

Introduction to Surgical Disorders of Pregnancy

SCOPE AND IMPORTANCE OF SURGICAL DISORDERS IN PREGNANCY

Pregnancy is associated with profound anatomical, physiological, and hormonal changes that significantly influence the presentation, diagnosis, and management of surgical disorders. Although the overall incidence of surgical conditions in pregnancy is relatively low, these disorders are an important cause of maternal and foetal morbidity and mortality, particularly when diagnosis or treatment is delayed. Surgical disorders may occur coincidentally during pregnancy, be precipitated or aggravated by pregnancy, or be directly related to pregnancy-induced physiological changes. The spectrum of surgical disorders encountered during pregnancy is wide, encompassing multiple organ systems and varying in severity.

Among the most commonly encountered non-obstetric surgical problems are general surgical disorders. Acute appendicitis represents the most frequent surgical emergency in pregnancy, and the risk of perforation is increased due to delayed diagnosis, as classical signs may be masked by physiological changes. Gallstone disease, including cholelithiasis and acute cholecystitis, is also common and results from oestrogen-induced cholesterol supersaturation and gallbladder stasis. Intestinal obstruction may occur due to adhesions, volvulus, or intussusception, while hernias—inguinal, umbilical, or incisional—can become symptomatic during pregnancy. Increased pelvic venous pressure and constipation often lead to hemorrhoids and anal fissures, which may require surgical attention.

Gynecological surgical disorders frequently pose diagnostic challenges, as their symptoms may mimic obstetric complications. Ovarian cysts and tumours carry a risk of torsion, rupture, or haemorrhage, while adnexal torsion is more commonly observed in early pregnancy. Degeneration of uterine fibroids, particularly

red degeneration, can cause acute abdominal pain. Pelvic abscesses, though less frequent, may also require surgical intervention.

Urological surgical conditions are common in pregnancy due to both mechanical compression by the gravid uterus and hormonal effects on the urinary tract. Urolithiasis often presents with renal colic and haematuria. Acute urinary retention, obstructive uropathy, and complicated pyelonephritis may necessitate prompt surgical management to prevent maternal and foetal complications.

Trauma and emergency surgical situations remain significant concerns during pregnancy. Pregnant women are not protected from blunt abdominal trauma resulting from road traffic accidents, falls, or domestic violence. Penetrating injuries, burns, fractures, and visceral injuries such as splenic or hepatic rupture may all require urgent surgical intervention.

Breast and soft tissue disorders also merit consideration. Breast abscesses, benign and malignant breast lesions, and soft tissue infections may necessitate surgical treatment during pregnancy. Additionally, rare vascular and surgical emergencies, including rupture of a splenic artery aneurysm, mesenteric ischaemia, and acute pancreatitis, can arise and require urgent operative management to prevent severe maternal and foetal outcomes.

The importance of surgical disorders in pregnancy is amplified by the diagnostic challenges posed by physiological changes of gestation. Displacement of abdominal organs by the enlarging uterus, physiological leucocytosis, and reduced peritoneal signs may obscure classical clinical features, while common pregnancy-related nausea and vomiting can mimic surgical pathology. These factors frequently result in delayed or missed diagnosis, increasing the likelihood of complications.



Delayed treatment of surgical disorders can have serious consequences for maternal health, including sepsis, haemorrhage, peritonitis, multi-organ failure, and death. Maternal survival is the primary concern, as foetal outcomes are closely linked to maternal condition. Surgical disorders and their complications may also adversely affect foetal well-being, leading to miscarriage, preterm labour, foetal distress, intrauterine growth restriction, or intrauterine foetal demise. Importantly, the risk to the foetus is often more associated with delayed maternal treatment, hypoxia, or sepsis than with the surgical procedure itself.

Management of surgical disorders in pregnancy often presents therapeutic and ethical dilemmas. Decisions must carefully balance the timing of surgery, choice of anaesthesia, and surgical approach, whether laparoscopic or open. Elective surgeries are generally safest in the second trimester, when the risk of teratogenicity and preterm labour is lower. Advances in imaging modalities, such as ultrasound and magnetic resonance imaging, provide safe and effective diagnostic options. Laparoscopic surgery is increasingly employed with favourable maternal and foetal outcomes, and improvements in anaesthesia techniques have further minimised foetal risk.

Optimal management requires a multidisciplinary approach, integrating the expertise of obstetricians, surgeons, anaesthesiologists, radiologists, and neonatologists. Continuous foetal monitoring and perioperative obstetric support are essential for ensuring safety. Surgical disorders can also influence broader obstetric management, affecting antenatal care, the timing and mode of delivery, postpartum recovery, and considerations for future pregnancies.

In conclusion, surgical disorders in pregnancy represent an important clinical entity due to their wide scope, diagnostic complexity, and potential for serious maternal and foetal complications. Early recognition, prompt surgical intervention when indicated, and a coordinated multidisciplinary approach are critical for improving outcomes. A thorough understanding of the scope and significance of these disorders is essential for healthcare providers involved in the care of pregnant women.

PHYSIOLOGICAL AND ANATOMICAL CHANGES IN PREGNANCY

Pregnancy represents a state of remarkable maternal adaptation, in which almost every organ system undergoes structural and functional modifications to support the developing foetus, maintain maternal homeostasis, and prepare the body for labour and lactation. These changes are progressive, hormonally mediated, and interdependent. While physiological in nature, they significantly alter disease presentation and

influence clinical decision-making, particularly in the context of medical and surgical disorders.

Anatomical Changes in Pregnancy

Uterus and Pelvic Structures

The uterus undergoes the most dramatic anatomical transformation. From a pelvic organ weighing approximately 70 grams in the non-pregnant state, it enlarges to nearly 1 kilogram at term. This increase is due to both hypertrophy and hyperplasia of smooth muscle fibers, stimulated primarily by estrogen. The uterine cavity expands from a potential space to accommodate a foetus, placenta, and amniotic fluid.

As pregnancy advances, the uterus rises out of the pelvis at around 12 weeks of gestation, reaches the level of the umbilicus by 20 weeks, and approaches the xiphisternum by 36 weeks. This progressive enlargement displaces intra-abdominal organs, alters their anatomical relationships, and modifies the location of pain and tenderness in abdominal pathology. The cervix becomes soft, oedematous, and highly vascular (Goodell's sign), while the vagina shows increased congestion and thickened mucosa, leading to bluish discoloration and increased secretions.

Gastrointestinal Tract

The expanding uterus displaces the stomach and intestines upward and laterally. Progesterone-induced relaxation of smooth muscle reduces gastrointestinal motility, resulting in delayed gastric emptying and prolonged intestinal transit. The lower esophageal sphincter becomes incompetent, predisposing to gastroesophageal reflux and heartburn. The appendix is displaced upward and outward, which may result in atypical presentation of appendicitis with pain localised to the right upper quadrant rather than the classical right iliac fossa.

Clinical Implications in Surgical Practice

Nausea and vomiting: Common in early pregnancy; may obscure diagnosis of surgical conditions such as appendicitis or bowel obstruction.

Gastroesophageal reflux: Frequently mistaken for biliary or pancreatic pathology.

Increased aspiration risk: Critical during anaesthesia; mandates rapid-sequence induction.

Constipation and bloating: May mask intestinal obstruction.

Urinary Tract

Anatomical changes in the urinary tract are prominent. The kidneys increase in size, and the renal pelvis and ureters dilate due to progesterone-mediated smooth muscle relaxation and mechanical compression by the gravid uterus. This physiological hydronephrosis is more



pronounced on the right side due to dextrorotation of the uterus. Bladder compression leads to increased urinary frequency, urgency, and nocturia, particularly in early and late pregnancy.

Respiratory System

The enlarging uterus elevates the diaphragm by approximately 4 cm, reducing vertical thoracic dimensions. Compensatory widening of the rib cage and increased subcostal angle help maintain lung volumes. Despite these adjustments, the functional residual capacity decreases, making pregnant women more vulnerable to rapid oxygen desaturation during apnoea or respiratory compromise.

Clinical Implications in Surgical Practice

Rapid desaturation: Reduced FRC leads to diminished oxygen reserve during apnoea (e.g., induction of anaesthesia).

Misinterpretation of ABG: A “normal” PaCO₂ (~40 mmHg) may indicate respiratory compromise in pregnancy.

Dyspnoea: Common in normal pregnancy; differentiating from pathological causes (e.g. pulmonary embolism, pneumonia) is challenging.

Cardiovascular System

Anatomically, the heart is displaced upward and laterally, assuming a more horizontal position. Peripheral vasodilatation and increased venous pressure in the lower limbs result in oedema, varicosities, and haemorrhoids. Compression of the inferior vena cava by the gravid uterus in the supine position can reduce venous return, leading to supine hypotension syndrome.

Physiological Changes in Pregnancy

Cardiovascular Adaptations

Pregnancy is characterised by a progressive increase in blood volume, which rises by approximately 40–50% by mid-pregnancy. Plasma volume expansion exceeds the increase in red cell mass, resulting in physiological anaemia of pregnancy. Cardiac output increases due to both increased stroke volume and heart rate, reaching its peak in the second trimester. Systemic vascular resistance decreases under the influence of progesterone and placental vasodilators, maintaining normal or slightly reduced blood pressure despite increased cardiac output.

Clinical Implications in Surgical Practice

Masked hypovolaemia: Due to increased circulating volume, a pregnant patient may lose up to 30–35% of blood volume before exhibiting classical signs of shock.

Baseline tachycardia: Makes early detection of sepsis or haemorrhage difficult.

Hypotension in supine position: May be misinterpreted as shock; improves with left lateral positioning.

Altered perfusion dynamics: Uteroplacental circulation is pressure-dependent; maternal hypotension directly compromises foetal oxygenation.

Haematological Changes

There is an increase in clotting factors, particularly fibrinogen and factors VII, VIII, IX, and X, accompanied by reduced fibrinolytic activity. This hypercoagulable state is protective against postpartum haemorrhage but predisposes pregnant women to thromboembolic events. Leucocytosis is common and may complicate the diagnosis of infection.

Respiratory Physiology

Oxygen consumption increases significantly to meet the metabolic demands of the foetus and maternal tissues. Tidal volume increases, resulting in mild hyperventilation and respiratory alkalosis. This facilitates carbon dioxide transfer from the foetus to the mother but also increases susceptibility to hypoxia during respiratory compromise or anaesthesia.

Clinical Implications in Surgical Practice

- Tachycardia and mild hypotension may mask early signs of hypovolemia. Significant blood loss can occur before classic signs of shock appear.
- Increased risk of thromboembolic events.
- Leucocytosis (up to 15,000/mm³ or higher in labour) may obscure infection diagnosis.

Renal and Fluid Balance

Renal plasma flow and glomerular filtration rate increase early in pregnancy, leading to lower serum creatinine and urea levels. Sodium and water retention occur under the influence of aldosterone and oestrogen, contributing to increased plasma volume and mild dependent oedema. Glycosuria and minimal proteinuria may be physiological.

Clinical Implications in Surgical Practice

- Dilated ureters may mimic obstructive uropathy.
- Baseline creatinine is lower; “normal” values may indicate renal impairment.

Endocrine and Metabolic Changes

The placenta functions as a major endocrine organ, secreting hormones such as hCG, progesterone, estrogen, and human placental lactogen. These hormones induce insulin resistance in late pregnancy, ensuring adequate glucose supply to the foetus. Basal metabolic rate increases, and weight gain reflects foetal growth, placental development, increased blood volume, and fat stores.

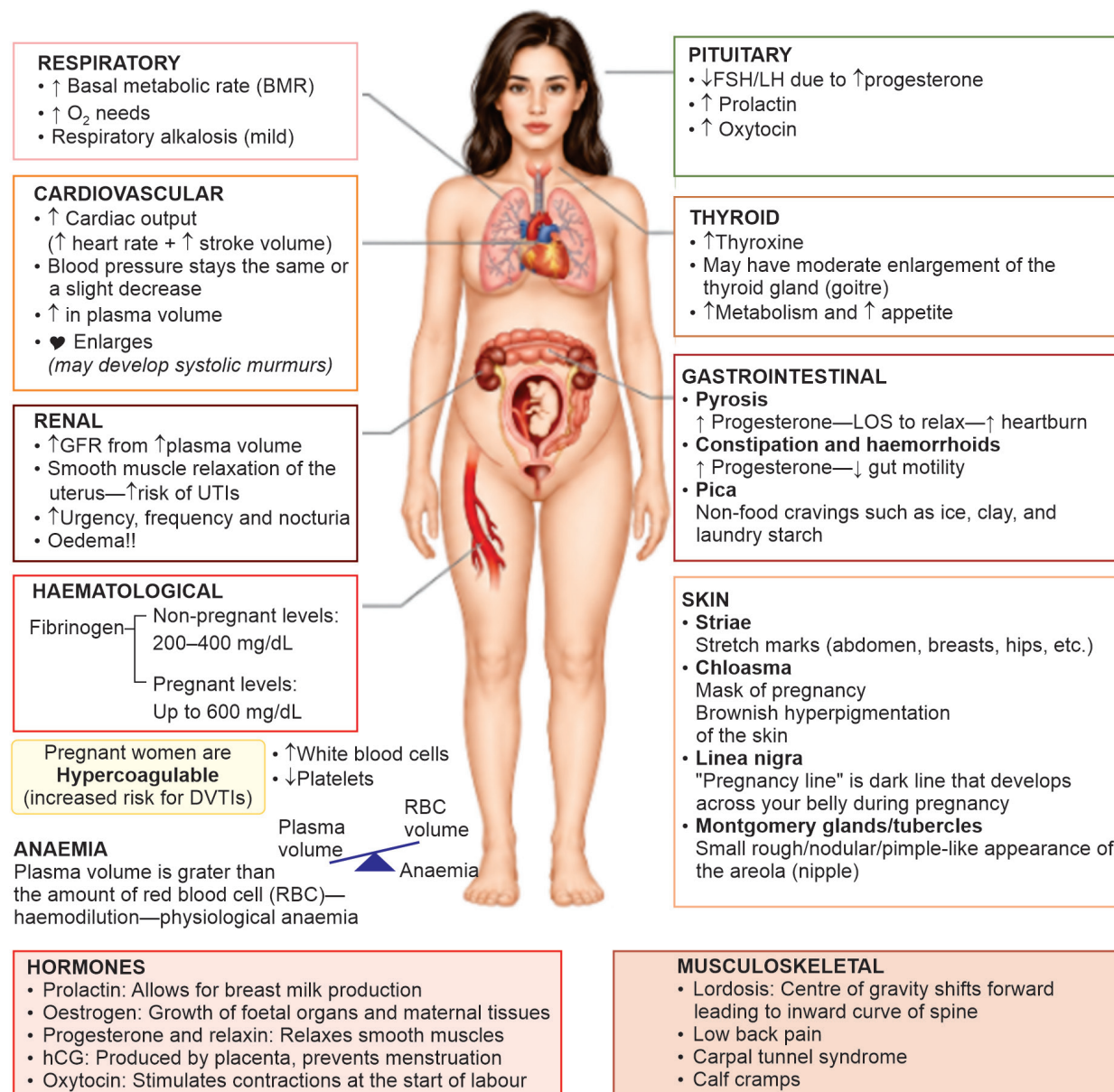


Fig. 1.1: Pregnancy physiology

Hepatic Changes

Although liver size remains unchanged, hepatic metabolism is altered. Serum alkaline phosphatase levels rise due to placental production, while serum albumin decreases because of haemodilution. These changes must be distinguished from pathological liver disease.

Clinical Implications in Surgical Practice

Increased incidence of

- Cholelithiasis
- Biliary sludge
- Acute cholecystitis

Diagnostic ambiguity: Dyspepsia and right upper quadrant discomfort are common in pregnancy.

Musculoskeletal Adaptations

Relaxin and progesterone cause ligamentous laxity, particularly in the pelvic joints, facilitating childbirth. The centre of gravity shifts forward, leading to increased lumbar lordosis, altered posture, and backache. Separation of the rectus abdominis muscles (diastasis recti) may occur.

Skin and Breast Changes

Increased melanocyte-stimulating hormone leads to hyperpigmentation, including chloasma and linea nigra. Striae gravidarum develop due to stretching of the skin. Breasts enlarge with increased vascularity and glandular proliferation, preparing for lactation.



Neurological Changes

Pregnancy is associated with increased sensitivity to local anaesthetics and susceptibility to compression neuropathies such as carpal tunnel syndrome due to fluid retention.

PRINCIPLES OF SURGICAL MANAGEMENT DURING PREGNANCY

Surgical intervention during pregnancy presents a unique challenge, as the clinician must simultaneously consider the well-being of two patients—the mother and the foetus—while managing conditions that may be life-threatening if left untreated. The guiding principle in the surgical management of pregnant women is that maternal health takes precedence, because optimal foetal outcome is closely linked to maternal stability. Modern advances in anaesthesia, imaging, and operative techniques have made surgery during pregnancy increasingly safe when guided by sound principles and a multidisciplinary approach.

The cornerstone of surgical management in pregnancy is the understanding that saving or stabilizing the mother is the most effective way to protect the foetus. Delays in indicated surgical interventions due to fear of foetal compromise often result in worse outcomes for both mother and foetus. At the same time, foetal safety must be integrated into every stage of care—from diagnosis through postoperative management—with measures aimed at minimizing foetal hypoxia, acidosis, and preterm labour.

The indications and timing of surgery are dictated by urgency and gestational age. Emergency surgical conditions such as acute appendicitis, bowel obstruction, torsion of adnexa, trauma, or haemorrhage require immediate intervention regardless of gestational age, as delays significantly increase maternal morbidity and foetal loss. Elective or semi-elective procedures, on the other hand, are ideally scheduled in the second trimester, between 14 and 28 weeks, when the risk of teratogenicity is reduced compared to the first trimester and the risk of preterm labour is lower than in the third trimester. If clinically acceptable, elective surgery may also be postponed until the postpartum period to further minimize foetal risk.

Comprehensive preoperative assessment and preparation are critical to optimizing outcomes. This includes evaluation of gestational age, foetal viability, the severity of the maternal surgical condition, maternal comorbidities, and obstetric history, as well as current pregnancy complications. Baseline foetal assessment through ultrasonography and cardiotocography, when the foetus is viable, is recommended. Imaging modalities should be chosen with foetal safety in mind. Ultrasound is the first-line diagnostic tool, while magnetic resonance

imaging (MRI) may be used if further clarification is required. Ionizing radiation should be avoided where possible; if necessary, the lowest effective dose with abdominal shielding should be employed. Multidisciplinary planning involving the surgeon, obstetrician, anaesthesiologist, radiologist, and, when appropriate, neonatologist is essential for coordinated care.

Anaesthetic considerations in pregnancy require careful planning. Both general and regional anaesthesia can be safely administered, with the choice dictated by the nature and duration of surgery, gestational age, and maternal condition. No commonly used anaesthetic agents have been proven to be teratogenic in humans at standard doses. Pregnant patients are at increased risk of difficult airway, delayed gastric emptying, and reduced lower esophageal sphincter tone, necessitating rapid sequence induction and appropriate aspiration prophylaxis. Positioning beyond 20 weeks of gestation requires a left lateral tilt to prevent aortocaval compression, with careful padding to avoid nerve injury.

Intraoperative principles emphasize gentle tissue handling to minimize uterine stimulation, meticulous haemostasis to prevent maternal hypotension, and efforts to minimize operative time. Laparoscopic surgery is increasingly favored due to reduced postoperative pain, lower risk of wound complications, and faster recovery. Key considerations for laparoscopy include using the open (Hasson) technique for port entry, maintaining lower insufflation pressures (10–12 mmHg), and modifying port placement according to uterine size. Continuous maternal monitoring and, when feasible, foetal heart rate monitoring are recommended throughout the procedure.

Postoperative care focuses on both maternal and foetal well-being. Maternal monitoring should be vigilant for haemorrhage, infection, and thromboembolic complications, with early mobilisation and thromboprophylaxis when indicated. Fetal surveillance includes postoperative heart rate monitoring and ultrasonography if concerns arise. Prevention of preterm labour involves monitoring uterine activity, minimizing uterine manipulation, and using tocolytics only when clinically indicated.

Pharmacological considerations require careful selection of medications. Antibiotics should be chosen based on established safety profiles in pregnancy, avoiding known teratogens. Adequate analgesia is essential to prevent stress-induced uterine contractions. Opioids may be used judiciously, while nonsteroidal anti-inflammatory drugs (NSAIDs) should be avoided, particularly in the third trimester.

Ethical and counseling aspects are integral to surgical management during pregnancy. Informed consent should involve detailed counseling regarding maternal



and foetal risks, discussion of alternatives, and potential outcomes, with proper documentation. Decisions must balance maternal benefit against foetal risk while respecting patient autonomy and cultural considerations.

Special situations, such as surgery in late pregnancy, require consideration of foetal viability, availability of neonatal intensive care, and, in rare cases, combined cesarean delivery and surgical intervention. Trauma surgery follows standard protocols with pregnancy-specific modifications, with maternal resuscitation taking priority.

In summary, surgical management during pregnancy requires a careful balance between timely intervention and foetal protection. Adherence to fundamental principles—including prioritizing maternal health, appropriately timing surgery, meticulous perioperative care, and multidisciplinary collaboration—ensures optimal outcomes. With modern advances in surgical and anaesthetic techniques, most necessary surgical procedures can be safely performed during pregnancy, reinforcing the principle that pregnancy alone is not a contraindication to surgery.

MATERNAL–FOETAL RISK ASSESSMENT

Pregnancy transforms the physiological milieu of the mother in ways that profoundly influence the natural history of surgical disease as well as the maternal and foetal response to surgical intervention. Any surgical disorder arising during pregnancy therefore mandates a careful and structured assessment of risk to both the mother and the foetus. This assessment is not static but evolves with gestational age, severity of disease, and the urgency of surgical intervention. The central tenet guiding risk evaluation is that **foetal survival is inextricably linked to maternal well-being**, and maternal compromise invariably precedes foetal compromise.

Risk Stratification Scales in Pregnancy-related Surgery

Risk stratification provides a framework for anticipating perioperative complications, guiding timing and extent of intervention, and facilitating informed consent. Although pregnancy-specific surgical risk scales are limited, established systems are adapted to the pregnant patient with appropriate clinical judgment.

Maternal Risk Stratification

The **American Society of Anesthesiologists (ASA) Physical Status Classification** remains the most widely used tool for assessing operative risk. Pregnancy itself is considered a physiological state corresponding to ASA class II, reflecting mild systemic alteration. However, the presence of comorbidities such as anaemia, pre-eclampsia, cardiac disease, sepsis, or significant

haemorrhage escalates the classification to ASA III or IV, correlating with increased perioperative maternal morbidity and a higher likelihood of adverse foetal outcomes.

The **Modified Early Obstetric Warning Score (MEOWS)** is particularly valuable in pregnant women undergoing surgery, as it allows early detection of physiological deterioration. Subtle changes in heart rate, blood pressure, respiratory rate, oxygen saturation, or mental status may signal evolving sepsis, haemorrhage, or cardiopulmonary compromise. Early recognition through MEOWS facilitates prompt intervention, thereby mitigating both maternal and foetal risk.

In patients with pre-existing cardiac disease, tools such as the **Revised Cardiac Risk Index (RCRI)** may be cautiously applied. Although not pregnancy-specific, it aids in predicting major cardiac events and assists anaesthetic planning, especially in surgeries associated with significant fluid shifts or haemodynamic stress.

Equally important is **surgical urgency stratification**, which categorizes procedures as emergency, urgent, or elective. Emergency surgery, undertaken to address an immediate threat to life, carries the highest maternal–foetal risk, yet paradoxically offers the greatest potential benefit. Delaying such surgery increases foetal loss far more than the surgical intervention itself.

Foetal Risks Associated with Surgical Disorders and Surgery

Foetal risk is influenced by gestational age, maternal physiological stability, and the nature of the surgical disorder rather than by surgery alone. The foetus is particularly vulnerable to disturbances in maternal oxygenation, circulation, and metabolic balance.

Teratogenesis

Teratogenesis refers to the induction of structural or functional foetal anomalies during critical periods of development. The foetus is most susceptible during the first trimester, particularly between the third and eighth weeks of gestation, when organogenesis occurs. Surgical intervention during this period raises concern primarily because of potential exposure to teratogenic agents and physiological insults.

Importantly, no anaesthetic agents in current clinical use have been conclusively shown to be teratogenic in humans at standard therapeutic doses. Instead, teratogenic risk arises indirectly through maternal factors such as hypoxia, hypotension, acidosis, hyperthermia, and severe infection. These disturbances impair placental perfusion and foetal oxygen delivery, potentially disrupting normal development. Similarly, exposure to ionizing radiation during diagnostic imaging carries a dose-dependent risk, with early pregnancy



exposure associated with growth restriction and neurodevelopmental impairment.

Miscarriage

Miscarriage represents the most feared foetal complication of surgery in early pregnancy. While baseline miscarriage rates in the first trimester range from 10 to 15%, the presence of acute surgical pathology may increase this risk. It is critical to recognize that foetal loss is more closely linked to the **severity and progression of the underlying disease**—such as peritonitis, sepsis, or uncontrolled haemorrhage—than to surgical intervention itself.

Mechanistically, miscarriage may result from maternal hypoxia, hypotension, systemic inflammatory response, or direct uterine stimulation. Emergency surgery performed in the context of advanced disease carries a higher risk of foetal loss than early, timely intervention. Thus, prompt diagnosis and decisive management are key to minimizing miscarriage risk.

Preterm Labour and Preterm Birth

In later pregnancy, the dominant foetal risk shifts from miscarriage to **preterm labour and delivery**. Surgical stress triggers the release of catecholamines and inflammatory mediators, which may stimulate uterine activity. Additionally, intra-abdominal or pelvic surgery can cause mechanical or reflex uterine irritation, further increasing the likelihood of preterm contractions.

The risk is highest during third-trimester surgery and in procedures involving prolonged operative time or significant maternal stress. Preterm birth carries substantial neonatal morbidity, including respiratory distress syndrome, intraventricular haemorrhage, sepsis, and long-term neurodevelopmental impairment. Consequently, prevention, early detection, and management of preterm labour form a critical component of postoperative care.

Maternal Risks Associated with Surgical Disorders in Pregnancy

Diagnostic and Disease-related Risks

Physiological and anatomical changes in pregnancy often obscure classical signs of surgical disease, leading to diagnostic delay. Displacement of abdominal organs, physiological leukocytosis, and altered pain perception may mask pathology until it becomes advanced. Such delays increase the risk of perforation, haemorrhage, sepsis, and multi-organ dysfunction, thereby escalating maternal and foetal risk.

Anaesthetic Risks

Pregnancy increases susceptibility to anaesthetic complications. Airway oedema and weight gain contribute to difficult intubation, while reduced lower esophageal sphincter tone and delayed gastric emptying

increase aspiration risk. Decreased functional residual capacity and increased oxygen consumption result in rapid desaturation during apnoea. These factors necessitate meticulous anaesthetic planning to maintain maternal oxygenation and haemodynamic stability.

Surgical and Postoperative Risks

Enhanced vascularity of pelvic and abdominal organs increases the risk of intraoperative bleeding. Displacement of viscera complicates surgical access and increases the risk of inadvertent injury. Postoperatively, pregnancy-associated hypercoagulability, compounded by surgical stress and immobilisation, significantly raises the risk of venous thromboembolism. Infection risk is also heightened due to pregnancy-related immunological modulation.

Obstetric Complications

Maternal surgical illness may precipitate obstetric complications such as placental abruption, foetal distress, and preterm premature rupture of membranes. These complications often arise secondary to maternal hypoxia, hypotension, or systemic inflammatory response and underscore the importance of vigilant maternal stabilisation.

Integrating Maternal–Foetal Risk Assessment into Clinical Care

A comprehensive maternal–foetal risk assessment allows clinicians to individualise management, select optimal timing and approach to surgery, and implement targeted perioperative monitoring. It also facilitates transparent counselling and informed consent, enabling the pregnant woman and her family to understand potential risks and benefits.

Maternal–foetal risk assessment in the context of surgical disorders during pregnancy is a dynamic and multifaceted process. By integrating structured risk stratification, understanding foetal vulnerabilities such as teratogenesis, miscarriage, and preterm labour, and recognising maternal risks related to disease, anaesthesia, and surgery, clinicians can make informed decisions that optimise outcomes. Timely intervention guided by meticulous risk assessment remains the cornerstone of safe surgical care in pregnancy.

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