.
  - Oliguria (<500 cc/day).
  - Thrombocytopenia (<100,000).

Table 8.1 Risk Factors for Preeclampsia

Maternal
Family history of pre-eclampsia
Early or late maternal age
Nulliparity
Prior history of pre-eclampsia
Assisted reproduction
Vascular disease
Diabetes
Obesity
Hypertension
Renal disease
Thrombophilia
Rheumatic disease
Primipaternity
Prior pregnancy complicated by pre-eclampsia
Donated sperm
Multifetal gestation
Hydrops fetalis
Prior pregnancy complicated by pre-eclampsia
Chromosomal abnormalities

The following outlines the diagnostic approach for pre-eclampsia, covering essential aspects of history taking, physical examination, and laboratory investigation.

History

While the diagnosis of pre-eclampsia primarily relies on blood pressure (BP) and proteinuria measurements, a comprehensive medical history should be taken to assess for known risk factors.

- Past and Family History: Previous pre-eclampsia or a family history of the condition.
- Maternal Factors: Age over 40, nulliparity, primipaternity, obesity, and smoking.
- Pregnancy/Conception: Assisted fertility and multiple gestation.
- Pre-existing Conditions: Chronic hypertension, diabetes mellitus, renal disease, thrombophilia, and maternal infection.

Furthermore, at every prenatal visit, patients must be screened for symptoms suggestive of potential pre-eclampsia, such as headache, visual changes, altered mental status, abdominal pain, nausea, or vomiting.

Physical Examination

- Blood Pressure (BP): BP documentation is mandatory at every prenatal visit. If an elevated BP reading is recorded, a recheck must be scheduled within one week.
- Focused Examination (for elevated BP): For patients with elevated BP, the physical examination must be expanded to include ophthalmological, neurological, and abdominal assessments, along with careful notation of peripheral edema (affecting the feet, hands, and face).

Laboratory Studies

- Proteinuria: The most definitive test for proteinuria involves a 24-hour urine collection to measure protein excretion. If a 24-hour collection is impractical, two separate dipstick urinalysis tests showing at least 1+ protein can serve as a substitute.
- Additional Labs (for suspected pre-eclampsia): Patients suspected of having pre-eclampsia require additional laboratory tests, specifically: a complete blood count with platelet count, liver enzyme measurements, and a coagulation panel.

Table 8.2 Complications for Preeclampsia

Complications
Preterm delivery
Intrauterine growth restriction
HELLP syndrome
Pulmonary edema
Acute renal failure
Abruptio placentae
Perinatal death
Eclampsia
Stroke
Death

Chronic Hypertension Management in Pregnancy

Patients with pre-existing hypertension should continue treatment throughout pregnancy. Providers must review the safety of the current antihypertensive regimen and adjust it as needed. Common antihypertensives used during pregnancy include methyldopa, nifedipine, and beta blockers.

For patients diagnosed with hypertension after conception but before 20 weeks' gestation, the role of pharmacological treatment is less certain. Severe hypertension (diastolic pressure >110 mmHg) requires pharmacological intervention. However, treating women with mild essential hypertension in pregnancy has not been shown to improve outcomes. Appropriate options for managing severe hypertension in pregnancy include intravenous labetalol or hydralazine, and oral nifedipine.

Crucially, patients with chronic hypertension must be closely monitored for signs and symptoms of pre-eclampsia, as 15–25% will develop superimposed pre-eclampsia.

Pre-eclampsia

Prevention

With the identification of increasing risk factors for pre-eclampsia, focus has shifted to prevention in high-risk patients. Proposed interventions have included dietary supplements, aspirin, and antihypertensive medications.

Based on mixed results, there is little evidence to support the preventive benefits of:

- Diet and exercise
- Protein or salt restriction
- Magnesium, fish oil, or antioxidant supplementation
- Heparin
- Antihypertensive medications

Low-dose aspirin has demonstrated a small to moderate benefit, with the greatest effect noted in the highest-risk patients. Calcium supplementation is beneficial in populations with low dietary calcium intake; however, its benefit in developed countries, such as the United States, is unclear.

Management

Managing pre-eclampsia requires carefully balancing the maternal risks of a prolonged pregnancy against the neonatal risks of premature delivery. The potential risks and benefits must be assessed individually for each patient.

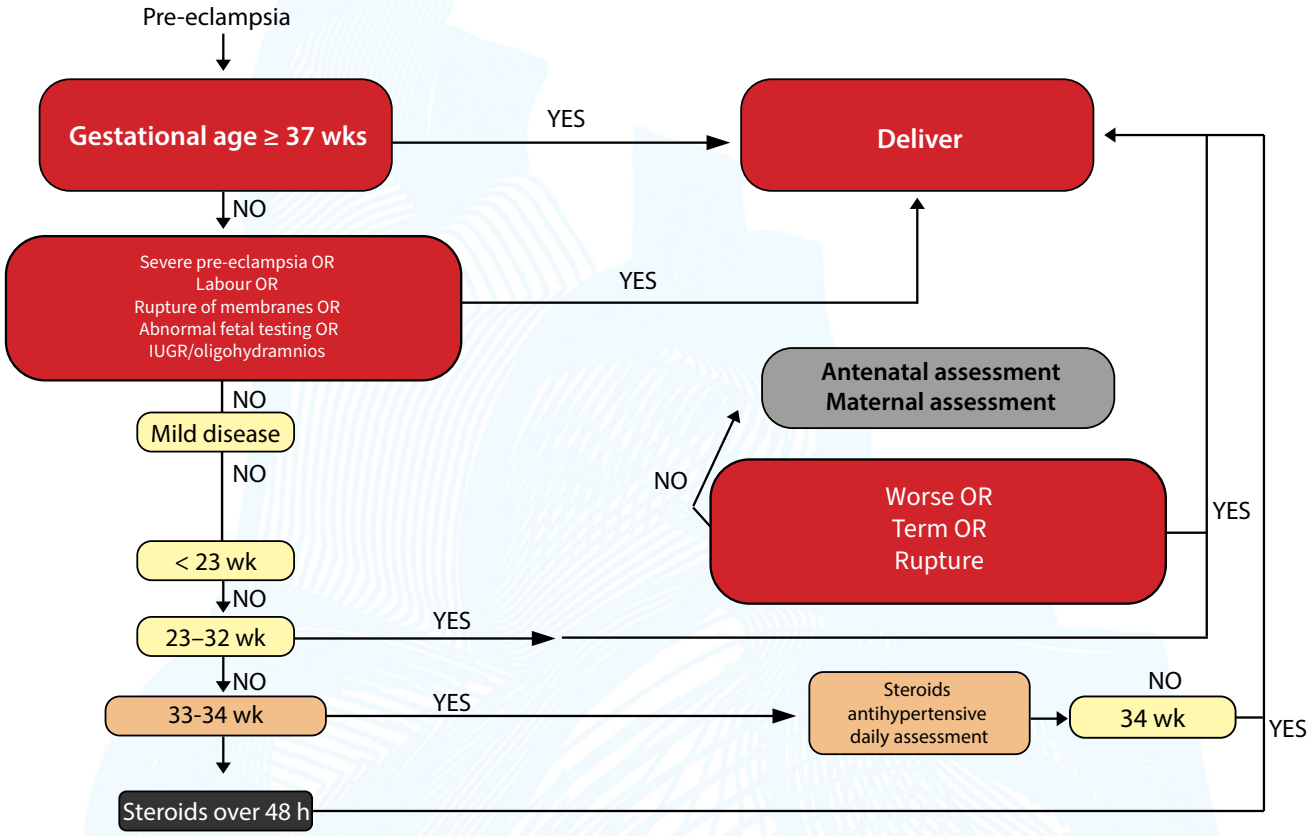


Figure 8.1 Management for Preeclampsia

Management of Pre-eclampsia: Delivery, Medications, and Seizure Prevention

1. Delivery as Definitive Management

Delivery is the definitive treatment for pre-eclampsia and should be achieved as soon as reasonably possible.

- Term Patients (Mild Disease): Induction of labor is the indicated management.
- Severe Pre-eclampsia (≥ 34 Weeks): Delivery is indicated, with appropriate neonatal support.
- Fetal Compromise (Stable Maternal Condition): Management should align with protocols for Intrauterine Growth Restriction (IUGR)
- Mild Disease, No Fetal Compromise (< 34 Weeks): Management is not well-established. This scenario requires close monitoring of both maternal and fetal well-being.
  - If conditions remain stable, delivery can be scheduled for 37 weeks.
  - If either maternal or fetal condition deteriorates, delivery must occur immediately.

2. Antihypertensive Medications

The role of antihypertensives is mixed, similar to their use in chronic hypertension.

- Severe Hypertension: Medication use reduces maternal complications but does not decrease neonatal complications or alter the progression of the maternal disease (e.g., multiorgan complications).
- Mild Disease: Antihypertensives have not been shown to improve either maternal or neonatal outcomes.
- Specific Agents: There is little evidence favoring any specific class of antihypertensive for pre-eclampsia treatment.
- Contraindicated Medications in Pregnancy:
  - Angiotensin-Converting Enzyme (ACE) inhibitors
  - Angiotensin II Receptor Blockers
  - Atenolol
  - Reason for contraindication: Association with IUGR, oligohydramnios, and fetal death.
- Thiazide Diuretics: Generally not initiated during pregnancy but may be continued if already started. They must be discontinued if the patient develops pre-eclampsia.

3. Corticosteroids

Corticosteroids do not improve maternal outcomes but are beneficial for neonatal outcomes in infants delivered prior to 34 weeks' gestation.

4. Seizure Prevention (Eclampsia Prophylaxis)

Eclampsia (seizure) is a major complication of pre-eclampsia and can occur without warning.

- Indication: Seizure prophylaxis with magnesium sulfate is indicated for patients with pre-eclampsia during the intrapartum period.
- Protocol Example (Regimens may vary by institution):
  - Loading Dose: 4 g intravenous magnesium sulfate
  - Maintenance Dose: 2 g per hour continuous intravenous infusion
- Monitoring for Magnesium Toxicity: Magnesium can be toxic at high doses, necessitating close patient monitoring.
  - Monitor: Maternal blood pressure (BP), deep tendon reflexes (DTRs), mental status, and urinary output.
  - Measure: Serum magnesium levels.
  - Toxicity Signs:
    - Levels > 7 mEq/L: Associated with diminished DTRs.
    - Levels > 10 mEq/L: Associated with respiratory depression.

Magnesium Toxicity and Reversal

Magnesium levels exceeding 12 mEq/L pose a risk of cardiac depression and arrest. Magnesium elevation can be reversed by administering 10 mL of 10% calcium gluconate intravenously over 10–15 minutes.

Postpartum Management of Gestational Hypertension and Pre-eclampsia

Maternal risk associated with gestational hypertension and pre-eclampsia continues after delivery, with the highest risk of postpartum eclampsia occurring within the first 24–48 hours. Therefore, patients who received MgSO4 should continue the treatment for 12–24 hours post-delivery.

Close monitoring of blood pressure is essential while the patient is hospitalized. Most patients will experience significant diuresis, a decrease in blood pressure, and symptom resolution. However, vigilant monitoring is required for patients with persistent blood pressure above 150 mmHg systolic or 100 mmHg diastolic. Antihypertensive medication should be initiated for patients with blood pressure greater than 160 mmHg systolic or 110 mmHg diastolic.

Following discharge, patients must have their blood pressure rechecked within one week.

1. Call for help

- Ask: “who will be the team leader?”
- Team leader assigns checklist reader and scribe
- Request eclampsia drug box.

2. Airway & breathing

- Position woman in left lateral (recovery) position
- If airway obstructed --> perform head tilt/chin lift or jaw thrust
- Start oxygen at 15 L/min via reservoir mask (titrate to SpO_2 95-98%)3.
- Start continuous monitoring: SpO_2, respiratory rate,

3. Circulation then the remaining as sub lead ECG and blood pressure• Insert wide bore IV access

- Take bloods: FBC, U&E, clotting, LFTs, blood glucose, venous blood gas
- If IV fluids are running --> 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
6. Stabilise woman’s condition prior to birth
7. Plan ongoing care In a suitable location

Box A: Magnesium sulfate emergency regimen

Loading dose: 4g Magnesium sulfate
Maintenance infusion: 1g/hr IV infusion; if creatinine >90µmol/L start at 0.5g/hr
Recurrent seizures: 2g magnesium sulfate over 5 minutes
Treatment for magnesium toxicity: 1g calcium gluconate

Box B: Alternative diagnosis for seizure

Hypo/hyper glycaemia, hyponatraemia, epilepsy, hypoxia, hypercarbia, hypotension, intracranial bleed, cerebral vein thrombosis, space-occupying lesion, drugs.
Urgent CT/MRI head if diagnosis remains uncertain

Box C: Treatment of severe hypertension

PO Labetalol: 200 mg orally. Can repeat after 15-30 minutesPO Nifedipine: 10 mg modified release orallyIV Labetalol: Loading dose 50 mg (10 mL) over 2 minutes

CHAPTER NINE

Shoulder Dystocia

Learning Objectives

The learner will be able to:

1. Identify key risk factors associated with shoulder dystocia.
2. Outline the essential steps required for managing this obstetrical emergency.
3. Demonstrate the correct technique for fundamental manoeuvres used to resolve shoulder dystocia.
4. Explain the significance of comprehensive and precise documentation following the event.
5. Detail the potential maternal and neonatal complications that may result from shoulder dystocia.

Definition and Mechanism

Shoulder dystocia is diagnosed when the delivery of the fetal shoulder(s) fails following gentle, downward traction on the fetal head, necessitating additional obstetric maneuvers. It typically occurs when the anterior shoulder is obstructed by the symphysis pubis, though it can also result from the impaction of the posterior shoulder on the maternal sacral promontory.

This condition is an unpredictable and unpreventable obstetric emergency that poses a risk of injury to both the pregnant woman and the fetus. It is reported to occur in 0.2% to 3% of all vertex vaginal deliveries. Evidence suggests that adopting a systematic approach and utilizing simulation training can lead to improved outcomes and documentation.

Identification (Clinical Signs)

Key signs that indicate shoulder dystocia include:

- The head has been delivered.
- The shoulder is impacted at the level of the pelvic brim, pubic bone, or sacral promontory.
- The fetal head delivers but then retracts against the maternal perineum (known as the “turtle sign”).
- Difficulty with, or arrest of, the delivery of the fetal head and chin.

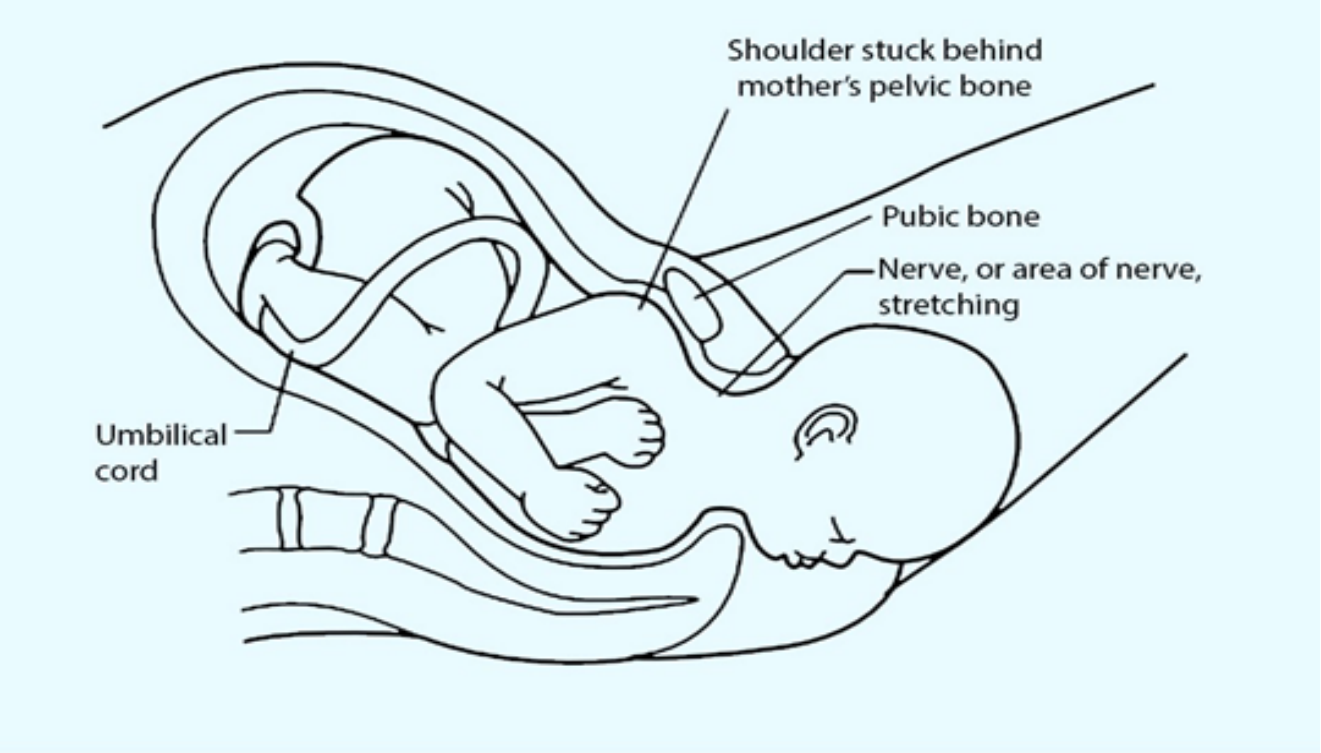


Figure 9.1: Shoulder Dystocia

Associated Risk Factors

The following characteristics, present before (antenatal) or during (intrapartum) labor, are associated with an increased risk of shoulder dystocia:

Antenatal Factors:

- Increasing birth weight (macrosomia)
- Maternal obesity (BMI > 30)
- Maternal diabetes
- History of prior shoulder dystocia
- History of a prior macrosomic infant
- Induction of labor

Intrapartum Factors:

- Prolonged second stage of labor
- Operative vaginal delivery (forceps or vacuum)
- Precipitous (very rapid) delivery
- Oxytocin augmentation of labor

Prevention

Routine elective induction of labor is not advised to prevent shoulder dystocia. Cesarean section for the prevention of shoulder dystocia should only be considered in specific, high-risk scenarios:

1. Estimated Fetal Weight (EFW) of ≥4500 gm in a diabetic patient.
2. Estimated Fetal Weight (EFW) of ≥5000 gm in a non-diabetic patient.
3. Prior shoulder dystocia resulting in significant infant injury (e.g., brachial plexus injury, limb fracture, or asphyxia).

Shoulder dystocia presents a significant risk of serious adverse outcomes for both mother and neonate. Maternal complications primarily include postpartum hemorrhage, obstetric anal sphincter injuries, uterine rupture, and post-traumatic stress disorder (PTSD). Neonatal complications frequently involve brachial plexus injuries, skeletal fractures (clavicle, humerus), hypoxemia, and fetal demise.

Shoulder Dystocia Training

Training in shoulder dystocia, through practical sessions or simulated drills, is essential for staff. It allows them to gain experience in the necessary preparation, guidance, and communication to effectively support a woman and her partner.The focus of this training is to teach staff a specific algorithm of evaluated and effective maneuvers designed to assist in the delivery.

Initial Maneuvers

The following steps account for 60% of the resolution:

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

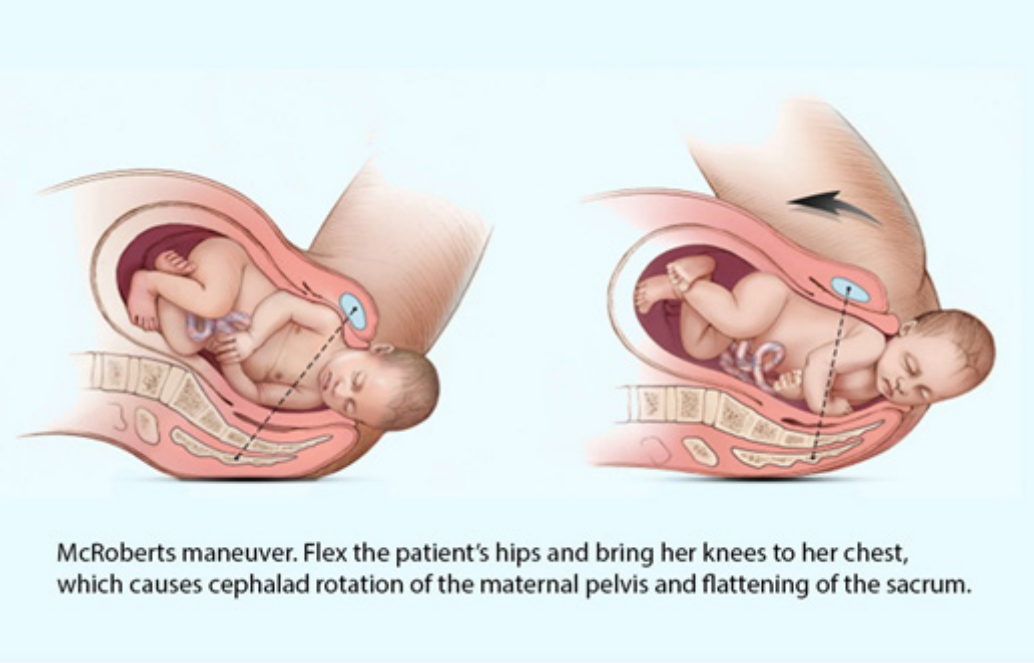


Figure 9.2: McRoberts Maneuver

- 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.

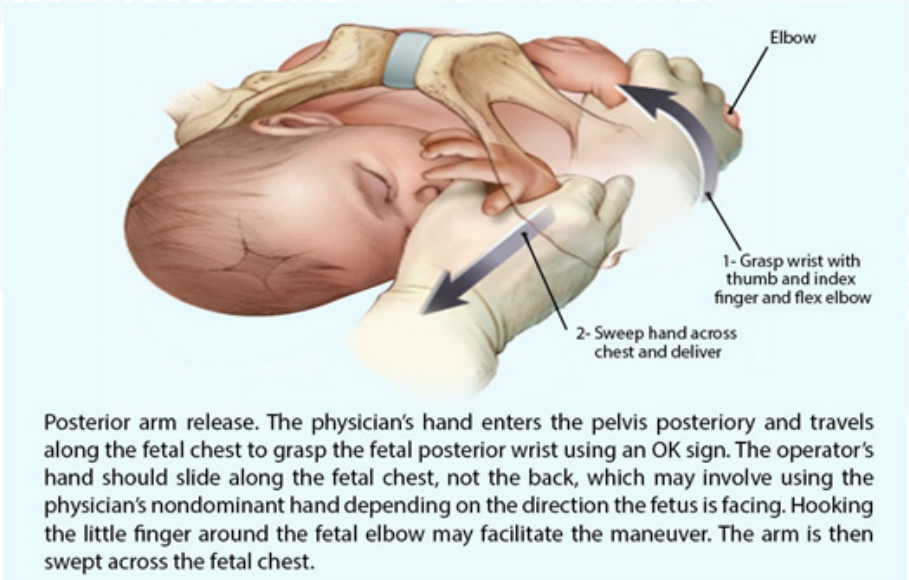
Figure 9.3: Supra-pubic pressure

- Avoid fundal pressure

Secondary Maneuver:

1- Posterior Arm Delivery

Resolution of shoulder dystocia is often achieved successfully in up to 95% of cases through the sequential application of the McRoberts maneuver, supra-pubic pressure, and posterior arm delivery.



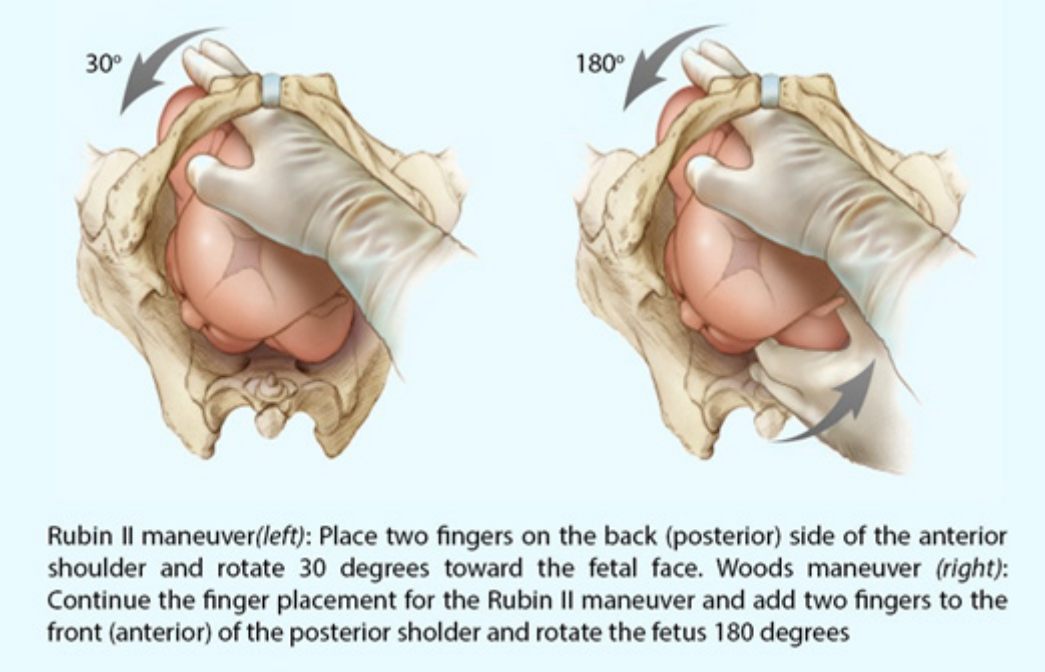
Posterior arm release. The physician's hand enters the pelvis posteriory and travels along the fetal chest to grasp the fetal posterior wrist using an OK sign. The operator's hand should slide along the fetal chest, not the back, which may involve using the physician's nondominant hand depending on the 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 9.4: Posterior Arm delivery maneuver

2. Rotational Maneuvers

These techniques involve rotation to free the impacted anterior shoulder:

- Rubin Maneuver: Place a hand behind the most accessible shoulder and apply pressure towards the fetal chest to disengage the anterior shoulder.
- Woods Corkscrew Maneuver: One hand attempts to move the anterior shoulder (similar to the Rubin maneuver), while the other hand is placed behind the posterior shoulder. The goal is to rotate the fetus up to 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 9.5: Robin II maneuver

Non-Destructive Maneuvers (Initial Steps)

1. McRoberts Maneuver: Hyperflexion of the mother's hips to the abdomen.
2. Suprapubic Pressure: Applying pressure above the pubic bone to dislodge the anterior shoulder.
3. Episiotomy:
    - Assess the need for additional posterior space.
    - Consider a Medio-lateral episiotomy.
    - Note: Should not be routinely performed for every shoulder dystocia.
4. All Fours Maneuver: Repositioning the patient into a hands-and-knees position to facilitate shoulder delivery.
5. Repetition: If initial maneuvers are unsuccessful, repeat the sequence, beginning again with McRoberts.

Destructive Maneuvers (Last Resort)

1. Cleidotomy: Intentional fracture of the clavicle.
2. Symphysiotomy:
    - Should only be performed by an experienced clinician.
    - Involves incising the pubic cartilage to separate the pubic bones.
    - Requires local anesthesia and lateral retraction of the urethra with the index and middle fingers prior to incision.
3. Zavanelli Maneuver: Replacing the fetal head back into the uterus, followed immediately by a Cesarean delivery.

Documentation

Accurate and detailed documentation of this difficult and traumatic birth is essential. The record should specifically include:

- Time of delivery for both the baby's head and body.
- The time interval between the delivery of the head and the body (Head to body time).
- Identification of the anterior shoulder.
- The timing and exact sequence of all maneuvers performed.
- The baby's condition at birth (Apgar score and cord blood gases).
- Listing of all attending staff present, including whether a pediatrician was called and was present at the delivery.

Debriefing

- Patient communication
- Staff debriefing (using the provided checklist)

Shoulder Dystocia Management (HELPERR Acronym)

The HELPERR mnemonic outlines the steps for managing a shoulder dystocia:

1. Help: Call for assistance immediately.
2. Evaluate for episiotomy (if necessary).
3. Legs: Perform the McRoberts' maneuver (flexing the mother's thighs toward her abdomen).
4. Pressure: Apply suprapubic pressure (above the pubic bone).
5. Enter: Attempt internal maneuvers (rotational techniques, e.g., Rubins or Woods screw).
6. Remove: Deliver the posterior arm.
7. Roll: Turn the patient onto her hands and knees (Gaskin maneuver).

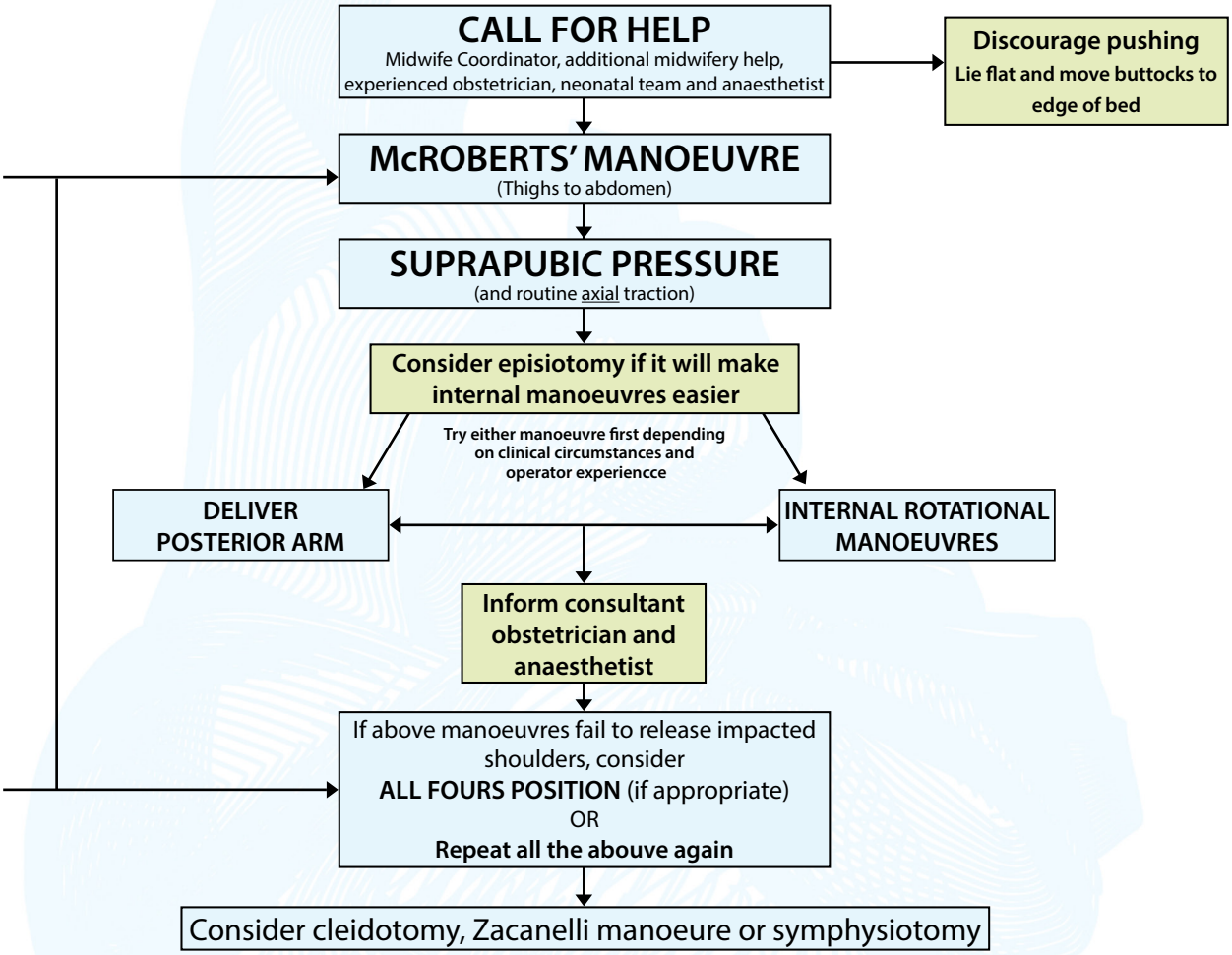


Figure 9.6: Management Protocol for Shoulder Dystocia

CHAPTER TEN

Malpresentations, Malpositions, and Multiple Gestation

Learning Objectives

The learner will be able to:

1. Analyze and Manage the complexities and potential complications associated with various fetal malpresentations.
2. Evaluate and Implement the appropriate management strategies for deliveries involving multiple gestations (e.g., twins).
3. Detail and Execute the procedural steps required to perform a safe and controlled breech delivery.

Definitions in Obstetrics

Lie: The relationship between the long axis of the fetus and the long axis of the mother. It is classified as longitudinal, transverse, or oblique.

Presentation: The part of the fetus that is located foremost, or presenting, in the mother's birth canal. Common presentations include vertex, breech, face, brow, or shoulder.

Position: Refers to a designated reference point on the presenting part and its orientation relative to the mother's pelvis. For example, the reference point for a vertex presentation is the occiput.

- When the fetal occiput is directed toward the mother's anterior, the position is Occiput-Anterior (OA).
- When it is directed toward the mother's spine (posteriorly), the position is Occiput-Posterior (OP).
- Other variations include 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).

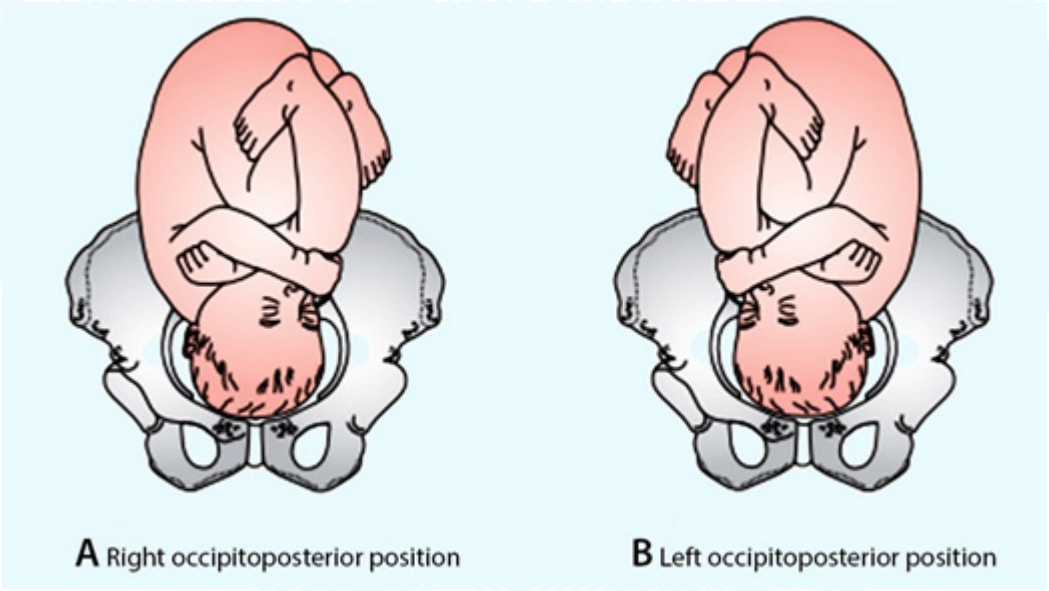


Figure 10.1: ROP & LOP fetal positions

How to diagnose:

There are three Ways To diagnose:

1. Leopold maneuvers, or abdominal palpation .
2. vaginal examination.
3. imaging with ultrasound

Vaginal Examination Findings for Fetal Presentations

- **Vertex Presentation:** Palpation reveals the scalp and hair, the sagittal suture, the Y-shaped posterior fontanel, and the diamond-shaped anterior fontanel.
- **Breech Presentation:** Palpation reveals the smooth, hairless buttocks. The anus (an orifice) and/or the ischial tuberosities may also be felt.
- **Face Presentation:** Palpation reveals the smooth, hairless face. The mouth (an orifice) may be felt, as well as the malar prominences, which form a triangle with the mouth.
- **Brow Presentation:** Palpation reveals the anterior fontanel, orbital ridges, eyes, and the base of the nose.
- **Transverse Lie:** Vaginal examination will show an empty pelvis. Diagnosis is typically confirmed by palpation or ultrasound.

Diagnosis of Other Conditions

- **Cord Prolapse or other Malpresentations:** Typically diagnosed either visually or by palpation during a vaginal examination.
- **Imaging:** Diagnosis may also be assisted by ultrasound.

Cause of Malpresentation

1. **Asynclitism:** This occurs when the baby's head is flexed laterally, preventing the sagittal suture from aligning centrally in the birth canal. While a slight degree is normal, severe asynclitism can halt the progress of labor.

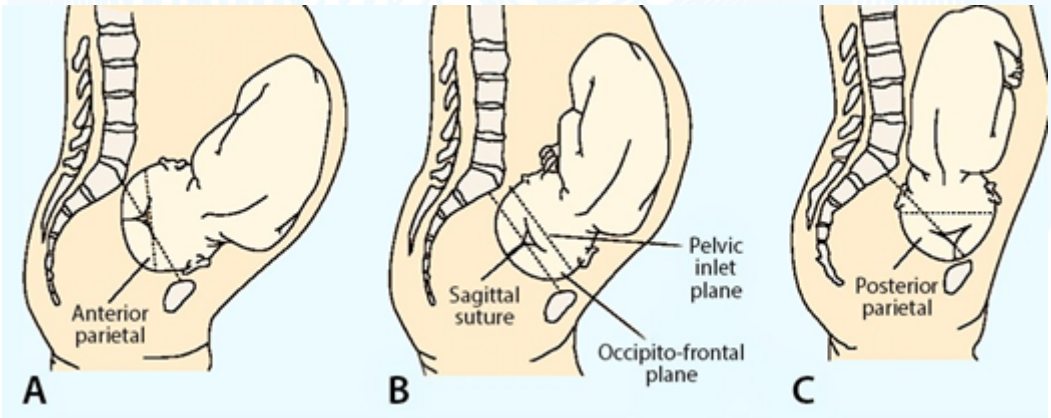


Figure 10.2: Synclitism and Asynclitism

2. Maternal Pelvis Type

The shape of the maternal pelvis significantly influences the risk of fetal malpresentations. There are four principal types of the female pelvis:

1. **Gynecoid:** The most common type, characterized by a round inlet.
2. **Anthropoid:** Oval inlet, with the long axis oriented anteroposteriorly. This type is associated with a persistent occiput posterior (OP) position.
3. **Platypelloid:** Oval inlet, with the long axis oriented transversely. This shape can lead to transverse arrest of the fetal head.
4. **Android:** Distinguished by a triangular or heart-shaped inlet with an anteriorly placed apex. This type is linked to an increased risk of all types of fetal malpresentations.

3. Fetal Head Diameter

The smallest diameter of the fetal head, the suboccipitobregmatic diameter, aligns with the pelvis when the head is fully flexed. This optimal alignment facilitates a simpler delivery. However, when the fetal head is extended as can occur in occiput posterior (OP), face, brow, and some breech presentations larger head diameters are presented to the pelvis, which complicates the delivery process.

Occiput Posterior (OP) Position

In the Occiput Posterior (OP) position, the back of the baby's head faces the mother's spine, with the baby's face toward the abdomen. While most fetuses rotate to the Occiput Anterior (OA) position before birth, the OP position persists in 5–12% of cases. When this occurs, the baby's head is slightly deflexed and engages in the curve of the lower spine.

Diagnosis

Diagnosis relies on patient observation and examination. Clinically, a persistent OP position is often indicated by prolonged labor and severe back pain. During a vaginal examination, the anterior fontanelle is typically the easiest structure to palpate due to the baby's partially deflexed head, making it a key diagnostic marker. Identifying the sagittal suture when palpating the anterior fontanelle is essential. Ultrasound imaging can also be a helpful diagnostic tool.

Comparison with Occiput Anterior (OA)

There is no significant difference in perinatal mortality or Apgar scores between deliveries in the persistent OP and the OA positions. Labor progression is assessed by cervical dilation and the descent of the vertex through the birth canal. However, labor in the OP position tends to be longer and is associated with a higher incidence of assisted vaginal delivery, cesarean sections, and anal sphincter lacerations.

Options for Vaginal Delivery

Five main approaches are available for vaginal delivery in the OP position: spontaneous delivery, manual rotation, vacuum delivery, forceps delivery, and forceps rotation.

1. Spontaneous Delivery:
   This occurs in 45% of deliveries. Because the baby's head must pass the symphysis pubis before it can move upward, the vertex has to navigate through the posterior pelvis. This movement puts strain on the perineum, though the delivery is generally straightforward.
2. Manual Rotation:
   Manual rotation is performed to reinforce the natural rotational forces. Rotation typically happens when the flexed fetal head contacts the pelvic floor muscles (levator sling). Therefore, the clinician must ensure the head is flexed. This maneuver is accomplished by placing a hand behind the occiput in the posterior pelvis and applying a rotatory force.
   The woman's natural effort to push her head down onto the levator sling should be used to try and rotate the baby through her ability to bend and turn. Manual rotation can be attempted with the patient in the lithotomy, Sims, or hands-and-knees positions.

   For a direct OP position, the dominant hand performs the rotation. If the baby is in a Right Occiput Posterior (ROP) or Left Occiput Posterior (LOP) position, the rotation should be kept as minimal as possible. The baby should be turned clockwise for ROP and counterclockwise for LOP. The hand that naturally pronates during the rotation should be used for both ROP and LOP positions.
   Manual rotation is considered safe and does not require instrumentation.
3. Vacuum Delivery:
   The OP position does not automatically necessitate an assisted vaginal delivery. To facilitate flexion, the vacuum cup must be correctly placed on the flexion point, which is anterior to the posterior fontanel.

   When using a vacuum extractor for delivery in the occiput posterior (OP) position, an ultrasound is advisable to confirm the head's exact position. Traction from the vacuum, applied by bending the head and pulling it onto the levator sling, can either encourage rotation to the occiput anterior (OA) position or facilitate delivery in the OP position. Rotation to the OA position often occurs spontaneously with traction.

   Important Note on Rotation: The cup itself must not be used to apply direct rotational force, as this can cause the cup to detach from the fetal head, potentially resulting in a 'cookie-cutter' injury.

   Vacuum Placement and Procedure: For a baby in the OP position, the vacuum cup should be placed as far posteriorly on the head as possible to achieve the necessary flexion point. The delivery process with the vacuum is similar to that of a forceps or spontaneous delivery for an OP presentation. As with all vacuum deliveries, the extractor's shaft must be kept perpendicular to the plane of the cup. Deliveries in the OP position, however, are associated with a higher incidence of third- and fourth-degree perineal tears.

4. Forceps Delivery in Occiput Posterior (OP) Position

   The general indications for forceps delivery apply in cases of OP presentation. The mechanism of delivery mirrors a spontaneous OP delivery, relying on fetal head flexion. Forceps are equally capable of accommodating the OP vertex as they are the occiput anterior (OA) vertex.

   Traction and Delivery: To ensure the fetal face passes under the symphysis pubis before the head flexes upward, traction with the forceps must be directed more posteriorly and for a longer

duration compared to OA deliveries. Applying pressure to the perineum during this process may increase the risk of third- and fourth-degree lacerations.

When Cesarean Delivery is Necessary: In prolonged second-stage OP deliveries, significant fetal head molding and edema can occur. Although the vertex may appear low (e.g., at a +2 station or visible at the perineum), a thorough examination might reveal an elongated head where the biparietal diameter is not fully engaged. In such scenarios, a Cesarean delivery is required.

5. Forceps Rotation (Scanzoni Maneuver)

Forceps rotation, such as the Scanzoni maneuver for rotating a baby from the OP position, should only be performed by clinicians who are highly skilled and specifically trained in this procedure.
Breech Presentation

Breech presentation is defined as the baby entering the birth canal with the buttocks or feet first, with the head delivering last.

Figure 10.3: Breech presentations

Breech presentations are categorized as follows:

1. **Frank Breech:** The hips are flexed, and the legs are extended, lying along the front of the body.
2. **Complete Breech:** Both the hips and legs are flexed, similar to a tailor-sitting or squatting position.
3. **Footling Breech:** One or both hips are extended, resulting in one or both feet being the presenting part. Often, one or both feet are easily felt during a vaginal examination.

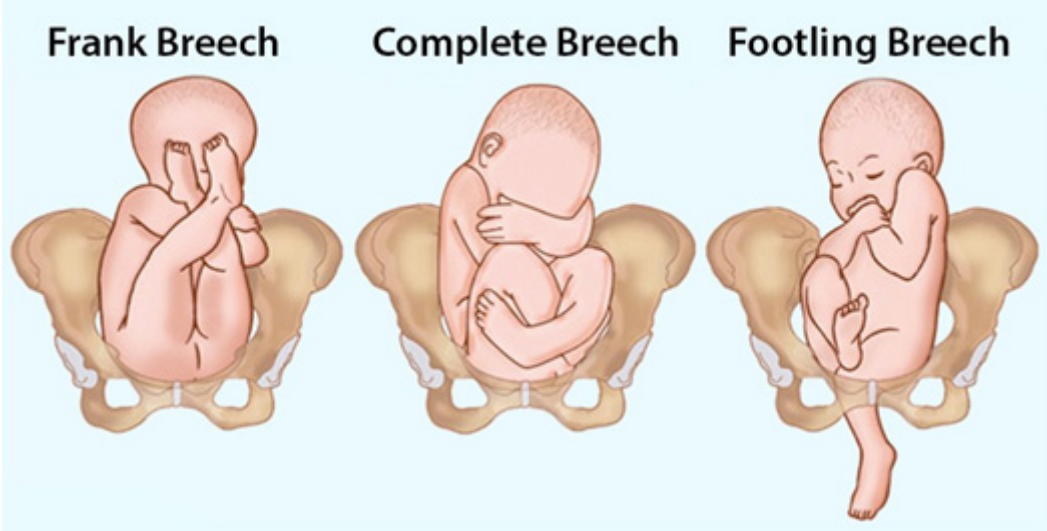


Figure 10.4: Classifications of breech presentation

The incidence of breech presentation decreases to 3-4% as pregnancy approaches term. Several factors are associated with an increased risk of breech presentation, including high parity, laxity of the abdominal and uterine walls, abnormalities of the uterus, pelvic tumors, excessive or insufficient amniotic fluid (poly- or oligohydramnios), fetal conditions such as hydrocephalus, anencephaly, Down syndrome, and macrosomia, as well as multiple gestations, placenta previa, cephalopelvic disproportion, and a history of previous breech delivery.

Diagnosis of Breech Presentation

The diagnosis of breech presentation can be made through abdominal palpation and vaginal examination.

- Abdominal Palpation: During Leopold's maneuver, the firm, round, and ballotable fetal head is typically felt in the uterine fundus.
- Confirmation: If breech presentation is suspected in the final trimester, an ultrasound is recommended for confirmation. The definitive diagnosis, however, is typically not made until the patient presents with ruptured membranes at full term or is in labor.
- Vaginal Examination: This method may reveal small parts of the breech. A critical step is distinguishing a foot from a hand, as well as differentiating the breech from a vertex presentation, as the two can feel similar.
    - Vertex Confirmation: Finding fontanels and sutures confirms a vertex presentation.
    - Breech Identification: In breech, the anus and ischial tuberosities form a straight line, while the mouth and malar prominences form a triangle. Gentle insertion of the examiner's finger into the opening can help: if it's the mouth, the fetus will suck; if it's the anus, the finger will be covered in meconium.

Management of Prenatal Breech Presentation

The management of prenatal breech presentation involves four main components:

1. **Finding the Cause (Etiology):** A reason for the breech presentation should be sought, typically through ultrasonography.
2. **Breech-Turning Exercises:** Specific exercises may be attempted by the woman. While considered safe, their efficacy is not definitively established.
3. **External Cephalic Version (ECV):** ECV is a recognized part of prenatal care for breech presentation. It involves manually manipulating the fetus through the woman's abdomen and uterine wall to change the presentation from breech to vertex.
    - Timing: ECV is generally not advised before approximately 37 weeks of gestation, but delaying it past this point increases the risk of labor or membrane rupture. It should be attempted in early labor if the membranes are still intact.
    - Benefits: This simple and affordable method has the potential to reduce the rate of cesarean deliveries, and the likelihood of adverse events is minimal.
    - Contraindications: While numerous clinical guidelines list several contraindications, robust evidence is lacking for many. ECV should be avoided when vaginal delivery is otherwise contraindicated (e.g., placenta previa or a history of classical cesarean delivery).
    - Evidence-Based Contraindications: Substantial evidence supports avoiding ECV in cases of a history of placental abruption, severe preeclampsia (or HELLP syndrome), and issues with fetal monitoring, particularly concerning abnormal Doppler ultrasound findings.

Procedure for External Cephalic Version

Patient preparation for ECV includes the following steps:

1. The patient should be NPO (fasting) for 6–8 hours before the procedure.
2. The patient should be gowned, and her bladder should be emptied.
3. Confirm breech presentation and check for fetal anomalies with an ultrasound.
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 su- pra-pubically beneath the fetal buttocks.
2. Physician 1 applies pressure to the fetus, directing it into the iliac fossa. Concurrently, Physi- cian 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 globu- lin. 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 stabi- lize, as it can be challenging to differentiate between fetal bradycardia caused by hypoten- sion and that resulting from the external cephalic version procedure itself.

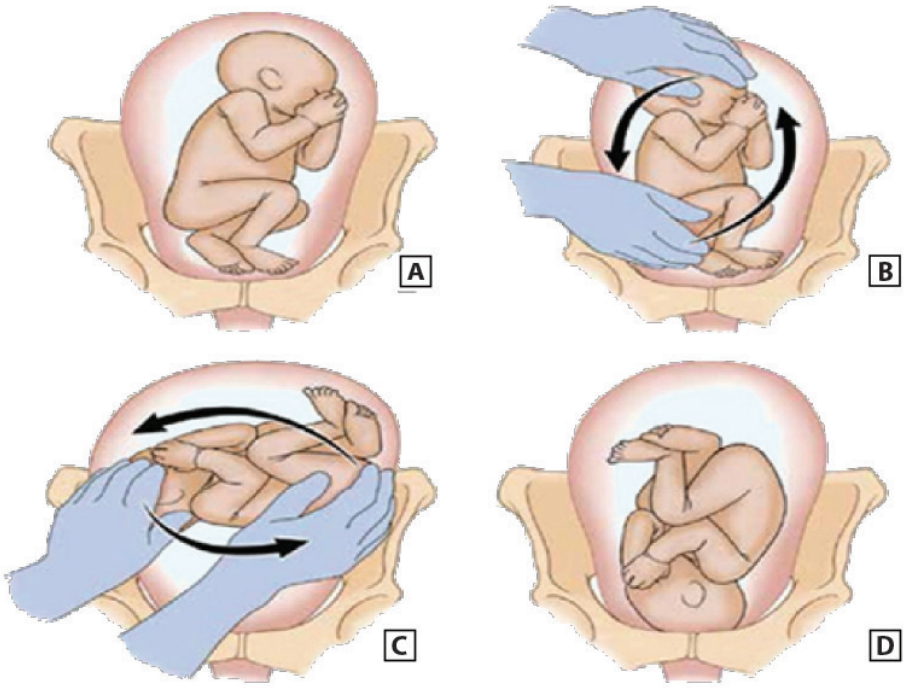


Figure 10.5: ECV technique

Although the majority of breech presentations in the United States are delivered by cesarean section, it is important to note that this method does not eliminate all risks of newborn morbidity. In some cases, adverse outcomes may stem from the underlying conditions that contributed to the breech presentation, such as neuromuscular illness or oligohydramnios.

Current ACOG guidelines permit offering a trial of vaginal breech delivery, provided the patient has received comprehensive risk counseling and a physician with the requisite skills is available.

Contraindications for Elective Vaginal Breech Delivery:

A vaginal breech delivery is generally contraindicated in the following circumstances:

- The fetus is suspected to be macrosomic (inconsistent definition, often based on a weight > 3,800 g).
- A doctor experienced in vaginal breech delivery is not present.
- The presentation is a footling breech.
- A prolapsed or concealed cord is present.
- Evidence of intrauterine growth restriction (IUGR).
- Lack of immediate access to facilities for an emergency cesarean delivery.
- Fetal abnormalities that preclude a safe vaginal delivery.
- Evidence of an inadequate pelvis.
- Fetal head hyperextension (stargazing position) is observed on ultrasonography.

Vaginal Delivery of Breech Presentation

1. Assessment of Presentation, Dilation, and Cord

- Patience and Descent: Allow the breech to descend spontaneously.
- Cervical Dilation: Full cervical dilation is essential to prevent head entrapment. Determining full dilation can be challenging as the physician must feel the soft cervix against the soft buttocks, rather than a firm skull.
- Occult Cord: Assessment for an occult cord is crucial due to the increased risk of cord prolapse. Recurrent variable decelerations in the fetus during the second stage may indicate cord compression.
- Cesarean Advisory: The Society of Obstetricians and Gynecologists of Canada (SOGC) guidelines recommend a cesarean delivery if delivery is not imminent after one hour of active pushing or 90 minutes of passive second stage.
- Episiotomy: A frank breech presentation typically distends the perineum and dilates the introitus similarly to a vertex presentation. While traditionally routine, an episiotomy is now performed selectively, primarily when additional space is required for maneuvers (e.g., Piper forceps application).

2. Umbilical Visibility and Delivery of the Legs

- Breech Position: In a frank breech, the baby is delivered with the hips in the anteroposterior plane and the sacrum positioned to the left or right. The anterior hip descends below the symphysis (similar to the anterior shoulder), and the posterior hip delivers across the perineum as the baby's body laterally flexes. External rotation then occurs, bringing the baby's back to the anterior position.
- Avoid Premature Traction: Delivery should proceed naturally until the baby's umbilicus is visible at the introitus. Physicians must avoid pulling on the baby before the umbilicus is delivered, as premature traction can cause the baby's head to extend or the arms to be displaced around the neck.
- Leg Delivery (Pinard Maneuver): For a frank breech, the legs can be delivered by performing the Pinard maneuver inserting a finger behind the knee to flex it and abduct the thigh. The legs usually deliver spontaneously, with the feet springing free.
- Torso Delivery: Once the umbilicus is delivered, gentle, continuous downward traction can be applied to deliver the torso. The physician grasps the baby's pelvis with fingers, placing the thumbs on the sacroiliac regions. Traction should be directed toward the floor at a 45-degree angle, which may necessitate the doctor kneeling beneath the infant.

3. Scapula Visibility and Delivery of the Arms

- Trunk Delivery and Rotation: The trunk's delivery may require variable effort. Rotating the baby's back from one anterior oblique position to the other can facilitate trunk extraction and encourage the arms to remain flexed across the chest.
- Sacrum Position: Maintaining an anterior sacrum is critical, as it guides the baby's head to enter the pelvis in an occipito-anterior (OA) position.
- Arm Delivery: The arms are delivered by rotating the baby's body into an oblique orientation. The tip of the baby's scapula will become visible and easily identifiable due to its winged appearance.

Delivery of the Arms

1. **Anterior Arm:** Gently sweep the anterior arm across the baby's chest and out through the introitus.
2. **Humerus Delivery Technique:** When delivering the humerus, it is safer to splint it using two fingers rather than hooking the antecubital fossa with a single finger.
3. **Opposite Arm:** The delivery of the opposite arm requires a similar approach, but first involves rotating the baby into the corresponding oblique position.

Delivery of the Head: Modified Mauriceau-Smellie-Veit (MSV) Maneuver

The head delivery, which immediately follows the trunk and arm delivery, is the most challenging part of a breech delivery.

- **Initial Step:** The doctor should try to visualize the nape of the neck. The infant can hang for up to 30 seconds with the head remaining inside the pelvis. The sacrum should be positioned anteriorly.
- **Mechanism of Delivery:** The head must be delivered in a flexed position through the pelvis. When the head is flexed and in the Occiput Anterior (OA) position, it passes through the birth canal by further flexion, similar to a vertex OA delivery, due to favorable diameters.
- **Modified MSV Maneuver:** This modification is used to promote head flexion:

    1. Doctor's Internal Hand: The doctor's hand is positioned inside the vagina, superior to the infant, with one finger on the baby's occiput and one on each shoulder.
    2. Doctor's External Hand: The baby is supported under the doctor's other hand.
    3. Traditional MSV (Jaw Hooking): The traditional method of placing a finger in the mouth is no longer recommended as it can dislocate the jaw. Alternatively, two fingers can be placed on the maxillae (lower face).
    4. Assistant's Role: An assistant should apply suprapubic pressure to help flex the head through the pelvis. The assistant may also hold the baby in a sling before the head is delivered.

- **Four Mechanisms for Flexion:** Once in the proper position, four mechanisms work together to flex the head through the pelvis:

1. The occipital finger flexes the occiput.
2. The assistant applies suprapubic pressure.

3. The maxillae fingers apply pressure to the lower face.
4. The sling raises the baby's body upward.

- **Traction:** Traction is achieved using downward pressure from the fingers on the shoulders. The assistant holding the baby in a sling may hold the feet and gently tug as the fetus's body defines its arc. The baby's body should be kept in a neutral position relative to the head to prevent hyperextension.

Lifting the Baby onto the Mother

- **Sacrum Position:** The sacrum almost always rotates into an anterior position during delivery. If it shifts posteriorly, the doctor must gently rotate and guide the baby back into the sacrum anterior position before the arms are delivered.
- **Immediate Care:** The mouth and nose may be suctioned as soon as they emerge over the perineum.
- **Final Delivery:** The skull's vault is delivered by further flexion using the Ritgen maneuver. Once the head appears, the baby's body is flipped over onto the woman's abdomen.

Vaginal Breech Delivery Considerations

- **Delayed Cord Clamping:** If a breech baby does not require immediate resuscitation, delayed cord clamping is an acceptable practice. This is because breech babies are at higher risk for needing resuscitation due to increased cord compression during the second stage of labor.
- **Neonatal Resuscitation:** The presence of additional personnel is mandatory for neonatal resuscitation during all vaginal breech deliveries.

Cesarean Delivery for Breech Presentation

- **Prevalence:** Cesarean sections account for the majority of planned breech deliveries. Even when a vaginal breech delivery is planned, a significant portion will ultimately require a cesarean delivery.
- **Emergency Cesarean:** Some deliveries necessitate an emergency cesarean section due to complications like cord prolapse and the fetus's inability to tolerate the second stage of labor.
- **Extraction Technique:** The same techniques used to extract the baby during a vaginal breech delivery must be employed during a cesarean delivery for a breech presentation.

Use of Piper Forceps

- **Indication:** Piper forceps are indicated when the Mauriceau-Smellie-Veit (MSV) maneuver fails.
- **Purpose and Design:** The primary purpose of Piper forceps is to assist in the delivery of the fetal head in a breech presentation. They are long instruments with an axis-traction curve. The blades are designed to gently grasp the fetal head in a "generic basket catch."
- **Guidelines:** Although there are no strict protocols, Piper forceps should be considered if the MSV maneuver is attempted and shows no improvement after two to three minutes. They may also be used in the delivery of a premature fetus in a breech presentation.

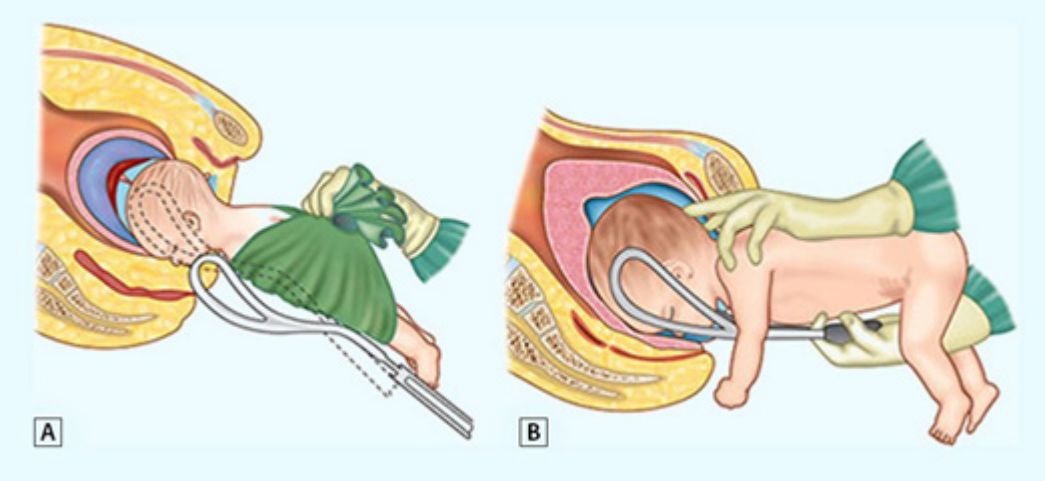


Figure 10.6: Piper forceps

1. Nuchal Arms

Nuchal arms are a complication where one or both of the fetus's arms are wrapped around the back of the neck, which can obstruct the delivery of the head. If the fetus is small or the pelvis is large, the head and extended arm(s) might deliver simultaneously. To resolve a nuchal arm, the physician may attempt to remove the arm from its position by:

- Rotating the fetus by 90 to 180 degrees toward the direction of the arm.
- Flexing the arm and sweeping it down over the face and chest.

2. Hydrocephalus

Hydrocephalus, when diagnosed prenatally, often results in a cesarean delivery. Symptoms like a breech birth or an entrapped head may indicate the condition. If an immediate cesarean delivery is not feasible, decompression of the fetal ventricles, despite potential harm to the fetus, is the only method to ensure a live birth. This procedure, called cephalocentesis, is performed using a long needle and can be done transvaginally or transabdominally.

3. Symphysiotomy

Symphysiotomy is an emergency procedure involving cutting the pelvic symphysis ligaments to free a trapped head. While rarely used in well-resourced settings, it is a life-saving measure in low-resource environments. Risks for the mother include orthopedic and urological injuries.

Transverse Lie (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.

Diagnosis is suspected when the fundal height is lower than expected, the fetal head is felt in the iliac fossa, and the fetal heart rate is heard near the umbilicus. Labor is contraindicated in patients with a transverse lie due to the high risks of cord prolapse and uterine rupture. Maternal complications can

include hemorrhage, infection, and complicated surgery, potentially leading to death. For the fetus, risks involve traumatic delivery, cord prolapse, and intrauterine death. Delivery is typically via a transverse lower segment incision, though a vertical lower uterine incision may be necessary if the fetal back position is unclear.

Optimal outcomes depend on early diagnosis, a skilled assessment, and planned delivery by the most appropriate route, executed by an experienced obstetrician. Operative delivery via cesarean section is mandatory in most cases, and successful management relies on timely intervention, with cesarean section being preferred over destructive procedures.

Face Presentation

In a face presentation, the fetal face from the forehead to the chin is the leading part descending into the birth canal. The neck is hyperextended, and the submento-bregmatic diameter is the largest leading diameter.

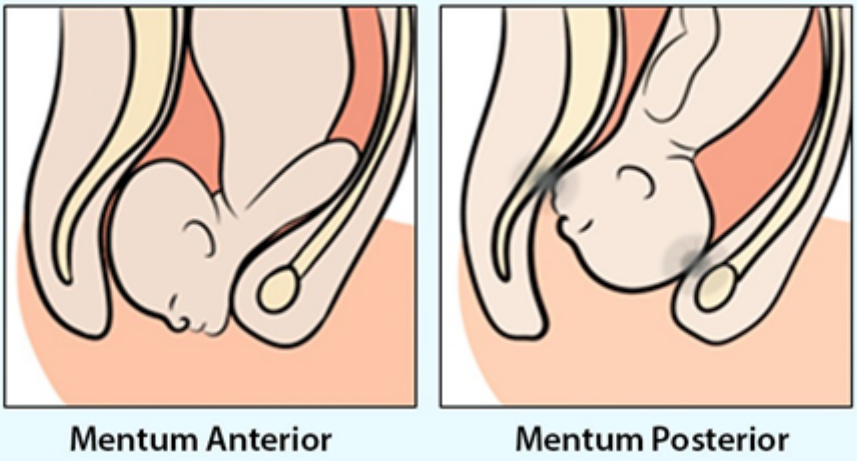


Figure 10.7: Face presentation

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 involves the simultaneous expectation of two or more babies (e.g., twins, triplets), occurring in approximately 1 in 60 pregnancies. The likelihood increases with maternal age and the use of fertility treatments.

Types of Multiples:

- **Identical (Monozygotic):** Result from a single fertilized egg splitting post-fertilization. These babies share the same genes, appearance, and sex.
- **Fraternal (Di/Tri-zygotic):** Develop from separate eggs fertilized by different sperm. They are genetically distinct, resembling each other no more than any other siblings.

Chorionicity

This refers to the number of placentas.

- **Monochorionic (Shared Placenta):** Always results in identical babies.
- **Dichorionic/Trichorionic (Separate Placentas):** Usually fraternal, but can also be identical.

Maternal Complications and Diagnosis

Multiple gestations are associated with an elevated risk of maternal complications, including: anemia, hyperemesis, gestational hypertension, gestational diabetes, preeclampsia, placental abruption, placenta previa, and postpartum hemorrhage.

Diagnosis:

Multiple gestation is typically diagnosed through routine prenatal ultrasound in privileged settings. Diagnosis of the second twin during labor is uncommon and usually indicates a lack of prenatal care. Suggestive findings include hyperemesis gravidarum, a uterine size larger than expected for the date, elevated maternal serum alpha-fetoprotein levels, polyhydramnios, a history of ovulation induction, and a family history of multiple gestations.

A. Prenatal Management

A multiple pregnancy can intensify common pregnancy symptoms (nausea, heartburn, varicose veins, back pain, fatigue, swollen ankles) and heighten the risk of specific conditions:

Table 10.2 A Multiple Pregnancy Complications Management

Condition	Description & Management
Anemia	Due to low iron; requires extra blood tests and possible iron supplements.
Pre-eclampsia	Characterized by high blood pressure and protein in the urine; necessitates regular monitoring and potential aspirin therapy for high-risk patients.
Gestational Diabetes	May require a glucose test during pregnancy.

Multiple pregnancies also increase the risk of needing a Caesarean or assisted vaginal birth and experiencing postpartum hemorrhage (heavier than normal bleeding after delivery).

Fetal Risks and Surveillance:

Babies in multiple gestations face a higher risk for certain conditions:

- **Prematurity:** Highly likely, with about 60% of twins born before 37 weeks (often 34–37 weeks). This increases the risk of respiratory, feeding, and infection issues, possibly requiring neonatal unit care. Steroids may be given if early birth is anticipated to aid lung development.
- **Growth Problems:** Affect 20–30% of twins, requiring more frequent scans.
- Intrauterine Growth Restriction (IUGR): Higher risk in multiples; surveillance with interval growth ultrasounds is required. An ultrasound every four weeks, starting around 24 weeks gestation, is recommended.
- **Twin to Twin Transfusion Syndrome (TTTS):** A risk for monochorionic twins sharing a placenta. The 'donor' twin may suffer from too little blood/low blood pressure, while the 'recipient' twin may have too much blood/high blood pressure.
- **Fetal Mortality:** Significantly higher compared to singleton pregnancies. Fetal Heart Rate (FHR) should be monitored via ultrasound at every prenatal appointment.

Delivery Timing:

Due to the increased risk of intrauterine fetal demise, routine labor induction is advised:

- Diamniotic/dichorionic twins: at 38 weeks gestation.
- Monoamniotic/dichorionic twins: at 36–37 weeks gestation.

B. Intrapartum Management

Intrapartum complications include malpresentations, cord prolapse, locked twins, placental abruption, and postpartum hemorrhage, primarily stemming from the twins' presentation.

Presentation and Delivery:

- Presentations can be transverse lie, breech, or vertex. Vertex-vertex is the most common.
- Vaginal delivery may be allowed with proper monitoring and emergency Caesarean arrangements.
- A physician experienced in vaginal breech deliveries should be available for all twin vaginal deliveries, as the second twin may present breech or transversely after the first delivery.
- If the second twin presents as a transverse lie or breech, the choice is between a Caesarean delivery or attempting an External Cephalic Version (ECV) to vertex.

Management of the Second Twin:

- Close monitoring is required for the second twin due to the risk of placental abruption and umbilical cord prolapse between deliveries.
- Delivery in an operating room is best practice to allow for prompt Caesarean section if needed. An anesthetist should be on call.
- Time between deliveries is not critical if the second twin is stable, though oxytocin augmentation is frequently used for delay.
- A breech extraction or internal podalic version is possible if the second twin presents obliquely, transversely, or as a footling breech, provided the baby weighs over 1,500 grams or is past 32 weeks gestation, and the doctor is skilled.

Circumstances Requiring Caesarean Delivery:

- First twin in a non-vertex presentation (Caesarean is advised in most cases).
- Cord prolapse.
- Placental abruption.
- Inability to reach the feet for internal podalic version.
- Breech extraction of a baby in a transverse lie.
- Risk of the cervix closing after the first twin's delivery (necessitating an option for an immediate Caesarean).
- Locking or collision of the twins (rare, catastrophic event) when the first twin is breech and the second is vertex or transverse.

Contraindication: ECV of a breech first twin is contraindicated.

Post-Delivery Considerations:

- Postpartum hemorrhage is common due to uterine overdistension. Complete preparations are essential, including blood products, oxytocic medications, and IV access.
- Neonatal resuscitation is frequently required due to prematurity.

CHAPTER ELEVEN

First-trimester pregnancy complications

Learning Objectives

The learner will be able to:

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

First Trimester Pregnancy Complications (Weeks 1-12)

The first trimester of pregnancy is a critical phase for development, during which several complications can arise that significantly impact both maternal and fetal health. Below are some of the most common complications encountered during this period.

1. Miscarriage (Spontaneous Abortion)

A miscarriage is defined as the loss of a pregnancy before 20 weeks of gestation, which precedes the period of fetal viability. The majority of miscarriages (over 80%) occur within the first trimester, affecting an estimated 10% to 30% of all pregnancies.

Common Symptoms:

- Vaginal bleeding
- Abdominal cramping
- Passing of tissue

Risk Factors:

- Advanced maternal age
- History of previous miscarriages
- Physical trauma
- Infections (e.g., TORCHES, malaria)
- Endocrine disorders (e.g., uncontrolled diabetes, hypothyroidism, PolyCystic Ovary Syndrome - PCOS)
- Uterine abnormalities (e.g., uterine fibroids)
- Psychological stress
- Fetal chromosomal abnormalities (e.g., Down syndrome)
- Maternal exposure to chemical agents (e.g., tobacco, arsenic, pesticides)

Types of Abortion:

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

2- Threatened Abortion

Definition:

- Painless vaginal bleeding occurring between the time of implantation and 24 weeks of gestation.
- It signifies that the Products OF Conception (POC) are at risk of being aborted, but the abortion has not yet occurred.

Clinical Presentation:

- Minimal, painless vaginal bleeding.
- Often accompanied by dull, aching lower abdominal pain.

Examination Findings:

- The size of the uterus is consistent with the estimated Period OF Amenorrhea (POA).
- The cervical os remains closed.
- Ultrasound (U/S): Reveals a well-formed, rounded gestational sac containing a fetus.

Management:

- Prescribe bed rest.
- Recommend folic acid supplements.
- Advise the patient to avoid sexual intercourse (coitus).

3. Inevitable Abortion

Definition:

Inevitable abortion is characterized by painful vaginal bleeding originating from the retro-placental site, where the Products OF Conception (POC) are in the process of being aborted but have not yet been fully expelled. This condition may progress to a complete or incomplete abortion, depending on whether all fetal and placental tissues are eventually expelled from the uterus.

Clinical Presentation:

Symptoms: Painful vaginal bleeding and associated cramping pain in the lower abdomen.

Examination Findings:

- Uterus Size: The size of the uterus is equal to or smaller than the Period OF Amenorrhea (POA).

Cervical Os: The cervical os is dilated.

Management:

- Hospitalization.
- Administration of analgesics for pain control.

Figure 11.1: Inevitable Abortion

4- Incomplete Abortion

Definition:

An incomplete abortion occurs when the Products OF Conception (POC) have been partially, but not entirely, expelled from the uterus.

Clinical Presentation:

Patients typically present with vaginal bleeding, which may be heavy and include the passage of fleshy masses (POC). This bleeding is often accompanied by colicky pain in the lower abdomen. Signs of shock may or may not be present, depending on the severity of blood loss.

Examination Findings:

- Uterine Size: The uterus is usually smaller than expected for the calculated period of amenorrhea (POA).
- Cervical Os: The cervical opening is patent (open).
- Ultrasound (U/S): Imaging will demonstrate retained products of conception (RPOC) within the uterine cavity.

Management:

- Resuscitation: If bleeding is severe, immediate resuscitation is necessary.
- Blood Work: Obtain blood for grouping and cross-matching.

- Pain Control: Administer analgesia for pain relief.
- Definitive Treatment: Perform evacuation of the retained products of conception (ERPC).

5- Missed Abortion

Definition:

A condition where the embryo or fetus has died but is retained within the uterine cavity for a period of time without the typical signs or symptoms of a spontaneous miscarriage.

Clinical Presentation:

- Symptoms: A decrease in or disappearance of typical pregnancy symptoms, and vaginal bleeding is either absent or minimal.
- Physical Examination: The size of the uterus is smaller than expected for the calculated period of amenorrhea (POA).
- Cervical Os: The cervical os is closed.

Ultrasound Findings (U/S):

- A 'crumpled' gestational sac may be observed.

Fetal pole is visible, but there is an absence of activity (no fetal heart activity).

Management:

Observation to await spontaneous expulsion, or management for retained products of conception (ERPOC) if expulsion does not occur or is incomplete.

Figure 11.2: Missed Abortion

6- Complete Abortion

Definition:

All products of conception (POC) have been completely expelled.

Clinical Presentation:

History: The patient typically reports a history of pain and passage of tissue/products, followed by the cessation of pain and minimal residual bleeding.

Examination:

Uterine size is smaller than expected for the Period of Amenorrhea (POA).

- Cervical os is closed.
- Ultrasound (U/S): Demonstrates an empty uterine cavity.

Management:

Confirmation of an empty uterine cavity via Ultrasound (U/S).

7- Recurrent Abortion

Definition:

Three or more consecutive spontaneous abortions. This condition is generally categorized into two groups based on the trimester of loss.

Etiology by Trimester:

1- Trimester Abortion (<12 weeks):

6. Uterine Abnormalities: e.g., uterine fibroid.
7. Endocrine Factors: e.g., Diabetes Mellitus (DM), thyrotoxicosis, Polycystic Ovary Syndrome (PCOS).
8. Autoimmune Conditions: e.g., Systemic Lupus Erythematosus (SLE).
9. Infections: TORCHES group (Toxoplasmosis, Others (syphilis, varicella-zoster, parvovirus B19), Rubella, Cytomegalovirus, Herpes Simplex Virus, HIV).

2- Trimester Abortion (>12 weeks):

1. Cervical Incompetence: Associated with a history of procedures such as termination of pregnancy, vigorous cervical dilatation, or cone biopsy.
2. Uterine Abnormalities: e.g., septate or subseptate uterus.

Ectopic Pregnancy

An ectopic pregnancy is the implantation of a fertilized egg (gestation) outside the uterus, most often in a fallopian tube. This condition is a medical emergency that can cause severe abdominal pain and necessitates immediate medical care.

Signs and Symptoms:

- Sharp pain in the lower abdomen, back, or pelvis
- Vaginal bleeding
- Shoulder pain (referred pain)
- Syncopal episodes (fainting) due to internal bleeding (hemoperitoneum)
- Symptoms of hypovolemic shock

Factors Increasing Ectopic Pregnancy Risk:

- Prior ectopic pregnancy
- History of Pelvic Inflammatory Disease (PID)
- Fallopian tube procedures or previous pelvic surgery
- Ovulation induction treatment
- Smoking
- Anatomical issues, such as uterine fibroids or congenital uterine anomalies.

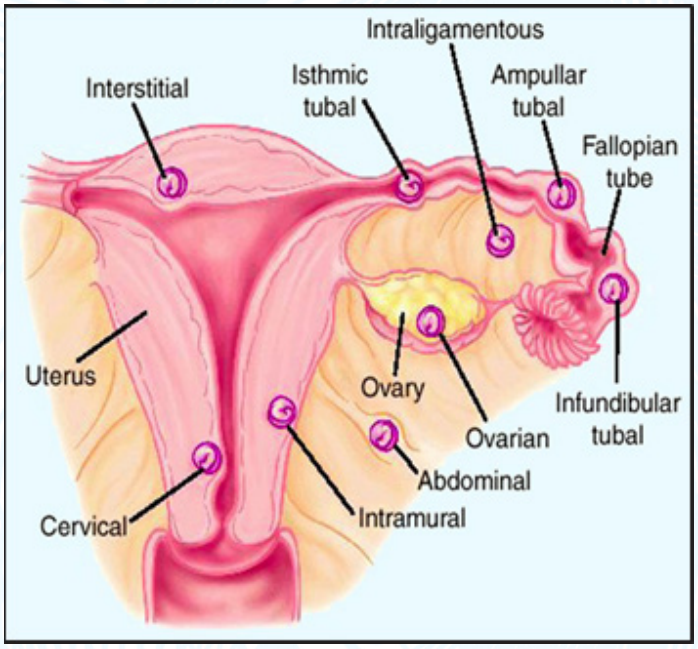


Figure 11.3: Ectopic Pregnancy

Common Implantation Sites:

- Fallopian Tube:
- Fimbriae
- Ampullary-isthmic junction
- Interstitial segment
- Ovary
- Abdominal Cavity
- Cervix

Clinical Examination Findings:

- Vital Signs: May show signs of instability, such as hypotension, tachycardia, or fever.
- General Appearance: Often presents with pallor.
- Abdominal Palpation: Uterus is typically non-palpable; presence of tenderness and/or guarding.

Speculum and Vaginal Examination:

- Cervical os is closed.
- Cervical excitation (tenderness upon moving the cervix).
- Possible adnexal mass.
- Bimanual examination of the uterus.

Diagnostic Investigations:

- Urinary Pregnancy Test: Positive.
- Quantitative Beta hCG (Human Chorionic Gonadotropin): Ectopic pregnancy should be highly suspected if the beta hCG level is 1,500 mIU/mL and a transvaginal ultrasound fails to demonstrate an intrauterine gestational sac.
- Imaging (Transvaginal Ultrasound):
- Evidence of an empty uterus.
- Detection of free fluid, particularly in the Pouch of Douglas.
- Surgical:
- Diagnostic laparoscopy.

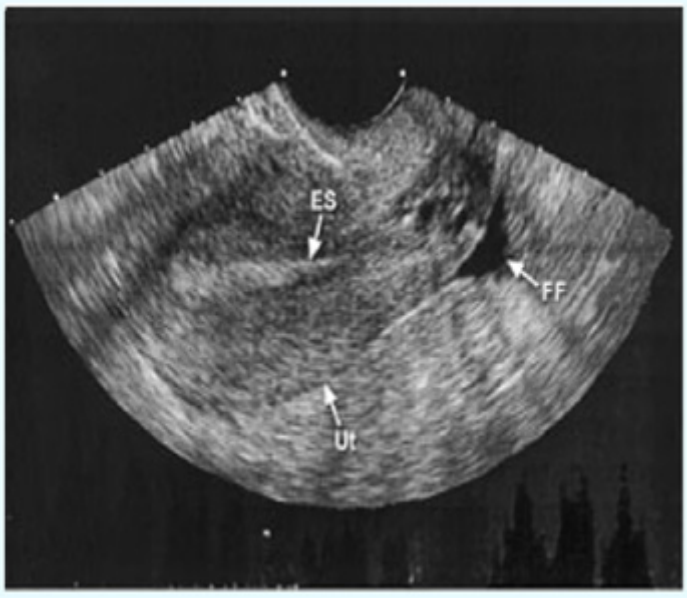


Figure 11.4: Ectopic Pregnancy

Management of Ectopic Pregnancy:

- Stabilization: Ensure patient stability.

Surgical Options:

- Salpingectomy (removal of the fallopian tube) or Salpingotomy (incision into the fallopian tube).
- Procedure can be performed via laparotomy or laparoscopy.

Medical Treatment: Methotrexate, administered intramuscularly or directly into the tubal pregnancy.

3- Hyperemesis Gravidarum

This condition is defined by severe nausea and vomiting leading to dehydration, electrolyte imbalance, and weight loss, often requiring medical intervention.

Symptoms:

- Inability to retain food or water.
- Severe vomiting.
- Extreme fatigue.

Risk Factors:

- A history of hyperemesis in previous pregnancies.
- Carrying multiple fetuses (e.g., twins, triplets).
- Having a molar pregnancy.

4- Bleeding in Early Pregnancy

Approximately 25% of pregnant women experience some form of bleeding early in their pregnancy. While minor spotting is often normal, heavy bleeding, especially when accompanied by pain, may signal a miscarriage or an ectopic pregnancy.

5- Gestational Trophoblastic Disease (Molar Pregnancy)

This is a rare pregnancy complication characterized by the abnormal growth of tissue inside the uterus instead of a viable fetus. Medical monitoring and potential treatment are required to prevent complications.

Symptoms:

- Severe nausea
- Rapid uterine growth
- Vaginal discharge that is dark brown or has a grape-like appearance

Risk Factors:

- Maternal age over 35
- A history of previous molar pregnancy

Classification of Molar Pregnancy:

- Complete Hydatiform Mole: No normal fetal tissue develops.
- Partial Hydatiform Mole: Incomplete fetal tissues form alongside the abnormal molar tissue.

Choriocarcinoma (Invasive Mole): This type contains numerous villi and may penetrate or grow through the muscular layer of the uterine wall. It has the potential to spread to tissues outside the uterus.

Table 11.1: 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 11.2: 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 11. 4 Chromosomes distributions in Molar Pregnancy

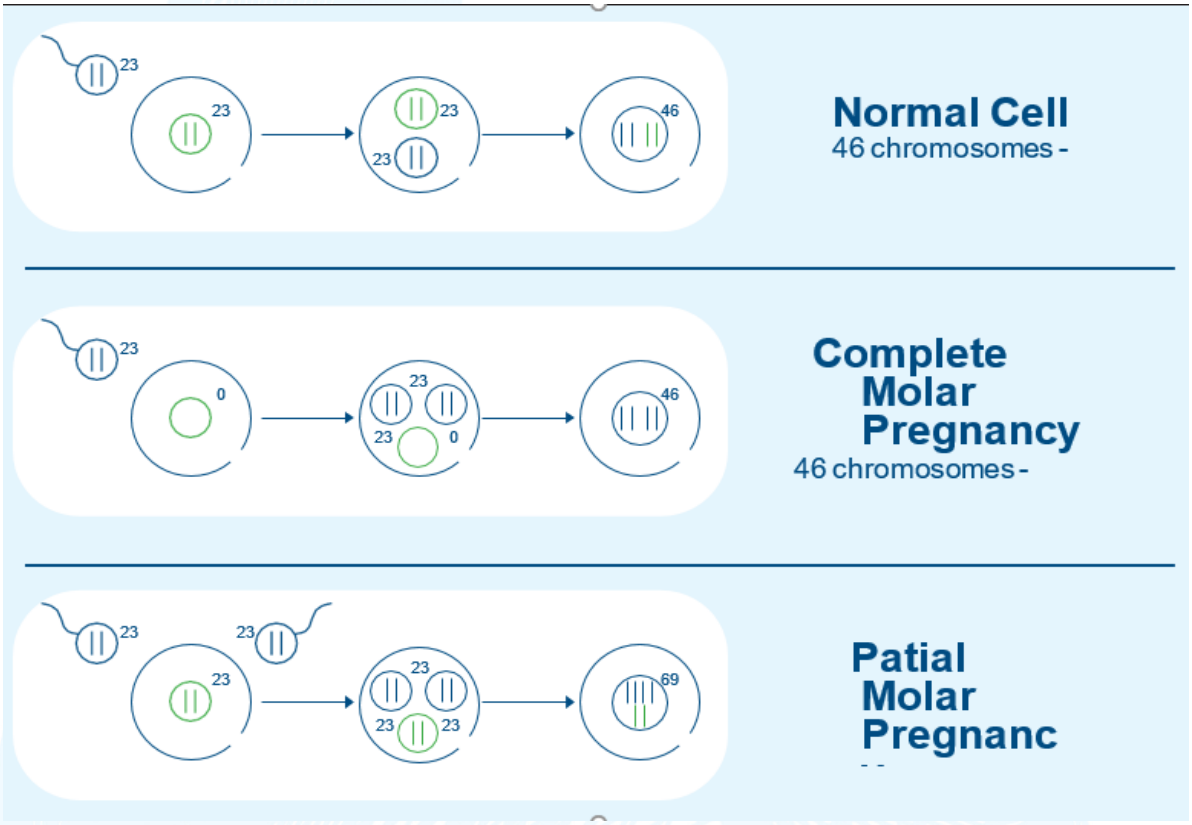


Table 11.3: Clinical features of molar pregnancy

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 of Gestational Trophoblastic Disease (GTD)

Initial Diagnostic Tests:

- Urinary Pregnancy Test
- Serum B-hCG Level
- Ultrasound (U/S)

Ultrasound Findings:

- Complete Molar Pregnancy: Characterized by the absence of a fetus and a classic “snowstorm” appearance.
- Incomplete Molar Pregnancy: May show molar degeneration of the placenta, with or without fetal anomalies. Features include multiple echogenic regions corresponding to hydropic villi and focal intrauterine hemorrhage.

Further Evaluation:

- Chest X-Ray (CXR): To assess for potential metastatic lesions.

Features Suggesting High Risk of Neoplasm:

- Local uterine invasion
- level greater than 100,000
- Excessive uterine size for dates
- Prominent theca-lutein cysts

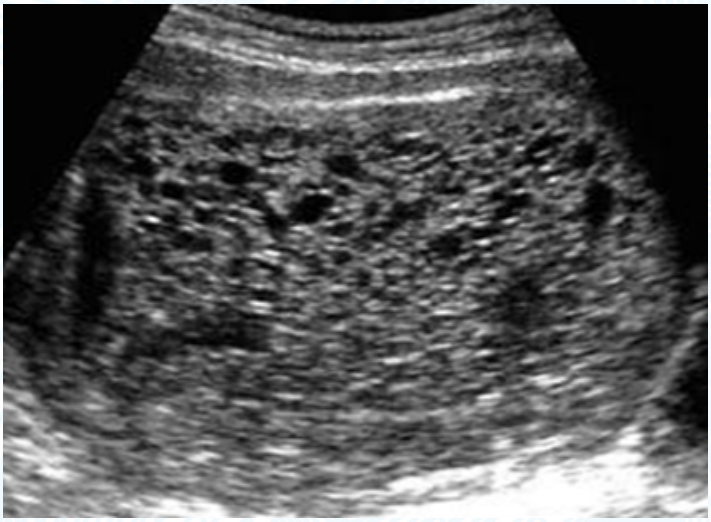


Figure 11.5: U/S for molar pregnancy

Treatment:

- Suction and curettage.
- Administer Rhogam if the patient is rhesus negative.
- Consider hysterectomy, especially if the patient has completed childbearing/no longer desires fertility.
- Chemotherapy for confirmed carcinoma.

Follow-up:

- TCA (Tissue Culture Assay) every two weeks (2/52) until a negative urinary pregnancy test is achieved.

- Monitor Beta-hCG levels every two weeks (2/52) until they return to normal.

Subsequently, follow-up should be:

- Monthly until one year.
- Every three months (3 monthly) until one year.

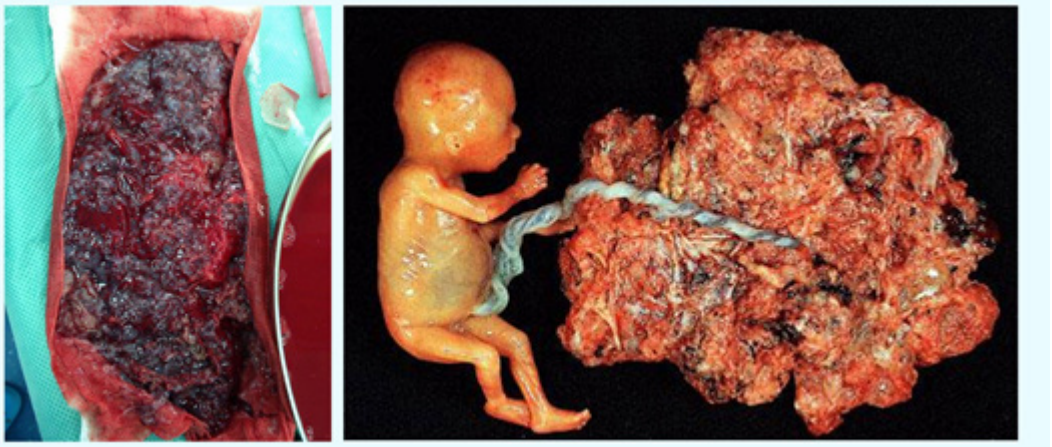


Figure 11.6: Suction and curettage for molar pregnancy

6. Subchorionic Hemorrhage (Subchorionic Hematoma)

Description: A collection of blood that forms between the uterine lining and the chorionic membrane, which envelops the embryo.

Symptoms: Typically presents as vaginal bleeding or spotting, often without associated pain.

Risk Factors: The underlying causes are not fully understood, though some individuals experience small, localized bleeds early in the gestation period.

7. Threatened Miscarriage

Description: A condition where vaginal bleeding and cramping occur, but the cervix remains closed, and the pregnancy continues to be viable.

Symptoms: Ranging from light spotting to heavy vaginal bleeding, accompanied by cramping.

Risk Factors: Implicated factors include hormonal imbalances or issues with placental function.

8. Blighted Ovum (Anembryonic Pregnancy)

Description: A situation where a fertilized egg successfully implants in the uterus, but an embryo fails to develop.

Symptoms: May include vaginal bleeding or cramping, with an ultrasound typically confirming the presence of an empty gestational sac.

Risk Factors: Primarily associated with chromosomal abnormalities within the fertilized egg.

9. Infections

Description: Various infections, such as urinary tract infections (UTIs) or sexually transmitted infections (STIs), can lead to pregnancy complications.

Symptoms: Can manifest as painful urination, pelvic discomfort, fever, or an abnormal vaginal discharge.

Risk Factors: Factors include unprotected sexual activity, poor personal hygiene, or pre-existing health conditions.

10. Severe Cramping

Description: While mild cramping is a common and normal occurrence during pregnancy, severe or intense cramping can signal a more serious underlying issue, such as a miscarriage or an 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 (Rh Disease)

This condition arises when an Rh-negative mother is pregnant with an Rh-positive fetus. The mother's immune system may recognize the fetal blood as foreign and produce antibodies that can potentially attack the fetus.

Signs and Risk Factors:

Early stages are often asymptomatic. However, if left untreated, Rh incompatibility can lead to serious complications. The primary risk factor is having an Rh-negative blood type.

CHAPTER TWELVE

Vaginal Bleeding in Late Pregnancy

Learning Objectives

The learner will be able to:

1. List the main etiologies of third-trimester hemorrhage.
2. Detail the necessary evaluation steps for a patient presenting with antepartum hemorrhage.
3. Explain the appropriate management strategies for third-trimester bleeding.

Vaginal bleeding in the later stages of pregnancy

> 20 wks necessitates immediate medical evaluation. This bleeding can signal a risk of miscarriage or severe hemorrhage, posing a danger to both the woman and the fetus. In extreme cases, substantial blood loss can lead to life-threateningly low blood pressure (shock) or disseminated intravascular coagulation, a condition characterized by small blood clots forming throughout the bloodstream.

Pathophysiology

The most common cause of late-pregnancy vaginal bleeding is the onset of labor. This may begin with the expulsion of the mucus plug, a sticky mass of mucus and sometimes streaks of blood from the cervix which suggests labor is likely to begin within the following week.

Labor is typically heralded by a slight discharge of blood mixed with mucus, known as the “bloody show.” This minimal discharge occurs as the cervix begins to dilate, tearing small veins to allow for the fetus to pass through.

More serious, but less frequent, causes of late-pregnancy vaginal bleeding include:

- Placenta previa
- Placental abruption
- Vasa previa (rare)
- Uterine rupture (rare occurrence)

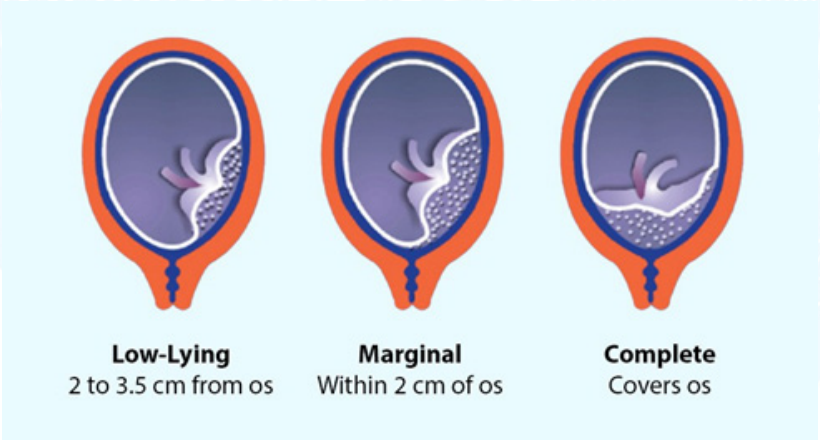


Figure 12.1: Abnormal placental implantation

Placenta previa is a condition where the placenta implants in the lower uterine segment rather than the upper portion. This abnormal positioning can result in the partial or complete blockage of the cervix, the exit for the fetus. Unanticipated bleeding, or bleeding triggered by a cervical examination to assess dilation or the commencement of labor, can occur.

Placenta previa causes about one fifth of late pregnancy bleeding, most often in the third trimester. Although it may be low earlier, the placenta usually moves up before this trimester.

Table 12.1: 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 con- tractions Some times, maternal hypotension Signs of fetal distress (eg, bradycardia or pro- longed deceleration, repetitive late decelerations, sinusoidal pattern)	Maternal vital signs and pelvic ex- amination 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 ultraso- nography	NOTE: DIGITAL CERVICAL EXAMINA- TION 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 Doppler studies
Uterine rupture	Severe abdominal pain, tenderness, cessation of contractions, often loss of uterine tone	clinical suspicion, based on charac- teristic signs and symptoms

Vasa previa

Vasa previa is a rare complication of pregnancy in which the fetal blood vessels from the umbilical cord cross or run near the opening of the cervix. Because these vessels block the fetal passage, their rupture during labor can cause significant, potentially fatal, blood loss for the fetus due to its small blood volume.

Placental Abruption

Placental abruption refers to the premature detachment of the placenta from the uterine wall.While the precise cause is often unknown, it may be linked to insufficient blood flow to the placenta or can follow an external injury, such as a car accident. Blood loss may be greater than it appears because it can be concealed behind the placenta. Placental abruption is the leading life-threatening cause of late pregnancy bleeding, accounting for roughly 30% of such cases, and while it can occur at any time, it is most common in the third trimester.

Uterine Rupture

Uterine rupture is most likely to happen during labor, particularly in women with a damaged uterus that has scar tissue. This damage frequently stems from a previous cesarean delivery or other uterine operations, like a myomectomy to remove fibroids.

Other Causes

Bleeding can also be caused by disorders unrelated to pregnancy.

Risk Factors for Late Pregnancy Bleeding

Several conditions heighten the risk of complications that may result in late pregnancy bleeding:

Risk Factors for Placenta Previa:

- Prior cesarean delivery
- Multiple previous pregnancies
- Carrying multiple fetuses (twins, triplets, etc.)
- History of placenta previa
- Maternal age over 35
- Cigarette smoking
- Undergoing In Vitro Fertilization (IVF)

Risk Factors for Vasa Previa:

- A low-lying placenta
- A segmented placenta
- Carrying multiple fetuses
- In vitro fertilization (IVF)

Risk Factors for Placental Abruption:

- High blood pressure
- Maternal age over 35
- Having had one or more previous pregnancies
- Cigarette smoking
- Cocaine use
- History of placental abruption
- Recent abdominal trauma, such as from a car crash

Risk Factors for Uterine Rupture:

- Previous cesarean delivery
- Any prior uterine surgery
- Maternal age over 30
- Past 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 12.2: Risk factors of bleeding during late pregnancy

Cause	Risk Factors
Placental abruption	Hypertension Age > 35 Multiparity Cigarette smoking Cocaine Previous placental abruption Physical 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 multiparity (delivery of > 5 viable fetuses) Uterine abnormalities Multifetal pregnancy

Diagnosis and Evaluation of Vaginal Bleeding in Late Pregnancy

The evaluation of vaginal bleeding in late pregnancy is critical, with doctors immediately prioritizing the exclusion of life-threatening conditions such as:

- Placental abruption
- Placenta previa
- Vasa previa
- Uterine rupture

If these serious causes are ruled out, the most probable diagnosis is the onset of labor, indicated by the "bloody show" (minimal, short-lived bleeding from the expulsion of the mucus plug).

Warning Signs and Alarming Symptoms

Bleeding during late pregnancy is always a concern and is viewed as a warning sign, with the minor exception of the minimal bleeding from the "bloody show" or mucus plug. Healthcare providers must pay close attention, especially when there are indicators of significant blood loss or fetal distress.

Signs of Low Blood Pressure/Shock:

- Fainting
- Lightheadedness
- Rapid heartbeat (indicative of very low blood pressure)

Other Alarming Symptoms:

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

Patient Assessment

A woman experiencing late-pregnancy vaginal bleeding will be thoroughly evaluated based on:

- Bleeding characteristics: duration, severity, and color.
- Accompanying symptoms: abdominal pain, light-headedness, or fainting.
- Obstetric history: number of pregnancies, live births, miscarriages, or abortions, and complications in previous pregnancies.
- Membrane status: whether the amniotic sac has ruptured (often signaling labor onset).
- Risk factors: assessment of risks for common and serious causes of bleeding, particularly previous cesarean deliveries.

Physical Examination

The physical exam focuses on assessing the mother's stability and fetal well-being:

Maternal Status: Checking for signs of significant blood loss, such as a rapid heart rate and low blood pressure.

- Fetal Monitoring: Continuous monitoring of the fetal heart rate, often using electronic fetal heart monitoring.

Abdominal Assessment: Palpation of the abdomen to determine the uterus's size, tenderness, and muscle tone.

Pelvic Exam: A pelvic examination is performed, including a speculum exam of the cervix.

Crucial Examination Protocol: If bleeding occurs late in pregnancy, ultrasonography must be performed first to check for placenta previa and vasa previa. A digital cervical examination is avoided if these conditions are diagnosed to prevent worsening the bleeding. Women with known placenta previa or vasa previa should inform their clinicians and decline a digital exam, though a careful speculum exam may still be conducted.Testing

The following diagnostic tests are conducted:

- Fetal heart rate monitoring
- Ultrasonography
- Complete blood cell count (CBC)
- Blood type and Rh status (for potential transfusion)
- Occasionally, blood tests to check for normal blood clotting

Diagnostic Imaging

Ultrasonography is vital for identifying the bleeding source. Transvaginal ultrasonography is specifically used to locate the placenta, umbilical cord, and blood vessels, helping to confirm or exclude placenta previa and vasa previa. However, placental abruption is often a clinical diagnosis, based on physical examination and known risk factors, as ultrasonography may not always reveal it. Uterine rupture is also diagnosed primarily based on physical examination findings.

Laboratory Work

A CBC is performed, and blood type and Rh status are established to ensure a compatible blood donor is available if a transfusion is required. In cases of significant bleeding or suspected placental abruption, tests for Disseminated Intravascular Coagulation (DIC) are conducted.

Management

The primary goal is to treat the underlying disorder causing the bleeding.

Hospitalization and Monitoring

For placental abruption or placenta previa, hospital admission is typically recommended unless immediate delivery is unnecessary and both the mother and fetus are stable. This ensures close monitoring and immediate access to treatment.

Delivery Decisions

Stable Condition: The woman may be allowed to return home if the bleeding stops and she remains stable.

Indication for Delivery: If bleeding persists, worsens, or if the pregnancy is near term, delivery is initiated.

Placenta Previa: Requires cesarean delivery.

Placental Abruption: May involve either vaginal or cesarean delivery.

Vasa Previa: Requires a scheduled cesarean delivery, typically between 34 and 37 weeks. Immediate cesarean delivery is necessary if bleeding occurs.

Uterine Rupture: Requires immediate delivery of the baby, followed by surgical repair of the uterus.

Resuscitation

A woman who has lost a significant amount of blood receives intravenous fluids. Blood transfusions are administered if fluid treatment alone is insufficient to stabilize her condition.

CHAPTER THIRTEEN

Postpartum Hemorrhage

Learning Objectives

The learner will be able to:

1. Define postpartum hemorrhage (PPH).
2. Differentiate between primary and secondary PPH.
3. Recall the four main causes of PPH, often referred to as the four Ts.
4. Identify risk factors for PPH and their potential implications for maternal and neonatal health.
5. Examine the full spectrum of postpartum bleeding prevention and management strategies.

Introduction

PostPartum Hemorrhage (PPH) is recognized as the leading cause of maternal mortality and morbidity worldwide, accounting for roughly one-quarter of all deaths during pregnancy, childbirth, or the puerperium. This high incidence is particularly pronounced in developing nations. Maternal mortality is a critical event and a key metric reflecting a country's overall health and development.

In Western countries, the five primary causes of maternal death include PPH, thromboembolic disease, hypertension-related conditions like preeclampsia, sepsis, and anesthesia-related complications. Globally, obstetric hemorrhage remains the main cause of maternal deaths, representing 27% of fatalities annually, with PPH being responsible for the majority. The World Health Organization (WHO) estimates that approximately 14 million women suffer from PPH each year.

The WHO reported an estimated 287,000 maternal deaths globally in 2020. The vast majority of these (99%) occur in developing countries, with 87% concentrated in sub-Saharan Africa and South Asia.

Sub-Saharan Africa alone accounts for 66% of all maternal deaths. In these regions, the risk of maternal death due to PPH is significantly higher approximately 1 in 1,000 deliveries which is about 100 times greater than the 1 in 100,000 rate observed in wealthier nations.According to a 2017 WHO report, Saudi Arabia had a Maternal Mortality Ratio (MMR) of approximately 17%, with a modest 29% reduction rate between 2000 and 2017. More recently, in 2022, the Ministry of Health in Saudi Arabia reported 5,464 pregnant women suffering from postpartum bleeding.

Table 13.1 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

Postpartum hemorrhage (PPH) constitutes significant blood loss following delivery. Primary PPH, as defined by the American College of Obstetricians and Gynecologists (ACOG), involves a cumulative blood loss of 1,000 mL or any volume accompanied by signs of hypovolemia within the day of delivery (or including intrapartum loss). This can manifest either before or after placental expulsion. Secondary PPH is defined as hemorrhage occurring from 24 hours up to 12 weeks postpartum. The consequences of PPH range from common sequelae such as postpartum fatigue and depression to severe outcomes, including life-threatening cardiovascular collapse and the requirement for hysterectomy.

Typically, Postpartum Hemorrhage (PPH) is defined by the Ministry of Health (MOH) and local practitioners as a blood loss of 500 mL following a vaginal delivery or 1000 mL after a cesarean section.

Table 13.2 Postpartum Hemorrhage Complications

Systemic/General	Severe Outcomes
Anemia	Death
Fatigue	Dilutional coagulopathy
Orthostatic hypotension	Blood transfusion (necessity)
Myocardial ischemia	
Endocrine/Psychological	
Sheehan syndrome (postpartum pituitary necrosis): Characterized by delayed or absent lactation due to anterior pituitary ischemia.	Postpartum depression

The Royal College of Obstetricians & Gynaecologists (RCOG) classifies postpartum hemorrhage (PPH) based on estimated blood loss. Minor PPH involves an estimated blood loss between 500 and 1,000 mL. Major PPH, defined as blood loss exceeding 1,000 mL, is further subdivided: major controlled refers to cases where the bleeding is managed, while major persistent signifies blood loss so severe that it poses an imminent danger to the mother's life.

Table 13.3 Clinical Manifestations of Postpartum Hemorrhage

Signs (Objective Findings)	Symptoms (Subjective Complaints)
Blood loss exceeding 1,000 mL	Restlessness
Tachycardia (rapid heart rate)	Weakness
Hypotension (low blood pressure)	Dizziness
Pallor (pale skin)	Confusion
Diaphoresis (profuse sweating)	Chest pain
Syncope (fainting)	Dyspnea (shortness of breath)
Oliguria (decreased urine output)	Palpitations
Hypoxia (low oxygen levels)	Nausea

Risk Factors for Postpartum Hemorrhage (PPH)

While risk factors serve as a prompt for increased vigilance, it is important to note that only a small percentage of women with these factors will actually experience PPH. Possible predisposing factors can be categorized as follows:

Antenatal Factors:

- Previous history of PPH
- Placenta praevia or accreta
- Fetal macrosomia (newborn weighing over 4 kg)
- Hypertensive disorders
- Obesity
- High parity
- Pre-existing bleeding disorders

Intrapartum Factors:

- Induction and/or augmentation of labor
- Prolonged first stage of labor (over 24 hours)
- Delay in the progress of the second stage
- Precipitate labor (very rapid)
- Instrumental delivery (e.g., forceps, vacuum)
- Caesarean section
- Retained placenta
- Genital tract lacerations

Prevention of PostPartum Hemorrhage (PPH)

Active Management of the Third Stage of Labor (AMTSL) is the most effective method for preventing PPH. AMTSL lessens the need for manual removal of the placenta and reduces the risk of the mother's hemoglobin levels falling below 9 g/dL (90 g/dL) after delivery.

Active Management of Third Stage of Labor (AMTSL) Components:

The Active Management of the Third Stage of Labor (AMTSL) involves three key interventions:

- Oxytocin Administration: Administer Oxytocin (Pitocin) either during or immediately after the delivery of the baby's anterior shoulder.
- Controlled Cord Traction: Utilize the Brandt-Andrews maneuver for placental delivery.
- Uterine Massage: Perform uterine massage immediately following the expulsion or delivery of the placenta.

Table 13.4 Strategies to reduce postpartum hemorrhage (PPH) complications, morbidity, and mortality

Preparedness
A postpartum hemorrhage (PPH) cart, containing necessary medications, supplies, a checklist, and detailed instructions, must be readily available. A dedicated response team and a clear contact protocol should be established. Protocols for massive and emergency blood release must be instituted. Regular unit education and drills should be conducted.
Prevention and Identification
Antenatal: Implement screening and treatment protocols for anemia; screen high-risk women for sickle cell disease and thalassemia; utilize ultrasonography for women at high risk of placenta accreta spectrum; ensure delivery of high-risk patients occurs at facilities equipped with blood banking and surgical services. **Intrapartum:** Employ active management of the third stage of labor. Refrain from routine use of episiotomy and instrumented deliveries, particularly forceps. Apply warm compresses to the perineum. Quantify cumulative blood loss and meticulously monitor postpartum vital signs.
Response
Implement an emergency management plan inclusive of detailed checklists. Establish a comprehensive support program for patients, their families, and staff.

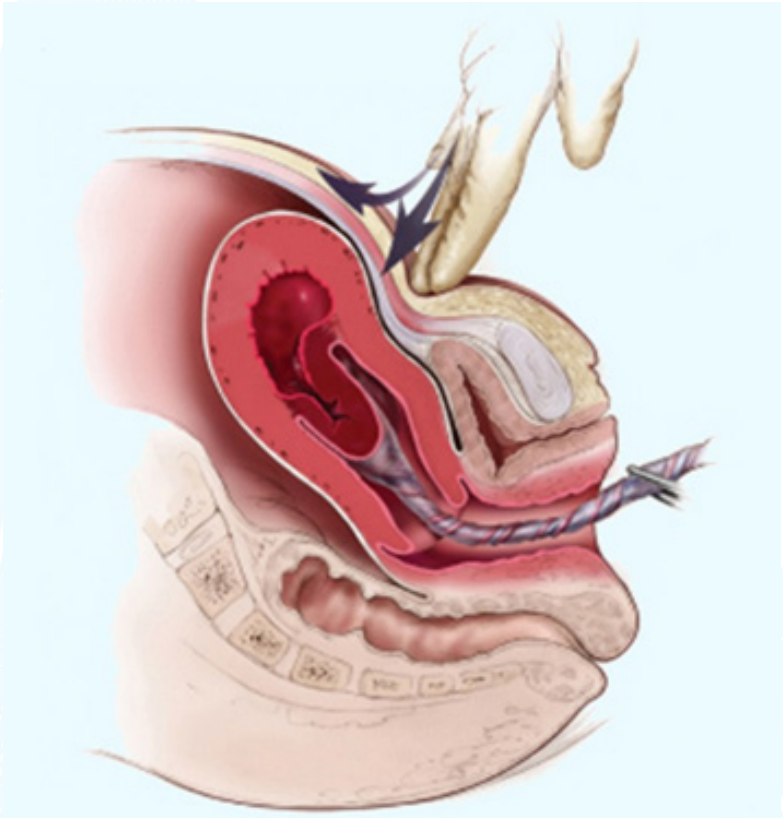


Figure 13.1 The Brandt-Andrews maneuver is a technique for controlled cord traction, involving firm umbilical cord traction with one hand and suprapubic counterpressure with the other.

Diagnosis and Initial Management of Postpartum Hemorrhage (PPH)

Diagnosing postpartum hemorrhage (PPH) involves two key steps: recognizing excessive blood loss and performing a targeted examination to find the source. Crucial to patient care is the accurate quantitative monitoring of blood loss during labor, delivery, and the postpartum period. While significant blood loss is possible during the intrapartum phase (e.g., due to uterine rupture or episiotomy), it is important to note that the majority of fluid expelled during delivery is typically amniotic fluid or urine, rather than blood.

Quantitative Measurement of Blood Loss

Immediate and quantitative assessment of bleeding is crucial and should begin right after birth. Accurate measurement involves a cumulative approach, which may include using a calibrated drape positioned under the buttocks, weighing all blood-soaked materials (pads and sponges), and/or weighing any clots. Combining these techniques helps ensure the most precise assessment.

Clinical Signs and Symptoms

Generally, healthy pregnant women can tolerate a blood loss of 500 to 1,000 mL without experiencing symptoms. Tachycardia (rapid heart rate) is often the earliest indicator of developing PPH. More significant hemorrhage, leading to hypovolemia, can be signaled by signs such as orthostatic hypotension, nausea, dyspnea (shortness of breath), oliguria (decreased urine output), and chest pain.

Identifying the Cause (The 'Four T's') and Immediate Action

The "Four T's" mnemonic serves as a helpful method for determining the precise cause:

- Tone: Uterine atony (most common cause)
- Trauma: Laceration, hematoma, uterine inversion, or uterine rupture
- Tissue: Retained placental tissue or invasive placenta
- Thrombin: Coagulopathy (a pre-existing or acquired blood clotting disorder)

Call for additional help and initiate emergency hemorrhage protocols.

Table 13.5 The Four T's: Etiologies of Postpartum Hemorrhage

Etiology (The Four T's)	Specific Causes	Approximate Incidence (%)
Tone	Uterine atony	70
Trauma	Genital tract lacerations, hematomas, uterine inversion, uterine rupture	20
Tissue	Retained placental tissue, abnormal placentation (placenta accreta, increta, or percreta)	10
Thrombin	Coagulopathies (pre-existing or acquired disorders of hemostasis)	1

Uterine atony

The main cause of PPH. If significant bleeding occurs after the placenta is delivered and does not stop with transabdominal massage, immediate steps are required. These include bimanual uterine compression and the administration of uterotonic medications.

The technique for bimanual compression involves one hand placed 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 to treat PPH. Oxytocin is considered the most effective agent.

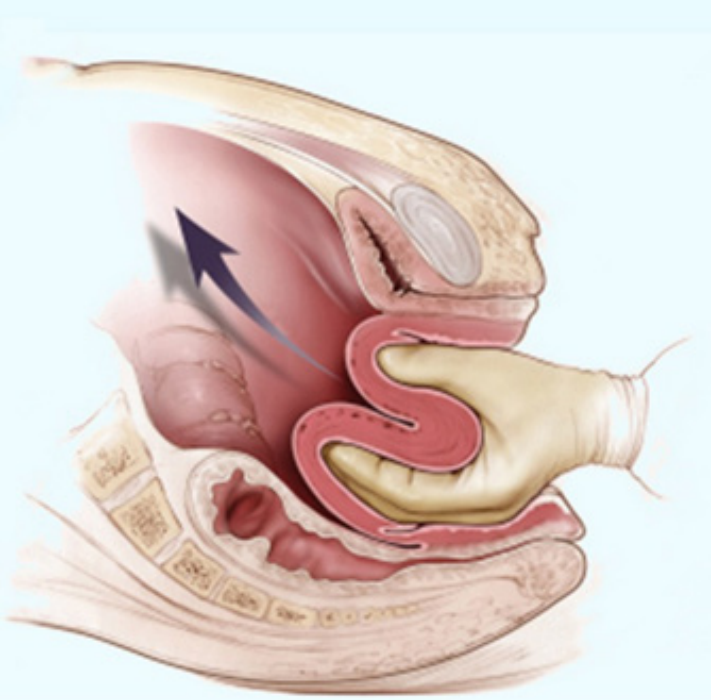


Figure 13.2 The massage technique

Selecting a secondary uterotonic agent requires considering individual patient factors, such as pre-existing conditions like HTN or asthma. Although not a uterotonic itself, tranexamic acid (Cyklokapron) can serve as a beneficial adjunct therapy. Administered within three hours of postpartum hemorrhage, it may help lower mortality associated with bleeding.

Medications for Postpartum Hemorrhage (PPH)

Table 13.7 Medications for Postpartum Hemorrhage (PPH)

Category	Medication
First-Line Agent	**Oxytocin (Pitocin)**
Second-Line Agents	**Carboprost (Hemabate)** (Prostaglandin F 2-alpha analogue)
	Methylergonovine
	Misoprostol (Cytotec) (Prostaglandin E analogue)
	Tranexamic acid (Cyklokapron)

Figure 13.2 The massage technique

Trauma

Quick repair and hemostasis are crucial to minimize severe blood loss associated with birth trauma, such as hematomas and lacerations. Episiotomy should be avoided to lower the risk of anal sphincter tears and blood loss. It is only warranted when the perineum impedes an urgent delivery.

Hematomas:

Hematomas in the vulvar or vaginal region can lead to pain or changes in vital signs that are out of proportion to the visible blood loss. Observation, analgesia, and ice packs are effective treatments for small hematomas.

Larger or expanding hematomas, or those where the patient shows persistent signs of volume loss despite fluid replacement, require incision and clot evacuation.

Achieving hemostasis in these instances involves several steps: first, irrigating the affected site, then ligating any bleeding vessels, typically with figure-of-eight sutures, and finally executing a layered closure.

Uterine Inversion:

- It is a rare complication.
- The contribution of other factors, such as excessive cord traction, fundal pressure, and fundal placenta implantation, is uncertain.
- Patients may present with symptoms of shock even without significant blood loss.
- Typically, an inverted uterus presents as a bluish-gray mass visible as it protrudes from the vagina (Figure 13.3) .
- Prompt repositioning is essential. The placenta should be left in place until the uterus has been repositioned to help control bleeding.
- The Johnson technique involves holding the protruding fundus in the palm with fingers pointing toward the posterior fornix and lifting the uterus back into the abdomen through the pelvis.
- After reversion, uterotonic medications can be administered to help maintain uterine tone and prevent recurrence.

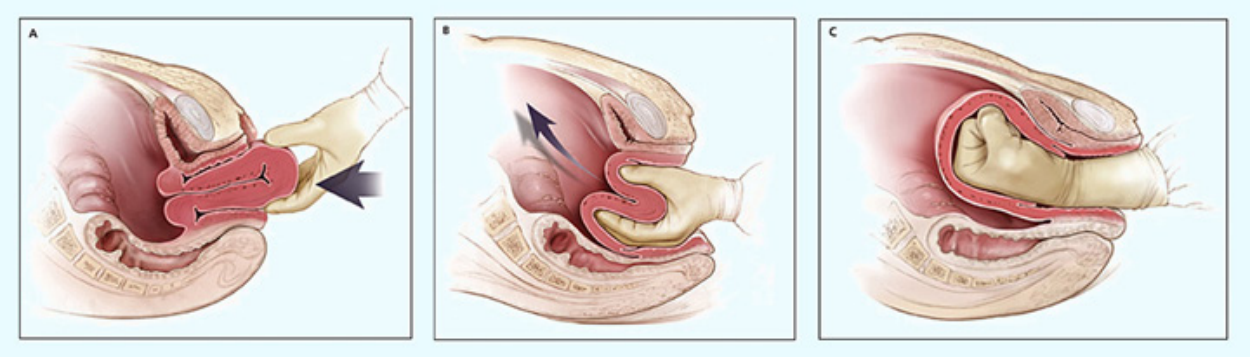


Figure 13.3 Johnson method

Should initial attempts to reposition the uterus fail, or if the lower uterine segment begins to contract,

medications such as magnesium sulfate, terbutaline, or nitroglycerin, or the use of general anesthesia, may be employed to sufficiently relax the uterus for manipulation.

Uterine rupture, though rare in an unscarred uterus, presents a risk for both intrapartum and postpartum hemorrhage. This risk is notably higher in patients with a history of cesarean section, particularly when labor is induced or augmented. Following a low transverse CS, significant uterine rupture is observed, with fetal bradycardia being the primary warning sign before delivery.

Tissue

Retained tissue, such as placental fragments, the entire placenta, or blood clots, is a common cause of postpartum hemorrhage because it prevents the uterus from achieving adequate tone (atony). The classic indicators of placental separation are a slight elevation of the uterus, a small gush of blood, and the lengthening of the umbilical cord.

A retained placenta is diagnosed when placental delivery does not occur within 30 minutes. Typically, the placenta is delivered 8 to 9 minutes after the birth of the baby. A delay of more than ten minutes doubles the risk of PPH. In cases of a retained placenta, manual removal with adequate analgesia should be considered. It is important to note that injecting a saline and oxytocin mixture into the umbilical vein has not been shown to significantly reduce the need for manual removal.

Invasive Placenta

Failure to separate the placenta from the uterine wall through blunt dissection with a gloved hand suggests the presence of an invasive placenta. Conditions such as placenta accreta, increta, and percreta fall into this category and pose a serious risk of life-threatening PPH.

The rising incidence of invasive placenta is closely linked to the increasing rate of cesarean deliveries. Additional risk factors include placenta previa, a previous history of invasive placenta, elevated maternal age, and high parity. While management for this condition frequently requires a hysterectomy, conservative options—such as expectant management (leaving the placenta in place) or weekly oral methotrexate—can be considered in carefully selected patients.

Coagulation defects can cause or result from hemorrhage. Suspect these in patients not responding to standard postpartum hemorrhage treatment or with generalized oozing. Failure of blood to clot within 5-10 minutes in bedside containers or red-top tubes is a key indicator.

Assessment should include PLT, PT, PTT, fibrinogen, fibrin degradation products, and quantitative D-dimer. Defects may be acquired or inherited.

Management involves treating the underlying disease, maintaining intravascular volume, monitoring coagulation status, and administering necessary blood components via an emergency release protocol to minimize delays and reduce dilutional coagulopathy risk.

Table 13.8 Disordered Coagulation: Underlying Causes

Category	Causes
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 enzyme levels, and low platelet levels) syndrome, Placental abruption, Preeclampsia with severe features, Sepsis, Use of anticoagulants (such as aspirin or heparin).
Hereditary	Hemophilia, Idiopathic thrombocytopenic purpura, Thrombotic thrombocytopenic purpura, Von Willebrand disease.

Handling Severe or Persistent Bleeding

Immediate and interdisciplinary resuscitation is essential for significant blood loss. prioritize a primary maternal survey and continuous assessment of blood loss.

Initial Resuscitation Steps:

- Oxygenation and Ventilation: Administer oxygen and provide ventilation if necessary.
- Intravenous Access and Fluid Replacement: Establish two large-bore IV lines for fluid and blood replacement.

Start with a bolus infusion of normal saline or other crystalloids.

Based on the patient's symptoms and vital signs, modify the rate of infusion accordingly.

- Blood Transfusion: Temporarily administer O-negative blood until type-specific blood becomes available.
- Enhanced Venous Return: Elevate the patient's legs.
- Monitoring: Insert a Foley catheter to monitor urine output and potentially aid in addressing uterine atony.

Massive Transfusion Protocol (MTP):

Established MTPs are designed to mitigate complications like dilutional coagulopathy from postpartum hemorrhage. Typical protocols suggest a transfusion ratio for massive hemorrhage: 4 units of FFP and 1 unit of platelets should be administered for every 4 to 6 units of PRBCs.

Uterus-Conserving Treatments:

To conserve the uterus, various treatment options are available:

Non-Surgical/Packing Methods:

Uterine Packing: This involves using plain gauze or gauze saturated with agents such as vasopressin, chitosan, or carboprost.

Surgical and Procedural Interventions:

- Artery ligation
- Uterine artery embolization
- compression sutures
- Balloon Tamponade: A balloon is inserted via the vagina and cervix and then inflated with sterile water or saline to e

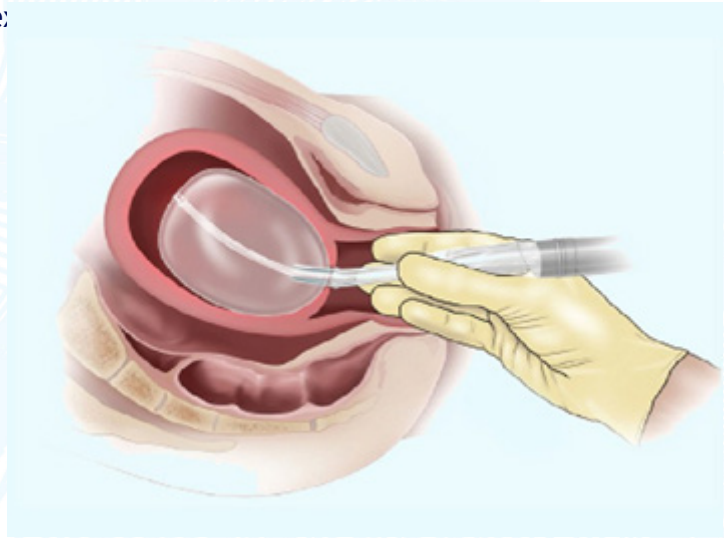


Figure 13.4 Uterine tamponade balloon catheter

For temporary hemorrhage control while awaiting definitive treatment or during transport, techniques such as uterine packing, aortic compression, and non-pneumatic anti-shock garments are available. None ion.

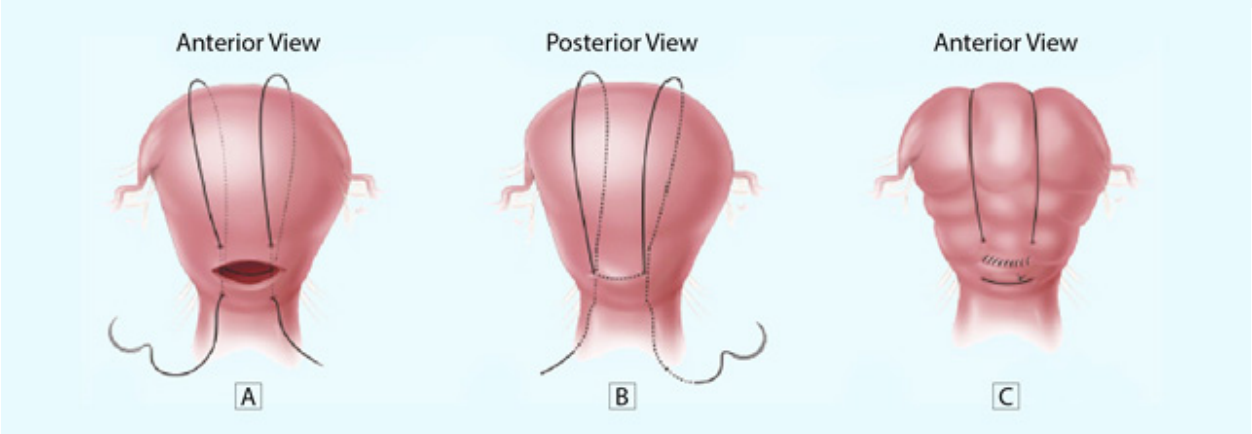
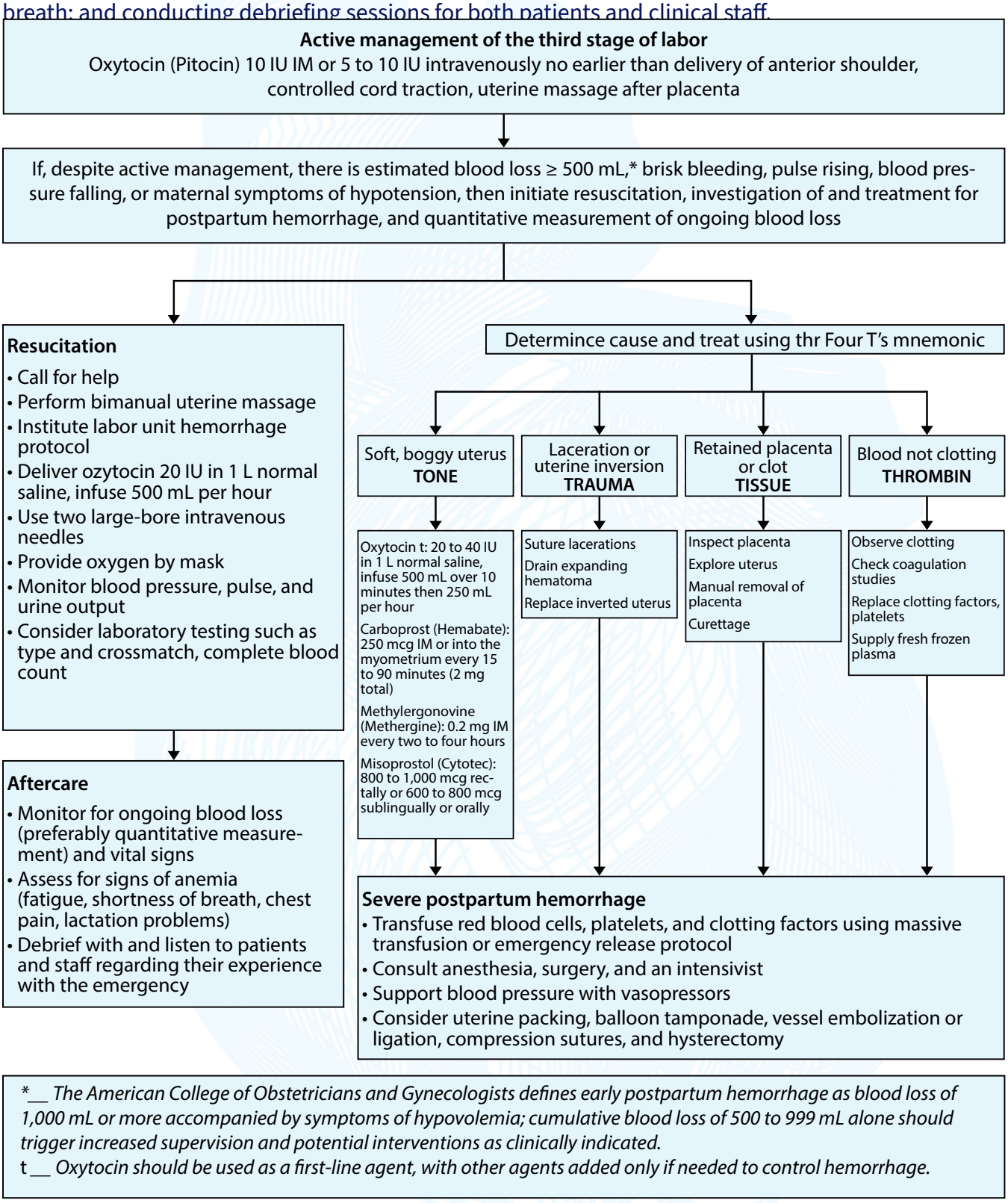


Figure 13.5 B-Lynch Suturing Techn

PPH management encompasses several crucial elements: constant monitoring of both blood loss and vital signs; assessment for signs of anemia, such as fatigue, chest pain, difficulty with lactation, or shortness of breath; and conducting debriefing sessions for both patients and clinical staff.



*__ *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.*

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

Figure 13.6 PPH Prevention and Management

CHAPTER FOURTEEN

Neonatal Resuscitation

Learning Objectives

The learner will be able to:

1. Recognize the signs and symptoms of cardiorespiratory distress in neonates.
2. Detail the essential initial evaluation procedures.
3. Explain when positive pressure ventilation is indicated during neonatal resuscitation.
4. Identify the criteria for initiating chest compressions.
5. Review the indications and contraindications for medication administration during neonatal resuscitation.

Introduction

The transition from intrauterine to extrauterine life involves significant physiological changes that can reveal previously undetected issues. Consequently, a neonatal resuscitation expert is essential at every birth. The need for intervention can be anticipated by assessing the newborn's gestational age and growth characteristics.

Need for Resuscitation

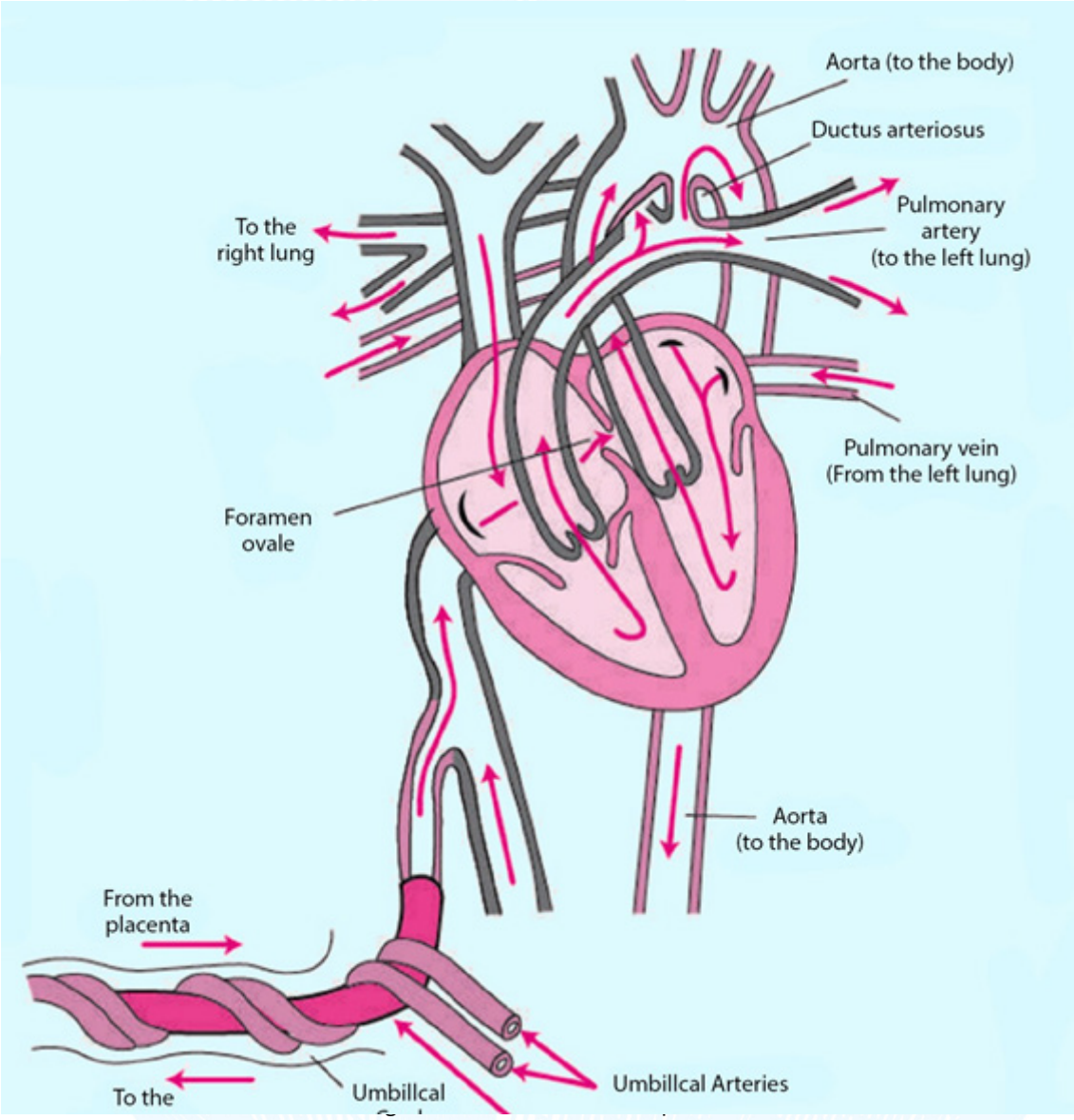
Approximately 10% of newborns require some form of respiratory assistance at birth, with only 1% needing extended resuscitation. Various factors, including maternal or fetal comorbidities, can cause newborn depression and necessitate resuscitation. The inability of newborns to initiate and sustain adequate or spontaneous breathing significantly impacts early fatality rates and the risk of adverse neurodevelopmental outcomes in survivors. Therefore, prompt and efficient resuscitation at birth is crucial for improving newborn outcomes.

Physiology of the Cardiorespiratory Transition

The newborn's adaptation from intrauterine life to the external environment involves numerous changes in cardiorespiratory function. Fetal circulation features a patent ductus arteriosus (connecting the pulmonary artery to the aorta) and a foramen ovale (linking the right and left atria), which enable right-to-left shunting of blood, bypassing the unventilated lungs.

This shunting is promoted by high resistance in the pulmonary arterioles and low resistance in systemic blood flow, including the placenta. As a result, 90% to 95% of the right heart's output bypasses the lungs and enters the systemic circulation.

The ductus arteriosus remains open due to locally produced prostaglandins and low fetal systemic oxygen levels (around 25 mm Hg). The foramen ovale stays open because the right atrial pressure is higher (due to substantial blood return) than the left atrial pressure (due to minimal blood return from the lungs). Oxygenated blood from the placenta enters the right side of the fetal heart. With non-functional lungs, only a small volume of blood passes through the pulmonary artery; the majority passes through the foramen ovale and ductus arteriosus, structures that typically close shortly after birth.



Neonatal Pulmonary Function: Fetal Development and Transition at Birth

Fetal lung development is a complex process involving organogenesis and cellular differentiation. Crucial to this development are Type II pneumocytes, which begin to appear around the 25th week of gestation and multiply throughout the remainder of the pregnancy. These cells are responsible for producing surfactant. The lungs continuously secrete fluid, a combination of transudate from pulmonary capillaries and surfactant from the Type II pneumocytes.

For successful gas exchange to occur at birth, this alveolar and interstitial fluid must be rapidly cleared from the lungs. The primary mechanism for this clearance is the activation of sodium channels in the lung epithelium, which facilitates fluid absorption into the lung cells. Thoracic compression during delivery plays only a minimal role in this process. A delayed clearance of this fluid is a probable cause of transient tachypnea in newborns.

The birth process involves strong inspiratory efforts and the elastic recoil of the ribs, which draw air into the lungs, creating air-fluid interfaces within the alveoli. With the first breath, surfactant is released into these interfaces. This critical action reduces surface tension, thereby preventing the collapse of the air sacs (atelectasis) and lessening the effort required for breathing.

Respiratory Distress Syndrome (RDS) in newborns can occur when the infant does not produce enough surfactant. Furthermore, surfactant function and development can be negatively impacted by factors such as maternal hyperglycemia, neonatal meconium aspiration, and neonatal sepsis. To address this, corticosteroid administration to the mother 24 to 48 hours before delivery is a strategy to boost surfactant production in preterm infants. Following delivery, intratracheal surfactant is another treatment option for affected newborns.

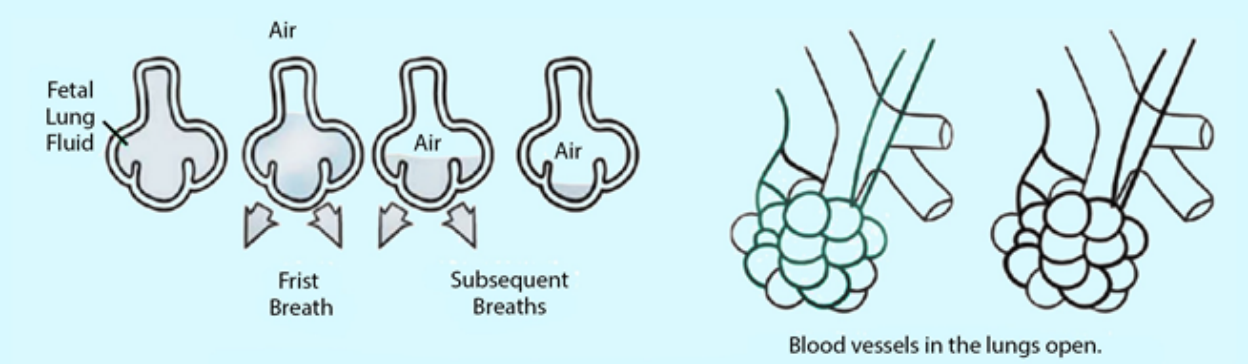


Figure 14.2 Air Replaces fluid in alveoli

Various perinatal risk factors, detailed in the attached appendix, increase the likelihood of requiring resuscitation, NICU admission, and heighten the risk of perinatal mortality. A validated antenatal risk score index is used to determine pregnancy risk, categorizing pregnancies into low, moderate, and high-risk groups. Based on this risk category, the institute may establish guidelines to facilitate the transfer of high-risk pregnancies to tertiary centers, ensure the allocation of suitable personnel and resources, and determine the necessity for a specialized team's presence in the delivery room.

Table 14.1 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 hydrops 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: An Assessment of Neonatal Status

The Apgar Score is a measurement tool utilized at birth to evaluate a newborn's cardiorespiratory and neurological condition. It is important to note that the score is an observation, not a diagnosis, and it should not be used to predict a patient's long-term prognosis or to guide immediate or future medical care.

The assessment comprises five distinct indicators of neonatal health:

- Appearance (color)
- Pulse (heart rate)
- Grimace (reflex irritability)
- Activity (muscle tone)
- Respiration (breathing effort)

Each indicator is assigned a score ranging from 0 to 2.

The overall score is influenced by various factors, including the newborn's physiological maturity, birthweight, the mother's perinatal therapy, and the presence of fetal cardiorespiratory and neurological conditions.

Interpreting the Apgar Score at Five Minutes:

- Normal: 7 to 10
- Intermediate: 4 to 6

- Low: 0 to 3

While a low Apgar score may indicate various underlying causes from acute, easily treatable conditions with a good prognosis to severe, chronic conditions with a poor prognosis it fundamentally serves as an observation of the newborn's status.

Table 14.2 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.				

Effective communication and coordinated care between obstetric and neonatal healthcare professionals are essential before every birth. Healthcare providers must first assess the antepartum and intrapartum risk factors and then address the following four critical prenatal questions:

Four Prenatal Inquiries:

1. What is the estimated gestational age?
2. Is the amniotic fluid clear?
3. Are there any additional risk factors present?
4. What is the plan for managing the umbilical cord?

Delayed Cord Clamping (DCC)

DCC, also known as deferred cord clamping, is the preferred standard for most newborns to enhance blood volume and cardiovascular stability. The recommended duration for clamping has been extended:

Vigorous Infants (Term & Preterm): Clamping should be delayed for at least 60 seconds (an increase from the previous 30–60 second recommendation).

Preterm Infants (<37 Weeks): A delay of at least 60 seconds is recommended for those who do not require immediate resuscitation to improve hematologic indices.

Umbilical Cord Milking (UCM)

UCM is a potential alternative when DCC is not feasible, with specific recommendations based on gestational age:

Term & Late Preterm (35–42 Weeks): For non-vigorous newborns who do not respond to initial stimulation, intact cord milking from the placenta is considered a reasonable alternative to early clamping.

Preterm (28–34 Weeks): While there is insufficient evidence for routine recommendation, UCM may be considered a "reasonable" option for infants in this range who do not require immediate resuscitation, provided DCC cannot be performed.

Very Preterm (<28 Weeks): Intact cord milking is not recommended due to an associated increased risk of severe intraventricular hemorrhage (IVH).

The composition of the necessary team members and required equipment should be determined based on the answers to these inquiries.

The Neonatal Resuscitation Team

For every birth, a minimum of one individual trained in the initial steps of neonatal resuscitation, including the administration of positive pressure ventilation (PPV), must be present. Additional staff capable of performing a full resuscitation should be readily available, even when risk factors are minimal (Low risk score 0-3).

If moderate risk factors (score 4-6) are identified, at least two skilled professionals must be present, dedicated exclusively to the newborn's care. The size and qualifications of the staff should be adjusted according to the anticipated risk, the number of infants, and the hospital's capabilities.

For complex or high-risk resuscitations (risk score >6), a larger team, potentially four or more members, may be required. Ideally, the complete resuscitation team should be present before delivery. For any anticipated advanced resuscitation, the fully qualified team, certified and trained in advanced techniques such as endotracheal intubation, chest compressions, emergency vascular access, and medication administration, should be at the birth.

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

Ensure that all equipment and supplies required for neonatal resuscitation are present and functional for every delivery, especially when a high-risk infant is anticipated (see Figure 14.3). Implementing a routine, standardized pre-birth checklist is recommended to streamline preparation, confirm immediate readiness, and quickly identify any missing items. Furthermore, for preterm births, the room temperature must be adjusted to be between 23 and 25 °C beforehand.

Figure 14.3 Equipment and supplies list

Initial Newborn Evaluation

A rapid assessment of a newborn must be performed immediately after birth to determine if the infant can remain with the mother or requires a radiant warmer for additional heat. This initial check can take place during the time between delivery and umbilical cord clamping.

The immediate post-birth evaluation for every newborn focuses on three crucial questions:

1. Is the baby full-term in appearance?
2. Is the baby crying or breathing adequately?
3. Does the infant exhibit good muscle tone?

If all three questions are answered affirmatively, the infant may stay with the mother while initial procedures are carried out on her chest or abdomen. If the answer to any of these questions is negative, the assessment must proceed to the next step.

Initial Steps in Neonatal Resuscitation

The following steps should be performed immediately to stabilize the newborn:

1. Provide Warmth:
   - Place the infant under a radiant warmer.
   - Attach a temperature sensor to maintain the body temperature between 36.5°C and 37.5°C, preventing both hypothermia and hyperthermia.
   - Leave the infant uncovered for better visualization.
2. Dry and Prevent Heat Loss:

- For very preterm babies (less than 32 weeks' gestation), do not dry; instead, immediately cover the baby in polyethylene plastic to reduce evaporative heat loss.
- For other infants, dry the baby thoroughly with a warm blanket. Remove the wet blanket immediately and replace it with a new, dry one to prevent heat loss.

3. Open the Airway:

- Position the baby's head and neck in the "sniffing position" (neutral or slightly extended, with the eyes pointed straight up) to ensure an open airway and unhindered air entry.

4. Remove Secretions (Suction):

- Routine suctioning is not advised for an active baby.
- Perform gentle suctioning only if the infant is gasping, not breathing, if the airway is blocked, if they are having difficulty clearing secretions, if Positive Pressure Ventilation (PPV) is anticipated, or if they have weak muscle tone.
- Turn the baby's head to the side and gently clear the secretions. Suction the mouth before the nose to prevent aspiration.

5. Stimulate (if needed):

- If respiration is inadequate, increase breathing by gently rubbing the back or clicking the sole of the foot.
  - Note: Refrain from intense stimulation and never shake the child.

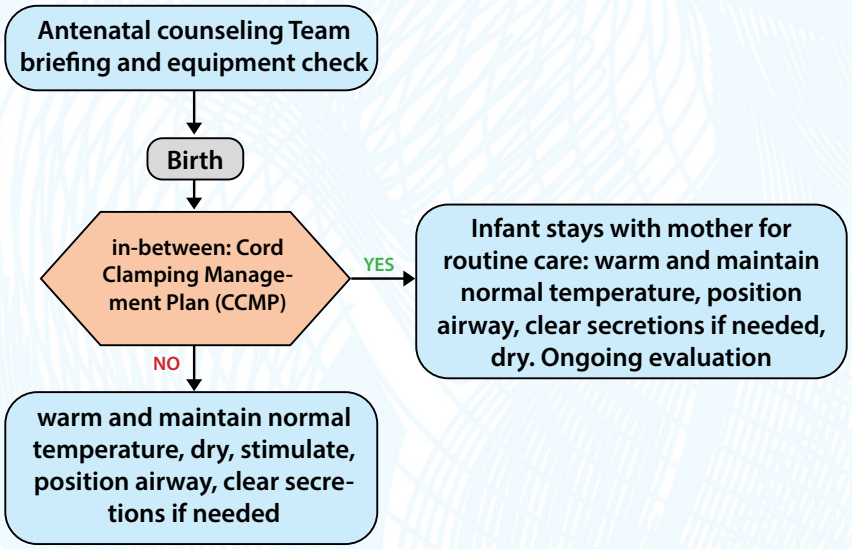


Figure 14.4 Initial evaluation

Table 14.3 Targeted SaO2

Time from birth	Neonates' target concentration during resuscitation in %
2 min	65-70%
3 min	70-75 %
4 min	75-80 %
5 min	80-85 %
10 min	85-95 %

Positive pressure 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.

Ventilation devices

1. A self-inflating bag

1. 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 14.5 Self inflating bag

A flow-inflating, or anesthetic, bag requires gas from a compressed source and a sealed outlet to inflate.

Figure 14.6 A flow-inflating bag

3. T-piece resuscitator

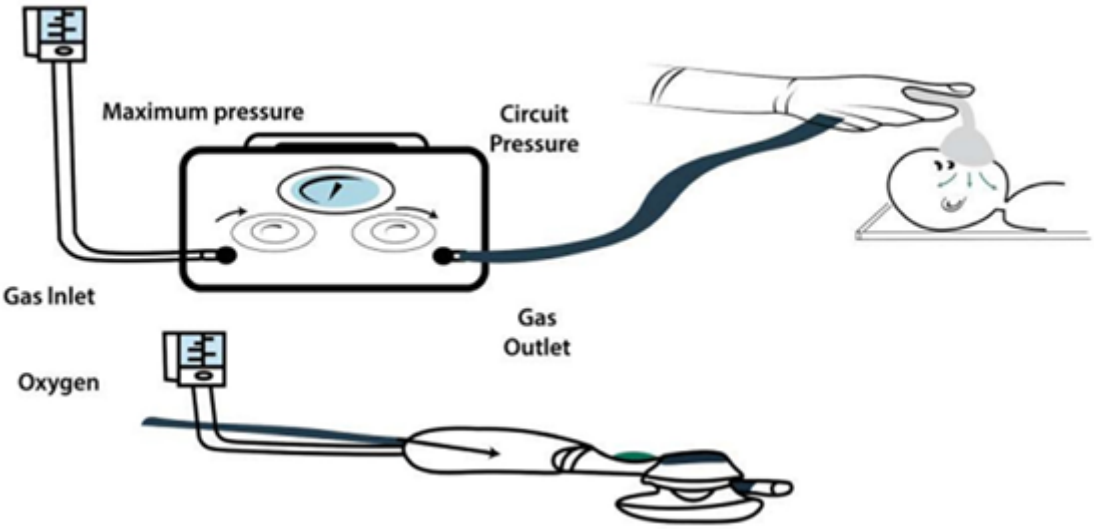


Figure 14.7 T-piece resuscitator

Indications of Effective Positive Pressure Ventilation

To determine if your positive pressure ventilation technique is effective, look for the following three signs:

1. An increase in the patient's heart rate.
2. Observable chest movement (rise and fall).
3. An increase in the patient's oxygenation.

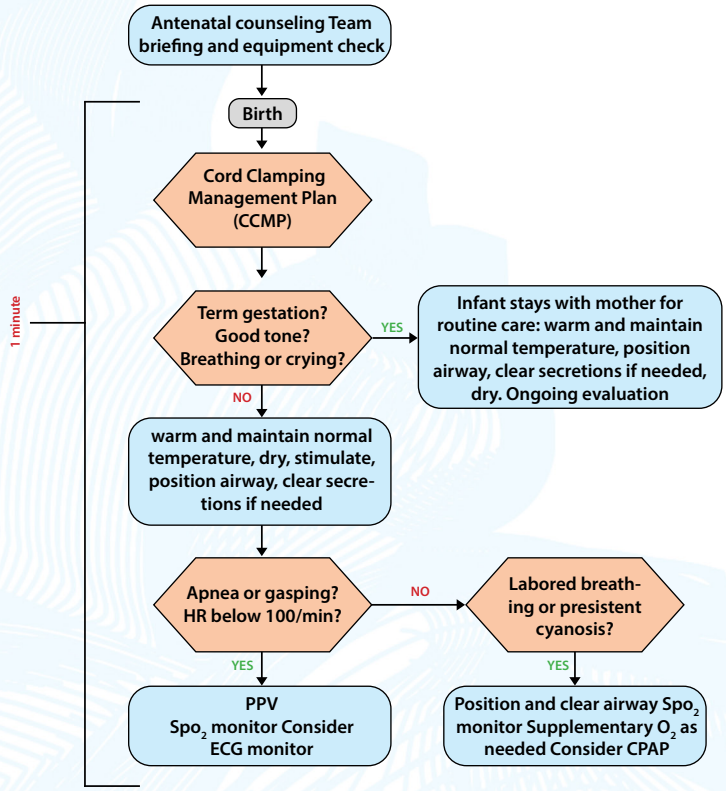


Figure 14.8 Neonatal Resuscitation algorithm

The infant's heart rate should be greater than 100 beats per minute within 30 seconds of starting Positive Pressure Ventilation (PPV).

During PPV:

- Continue PPV if the baby's heart rate begins to rise after the first 15 seconds. You will reassess the response after a total of 30 seconds of PPV.
- If the baby's heart rate does not increase after the first 15 seconds, ask your assistant if the baby's chest is moving.

If the Heart Rate Does Not Increase and the Chest Does Not Move:

This indicates poor mask ventilation, likely caused by mask leaks, airway obstructions, or low ventilation pressure. You will need to implement a series of adjustments known as the ventilation corrective steps (detailed in the accompanying table) to address these common issues.

Based on your assessment of the infant and clinical situation, you may choose the steps that are most likely to be helpful and prioritize the order in which you perform them.

Table 14.4 The corrective steps (MRSOPIA)

Corrective Step	Actions
M: Mask adjustment	Reapply the mask, then forward the jaw. Think about the two-hand hold
R: Reposition the 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 there is no chest movement, do the next step.	
PI: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 there is 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.	

After 30 seconds of positive-pressure ventilation (PPV) that effectively ventilates the lungs (indicated by an increasing heart rate or chest movement), you must recheck the infant's heart rate response.

Based on the Heart Rate (HR) Response:

- If HR is 100 beats per minute: The assisted ventilation is successful. Continue PPV at 30–60 breaths per minute while monitoring the infant's heart rate, breathing effort, and chest movement.
- If HR is 60 but less than 100 beats per minute: Continue giving PPV as long as the infant is showing steady improvement and the heart rate is increasing.

In order to achieve the target oxygen saturation range, monitor the oxygen saturation and adjust the FiO2 as needed. If the heart rate does not increase, immediately re-evaluate your ventilation strategy.

Initiating Chest Compressions

The window for the above steps should not exceed two minutes. If the infant's heart rate remains below 60 beats per minute (BPM) after at least 30 seconds of effective positive pressure ventilation (PPV) indicated by chest movement and ideally delivered through an advanced airway (laryngeal mask or endotracheal tube) then chest compressions must be started. At this point, increase the FiO2 to 100%.

Prerequisite for Chest Compressions

Chest compressions are only initiated if the heart rate is still below 60 BPM after 30 seconds of efficient ventilation. Before beginning chest compressions, confirm that the chest rise during PPV indicates successful ventilation. If the chest is not rising, first use the necessary corrective ventilation procedures (MR-SOPIA) to establish effective ventilation.

To perform compressions, use the thumbs technique to support the baby's back. Place your thumbs right below the intermammillary line, on the bottom third of the sternum.

Figure 14.9: Compression hands placement

Chest Compression Technique and Rate:

- Technique: Use only the thumbs to depress the sternum by approximately one-third of the chest's anterior-posterior (AP) diameter.
- Release: Ensure a complete release after each compression to allow for complete heart refilling, coronary perfusion, and lung expansion.
- Rate and Ratio: The compression rate is 90 per minute, coordinated with positive-pressure ventilation (PPV) at a 1/3 ventilation-to-compression ratio.
- Cycle Time: Each complete cycle (3 compressions and 1 ventilation) should be performed over 2 seconds.

Monitoring and Adjusting Intervention:

- Check Heart Rate: After 60 seconds of PPV-coordinated chest compressions, check the infant's heart rate.
    - If Heart Rate > 60 bpm:
        - Stop chest compressions.
        - Adjust the FiO2 to achieve the desired oxygen saturation level.
        - Increase the PPV rate to 40–60 beats per minute.
    - If Heart Rate is Still < 60 bpm:
        - Check and Optimize:
            - Confirm effective PPV (observe chest rise).
            - Ensure FiO2 is 100%.
            - Verify the depth of chest compression is adequate.
            - Confirm the chest compression rate is 90/min.
        - Escalate Intervention: If the heart rate remains below 60 bpm, resume chest compressions, insert an umbilical venous catheter, and inject epinephrine.

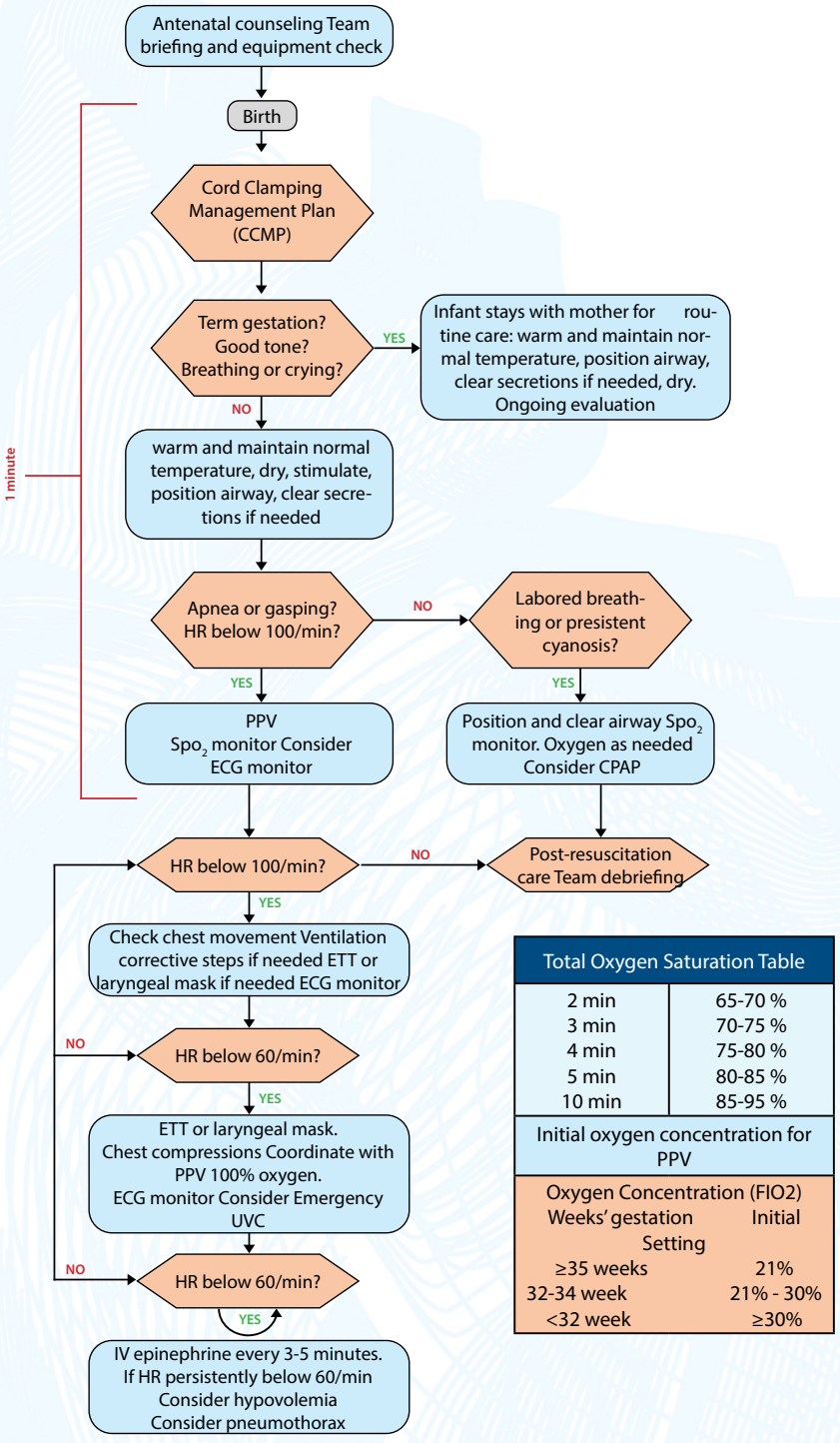
Medication and Fluids

Epinephrine:

- Indication: Administer if the heart rate remains below 60 beats per minute (bpm) following:
  1. At least 30 seconds of effective PPV (with chest movement indicating lung expansion).
  2. Another 60 seconds of chest compressions coordinated with 100% oxygen using PPV.
- Concentration: 1 mg/10 mL (0.1 mg/mL).
- Route (Preferred): Intravenous (IV) or intraosseous (IO). An endotracheal dose may be considered while vascular access is being established.
- Dose: 0.02 mg/kg (equivalent to 0.2 mL/kg) IV/IO, repeated every 3–5 minutes. The acceptable range is 0.01 to 0.03 mg/kg (0.1 to 0.3 mL/kg).

Volume Expanders:

- Indication: Recommended if the infant is unresponsive to resuscitation steps and exhibits indicators of shock or has a history of severe blood loss.
- Solution: Type O Rh-negative blood or normal saline (NS).
- Route: Intravenous or intraosseous.
- Administration: Use a 30- to 60-mL capacity syringe (labeled NS or O- blood).
- Dose: 10 mL/kg.
- Rate: Administer over five to ten minutes or more.



Total Oxygen Saturation Table	
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	
Oxygen Concentration (FIO2)	
Weeks' gestation	Initial Setting
≥35 weeks	21%
32-34 week	21% - 30%
<32 week	≥30%

Figure 14.10 Neonatal Resuscitation algorithm

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