

REVIEW

Abdominal Surgery in Pregnancy and Care of the Pregnant Patient

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Abstract

During pregnancy, surgical intervention may be required for reasons that are not related to pregnancy but are frequently seen. Diseases that require surgical intervention for non-obstetric reasons during pregnancy include acute appendicitis, acute pancreatitis, cholecystitis, trauma, and intestinal obstruction. The incidence of non-obstetric surgical interventions during pregnancy is reported as 1% or 2%. Physiological changes during pregnancy require a significantly different approach both in the diagnosis and treatment processes. Physiological, biochemical, anatomical, and immunological changes should be considered to ensure an accurate and fast diagnosis and treatment. Furthermore, it should be kept in mind that late diagnosis may lead to maternal morbidity, mortality, fetal loss, and the risk of premature birth. Balancing the health and well-being of the fetus against the mother's need for surgical intervention is a most important focus of care. In a surgical intervention during pregnancy, the risks involved for the mother and the baby vary depending on the type of intervention needed, the trimester of the pregnancy in question, and the health status of the mother and the fetus. A multidisciplinary teamwork as well as preliminary evaluations and preparations are essential to ensure optimal safety for both the mother and the fetus. The aim of this study is to provide information for midwives and nurses on various diagnoses requiring surgical procedures during pregnancy albeit unrelated to pregnancy, on the differences in diagnosis and treatment processes due to physiological changes in pregnancy, and the nursing care of pregnant patients before, during, and after surgery.

Keywords: General surgery, nursing care, pregnancy, pregnant women, surgery

Introduction

During pregnancy, surgical intervention may be necessary for reasons related (obstetric) or unrelated to pregnancy (non-obstetric). Epidemiological data show that 1 out of every 500 pregnant women undergoes surgical intervention for reasons not related to pregnancy (Nezhat et al., 2019). Studies in recent years find this rate to be 1% or 2% (Arkenbosch et al., 2020; Balinskaite et al., 2016; Tolcher et al., 2018; Yu et al., 2018). Non-obstetric diseases requiring surgical intervention during pregnancy can be listed according to incidence as follows: acute appendicitis, acute pancreatitis, cholecystitis, malignancy, trauma, and intestinal obstruction (Dietrich et al., 2008; Ertürk & Karabulut, 2015; Günaydın, 2012; Vujic et al., 2019). As for the surgical procedures not related to pregnancy, 42% is reported to occur in the first trimester, 35% in the second, and 23% in the last trimester of pregnancy (Günaydın, 2012; Okeagu et al., 2020; Reitman & Flood, 2011).

Surgical approach involves significant differences among pregnant patients in terms of diagnosis and treatment. Surgical intervention during pregnancy brings along certain

risks for the mother and the fetus. Balancing the health and well-being of the fetus against the mother's need for surgical intervention is the most important focus of care. In a surgical intervention during pregnancy, the risks involved for the mother and the fetus vary depending on the type of intervention needed, the trimester of the pregnancy in question, and the health status of the mother and the fetus (Edward & Newton 2008; Nezhat et al., 2019).

It is recommended to postpone any elective surgery until after the birth where possible and wait for the second trimester for semi-elective surgery as the organ development of the fetus is complete at that time and the chance of preterm delivery and risks associated with anesthesia are at the lowest. The Society of American Gastrointestinal and Endoscopic Surgeons recommends the 26–28th weeks of pregnancy as the ideal timing for laparoscopic procedures (Pearl et al., 2017). On the other hand, since it is not possible to consider an optimal timing in emergency operations, the main aim is to save the mother's life (American College of Obstetricians and Gynecologists [ACOG], 2017; Ertürk & Karabulut, 2008; Günaydın, 2012; Huang et al., 2016; Ramirez et al., 2020).

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American College of Obstetricians and Gynecologists published the following joint board resolutions on non-obstetric surgery in 2017:

- There is no anesthetic agent available with teratogenic effects where concentrations suitable for the gestational age are used.
- Obstetric consultation is of utmost importance prior to non-obstetric surgery and certain invasive procedures such as cardiac catheterization and colonoscopy.
- Surgical intervention should be performed in an environment and circumstances appropriate for the situation and by a team with multidisciplinary experience including the surgeon, anesthesiologist, obstetrician, pediatrician, surgical nurse, and midwife.

This study was conducted with the aim to provide information for the benefit of surgical nurses on various diagnoses requiring surgical procedures during pregnancy albeit unrelated to pregnancy and on the differences in diagnosis and treatment processes due to physiological changes in pregnancy. Explaining comprehensive patient assessment in pregnant women before surgical intervention provides guidance for planning nursing care necessary to maintain the health of the mother and fetus during the surgical process, as well as for creating and maintaining safe and effective operating room conditions in the most common non-obstetric surgical procedures performed during pregnancy.

Physiological Changes in Pregnancy

Physiological, biochemical, anatomical, and immunological changes from fertilization to the end of term should be considered in pregnant patients to ensure an accurate and fast diagnosis and treatment of any diseases to occur during pregnancy and the related care of the patient. An understanding of the normal changes and early recognition of any abnormal changes during pregnancy are a crucial part of the nursing diagnostic process and care and ensure the safety of the pregnant patient and the fetus (Boisseau, 2012; LoMauro et al., 2015).

Laboratory Values in Pregnancy: Normal clinical and laboratory findings of pregnant women are different from those of the non-pregnant women. Understanding these differences is of crucial importance to avoid unnecessary and even sometimes risky diagnostic tests for pregnant women. Table 1 summarizes the differences in laboratory values between pregnant and non-pregnant women.

Central Hemodynamics and Cardiovascular System: As a result of the increased levels of progesterone, smooth muscles in the body start loosening from the 10th to 12th weeks

Finding	Pregnant	Non-pregnant
Electrolytes, acids, and Bbases		
Sodium (mEq/L)	135–145	132–140
Bicarbonate (mEq/L)	24–30	17–22
PCO ₂ (mmHg)	35–50	25–30
PO ₂ (mmHg)	98–100	101–104
Blood urea nitrogen (mg/dL)	10–18	4–12
Total cholesterol (mg/dL)	120–220	250
Triglyceride (mg/dL)	45–150	230
Hematologic laboratory values		
Hematocrit (%)	37–48	32–42
Hemoglobin (g/dL)	12–16	10–14
Leucocyte (count/mm ³)	4300–10,800	5000–15,000
Lymphocyte (%)	38–46	15–40
Fibrinogen	250–400	600
Ferritin (ng/mL)	35	10–12
Lipids and liver function tests		
Total bilirubin (mg/dL)	1.0	1.0
Alkaline phosphatase (IU/mL)	13–35	25–80
Total protein (g/dL)	6.0–8.4	5.5–7.5
Albumin (g/dL)	3.5–5.0	3.0–4.5

Source: Edward and Newton (2008).

of pregnancy and consequently blood pressure drops until the 28th week. Heart rate becomes 10–15 beats/min compared to baseline, cardiac output increases by 30%–50%, and systolic and diastolic pressure decreases by 5–15 mmHg. These central hemodynamic changes may lead to a reduced systemic vascular resistance and venous return, which in turn may cause tachycardia in pregnant women. Blood volume increases by 50% and erythrocyte count by 30%, to be considered as physiological anemia. All pregnant women with high blood pressure should be evaluated in detail in terms of complaints involving the rhythm, rate, and count of pulse, as well as symptoms such as edema, warming up and color change in extremities, fatigue, and shortness of breath (Elassy et al., 2014).

In the second half of pregnancy, women may have complaints such as hypotension, perspiration, dizziness, and nausea due to the inhibition of the venous return and cardiac output as a result of the pressure the growing uterus applies on the inferior vena cava. Furthermore, fetal oxygenation may decrease due to reduced uterine blood flow in supine position. In order to prevent or minimize the supine hypotension syndrome, it is recommended to have the pregnant patient lie on her left side or to support the right hip during any procedure after the 20th week of pregnancy. This measure helps increase fetal oxygenation and prevent any decrease in the heart rate of the patient, ensuring adequate circulation (Boisseau, 2012; Günaydın, 2012; Nezhat et al., 2019).

Respiratory System: The risk of hyperventilation increases in pregnancy because of mechanical reasons such as the

Main Points

- Surgical care in pregnant women includes important differences due to the changes that occur during pregnancy.
- Awareness of these changes contributes to the early and correct diagnosis, thus reducing maternal and fetal death and disability rates.
- The focus of care is to balance the health and well-being of the fetus against the mother's need for surgical intervention.

progesterone causing respiratory rate and tidal volume to increase, as well as the uterine enlargement. After the first trimester, progressive anatomical changes cause a decrease in lung capacity, an increase in PO₂, and a decrease in PCO₂ as a result of mild respiratory alkalosis (Edward & Newton 2008).

Gastrointestinal System: Intra-abdominal pathologies are seen frequently in pregnancy and require surgical intervention. However, the difficulty of distinguishing their symptoms from the normal signs of pregnancy complicates the diagnosis process. The nausea and vomiting seen with a frequency of 70% in the first months of pregnancy are expected to decrease in the later months (Nezhat et al., 2019). Physiological processes such as the changes in the gastric position, progesterone-related tonus, and decreased motility in the gastrointestinal tract increase the risk of aspiration during surgery and anesthesia. Increased intra-abdominal pressure, prolonged gastric emptying, and the lower esophageal sphincter relaxation may cause aspiration, especially during intubation (Mihmanlı & Karahisar, 2012). Table 2 summarizes the effect of the physiological changes in pregnancy.

Surgery Unrelated to Pregnancy During Pregnancy

Acute Abdomen in Pregnancy: Changes in the gastrointestinal tract and uterine pressure on the abdominal organs as well as the physiological changes brought along by pregnancy can cause abdominal pain. In a pregnant woman presenting with abdominal pain, it is necessary to determine first whether the pain is related to pregnancy (Mihmanlı & Karahisar, 2012; Okeagu et al., 2020).

The most effective method for the diagnosis of acute abdomen is a detailed history and physical examination performed by an experienced obstetrician. This should be followed by intermittent pelvic examination results, electronic fetal monitoring, and ultrasonographic examinations. Diagnostic imaging methods such as computed tomography (CT) or positron emission tomography (PET) are recommended for use during pregnancy at allowed radiation doses (Bouyou et al., 2015; Nezhat et al., 2019; Tolcher et al., 2018).

The consideration of three points should be emphasized in the diagnosis and treatment of acute abdomen in a pregnant patient.

- Physiological, biochemical, and anatomical changes in pregnancy may lead to false, incorrect, or delayed diagnosis and treatment, which constitute a major risk health for the patient.
- Common complaints associated with pregnancy (abdominal pain, and nausea) may cause the signs and symptoms distinctive to acute abdomen be disregarded.
- The fetus is a passive participant in the disease process and can be directly affected by the utero-placental changes in the progress or management of the disease or the transfer of bioactive agents to the placenta (Bouyou et al., 2015; Kapan et al., 2013).

Transvaginal or intra-abdominal ultrasonography is the preferred method in pregnant women with abdominal pain because of its safety. However, because of the changes in the position of abdominal organs under the pressure of the growing uterus, ultrasonography may not be reliable for diagnosis. High accuracy rates are reported in pregnant patients with magnetic resonance imaging (MRI) as compared to medical follow-up and postoperative diagnosis. Furthermore, the change of position in the abdominal organs under the pressure of the growing uterus and the associated difficulties in a physical examination, as well as evaluating nausea, vomiting, or abdominal pain as normal in pregnant women, may delay the diagnosis of acute abdomen (Ray et al., 2016).

Pain and the associated abdominal tenderness are the most common signs and symptoms. In the presence of pain, its location, type, intensity, and extent must be carefully identified. Pain may be diffuse or limited to the lower, middle, or upper abdomen. In case rebound accompanies diffuse pain, a severe irritation of the peritoneum such as severe infection or intra-abdominal bleeding should be considered. Diffuse pain following a localized pain on one part of the abdomen suggests sudden rupture of an organ, cyst, abscess, or tumor (Günaydın, 2012).

Acute Appendicitis in Pregnancy: Acute appendicitis is the most common cause of surgical intervention during a pregnancy with a reported incidence of approximately 1 in 1500 pregnant women.²⁴ One in two pregnant women diagnosed with appendicitis is in the second trimester of pregnancy. Uncomplicated acute appendicitis results in a fetal mortality of less than 5%; however, fetal mortality after

Physiological Change	Effect
Reduced functional residual capacity (FRC) lung volume	Atelectasis, hypoxemia risk
Increased erythrocyte and leukocyte count	Tendency to disseminated intravascular coagulation
Increased cardiac output	Increased metabolic needs
Increased heart rate	Failure to distinguish the early stages of shock
Enlarged uterus	Supine hypotensive syndrome developing as a result of aortocaval compression
Uterus anatomically growing into the frontal and outer pelvis	Increased risk of injury in the uterus and placenta

perforation is 20%–25%, and maternal mortality is around 4%. Appendectomy makes up 25% of all surgical procedures performed on pregnant women (Edward & Newton 2008; Yu et al., 2018).

High body temperature and leukocytosis in pregnant women are not clear indicators of appendicitis, but loss of appetite, nausea, vomiting, and a shift in periumbilical pain toward the appendix are considered common symptoms. It is difficult to distinguish nausea and vomiting from the common symptoms associated with pregnancy. Tenderness localized in the right lower quadrant of the abdomen is the most reliable finding. Approximately 70% of patients present with muscle defense, rebound, and tenderness (Machado, 2009). Pregnant women with suspected acute appendicitis or diagnosed as such require urgent surgical intervention. A delay of more than 24 hours, on the other hand, significantly increases appendicitis perforations and thus fetal losses and maternal mortality. Intervention is performed by open or laparoscopic method as per surgeon's preference. However, it is stated that the use of laparoscopic method can be technically difficult in later months (Alkiş et al., 2010; Corneille et al., 2010).

Acute Cholecystitis in Pregnancy: Approximately 1 in 1600–10,000 pregnant women suffers from this complication. Its most common cause is gallstones. The risk of cholelithiasis and acute cholecystitis increases in pregnant women due to the lithogenic effect of bile stasis and estrogen as a result of the relaxation of smooth muscles with progesterone. In routine ultrasonographic examination, the incidence of cholelithiasis in pregnant women was found as 3.5%–10% (Günaydın, 2012). Typical symptoms include nausea, vomiting, dyspepsia, intolerance to fatty food, and abdominal pain that is epigastric in character or that begins in the upper right quadrant and spreads to the backside in a colic or stabbing-like manner. As in non-pregnant women, direct bilirubin and transaminases may be elevated. Ultrasonography imaging allows the visual detection of approximately 95%–98% of the gallstones. Surgical intervention is the recommended primary treatment (Augustin & Majerovic, 2007; Centers for Disease Control and Prevention [CDC], 2016). Due to a high rate of fetal loss, in previous studies, it was recommended to postpone medical treatment and operation until the postpartum period. However, cholecystectomy is currently recommended as a primary treatment, because it reduces the need for medical treatment and the possibility of recurrent acute episodes in the third trimester in the 44%–92% of pregnant women (Alkiş et al., 2010; Nasioudis et al., 2016; Sachs et al., 2017).

Intestinal Obstructions in Pregnancy: Obstruction is the partial blocking or inhibition, slowing down, or a complete halt of the progression of intestinal contents to the rectum. It may be partial or complete. It is commonly seen in the small intestine, especially the ileum, its narrowest section. Intestinal obstruction is the third leading cause of acute abdomen in pregnancy and it is seen in 1 out of 1500–16 000 pregnant women and frequently in the third trimester. Delay in diagnosis and treatment increases the risk of morbidity and

mortality due to intestinal obstruction during pregnancy. The incidence of fetal death in maternal intestinal obstruction is 20%–26%, whereas the incidence of maternal mortality is 6%–20%. Adhesion, volvulus, hernia, invagination, tumor, and diverticulitis due to a previous abdominal surgery are the main causes of intestinal obstruction in pregnancy. Around 25% of intestinal obstruction is a result of volvulus. Sigmoid volvulus refers to the torsion in a segment of the digestive tract and often leads to obstruction and ischemic changes in the intestine (Dhar et al., 2015).

Trauma in Pregnancy: As a major cause of non-obstetric maternal deaths, trauma affects 6%–7% of pregnant women according to statistics. Cranial injuries can be seen in the fetus in the presence of pelvic fractures in the mother. Fetal mortality rate following a blunt trauma to the mother is reported to be around 3.4%–38%. The most common causes of fetal mortality due to trauma are *ablatio placenta*, maternal shock, and maternal death (Tejwani et al., 2017). Blunt or penetrating injuries such as gunshot wounds, vehicle accidents, poisoning, burns, falls, and penetrating injuries are among the main causes of trauma in pregnant women (Deshpande et al., 2017; Özşeker et al., 2015).

Perioperative Nursing Care in the Abdominal Surgery in Pregnant Patients

Preoperative Care

In the preoperative diagnostic process and the intraoperative and postoperative care of the pregnant patient requiring major surgical intervention or undergone trauma, as well as of the fetus, nurses as members of a multidisciplinary team have a crucial part to play. Preoperative preparation for the pregnant patient undergoing a non-obstetric surgery should follow the standard procedures used for non-pregnant patients, including laboratory and other testing as indicated by any comorbidities and the surgery being performed.

Nurse should collect the necessary data in the first interview with the patient. This includes the trimester of pregnancy, vitals, any complaints, diseases, medications, dietary restrictions or allergies, use of alcohol, nicotine or recreational drugs, previous operations and anesthesia, occupation, religious beliefs, marital status, etc. Generally, preoperative anxiety is caused by the fear of the unknown. Moreover, the patient may also fear postoperative pain, the possibility of cancer, loss of organs, danger of death, risks of anesthesia, loss of job, and the loss of loved ones and activities. However, the leading type of fear in pregnancy is the fear of premature birth and miscarriage, which is common to all pregnant women (Edward & Newton 2008). When surgical intervention is considered in a pregnant patient, oral intake should be stopped, heat must not be applied in the presence of acute appendicitis to avoid rupture of the appendicitis or peritonitis, and an ice bag should be placed on the right lower quadrant. Moreover, analgesics and laxatives must not be given as they suppress the symptoms. Pain control should be maintained through non-pharmacological methods and vitals should be checked frequently. In case of an

appendicitis perforation, antibiotics should be given as per the doctor's prescription. (Wilson et al., 2016). Information regarding the low risk of teratogenicity from anesthetic drugs should be shared. Coordination between anesthetic, surgical, obstetric, and pediatric teams should take place. Standard preoperative fasting guidelines should be followed. Antacid prophylaxis is recommended after week 14 given the increased risk of aspiration and, therefore, aspiration pneumonitis (Nezhat et al., 2019; Okeagu et al., 2020).

Symptoms of an intestinal obstruction are similar to those seen in non-pregnant women and include abdominal cramps, nausea, vomiting, and constipation. Conservative treatment of intestinal obstruction is provided, such as securing the fluid–electrolyte balance, decompression with nasogastric tube, enema, fetal monitoring, and the measurement of maternal oxygenation. Standard objective of this treatment is to prevent colonic ischemia and its recurrence. In patients with intestinal obstruction, prophylactic antibiotic therapy should be administered before surgery. The amount of vomiting and the amount of drainage from the intestinal tube are measured, its color, smell, and appearance are evaluated and recorded, and the patient is observed for signs and symptoms of shock.

A careful assessment of the injury status is vital in pregnant patients of trauma. The patient must be rapidly prepared for emergency surgical intervention. Oral intake should be halted, and vital signs are monitored. The cause, time, and circumstances of the trauma should be reported, as well as whether the patient is conscious. The standard Advanced Trauma Life Support protocol should be used for all patients. It addresses the treatment of airway, respiratory, and circulatory failure. After a trauma, the mother's airways should be cleared, breathing and circulation are provided, and necessary fluid resuscitation is performed followed with hemodynamic monitoring. Fetal monitoring should also be performed with caution. Intermittent abdominal examination should be performed in pregnant women who are exposed to abdominal trauma. These patients must be followed up closely in terms of shock symptoms (tachycardia, mental change, hypotension, perspiration, tachypnea, or pallor) since the most common hypovolemic shock develops in the aftermath of the trauma (Okeagu et al., 2020; Tejwani et al., 2017).

Intraoperative Care

For non-obstetric surgical procedures, the perioperative surgical team requires extensive knowledge of safe patient placement. This section provides guidance for the most frequent non-obstetric surgical procedures done on pregnant surgical patients in terms of operating room configuration, setup, and positioning. The surgical team begins the care planning process as soon as the pregnant patient is admitted to the operating room and makes the necessary changes by regularly re-evaluating the patient's condition. In order to avoid pressure wounds, the team must anticipate the positioning equipment and materials that will be required based on the initial comprehensive patient evaluation (Nezhat et al., 2019; Okeagu et al., 2020).

By providing the necessary equipment and having a sufficient number of suitable qualified health care experts, it is possible to determine, before the surgery, the risks that may be experienced during and before the transportation. The operating room arrangement and setup will be determined by the type of anesthesia to be used, the scheduled surgical operation, and the desired surgical position.

The purpose of positioning of the surgical equipment is to maximize the use of the operating room area while providing a safe and comfortable environment for the whole team. The pregnant patient should be kept under the supervision of appropriate personnel throughout transport and transfer by maintaining her in the left lateral recumbent position with a positioning wedge and avoiding the flat supine position. In general, pregnant patients at or older than 20 weeks of gestation should be positioned in a left lateral recumbent position, which is done by placing a wedge under the patient's right hip and moving the abdominal contents away from the midline. Positioning the pregnant patient in a way other than the semi-Fowler, sitting, or reverse Trendelenburg positions may compromise the respiratory system (Nezhat et al., 2019).

When the seat belts are removed or the patient is transferred, a predetermined team member should be present to protect the patient from falling due to position changes during surgery. Towel and sheet rolls do not relieve pressure and can cause friction injuries. Convoluted foam mattress covers can be more effective at redistributing pressure and resist compression best if they are made of thick, dense foam.

Providing the surgical team with information on the possible response and reaction of the fetus and mother to the surgical intervention is among the fundamental and primary duties of the operating room nurse. Intraoperative fetal monitoring is suggested, especially in patients with 26 weeks of gestation and above. Fetal heart rate monitoring allows for timely intervention in cases of distress and uterine activities. To manage both obstetric and neonatal crises related to the possibility of preterm birth, the surgical team must determine action plans and carefully evaluate resources. When a decision is made for the emergency cesarean section, the circulating nurse and surgical assistant should prepare and count all of the necessary instruments before beginning the surgery. In addition, in case of emergency cesarean section, the perinatal circulation nurse should bring the infant warming device and baby resuscitation equipment to the operating room for postpartum (Boisseau, 2012).

The patient's overall skin and extremity condition should be noted at regular intervals upon arrival in the operating room, throughout the surgery, and while being discharged. It is important to keep track of the type and location of positioning equipment used, as well as any required position changes throughout surgery.

Even though the intraoperative care of pregnant women is similar to that in non-pregnant patients, the position maintained during surgery is significantly different. Complications such as fetal hypoxia, infection, and preterm

labor may develop during and after surgery, especially from the 24th week. Supine hypotension is called as the extra pelvic organ of the uterus in 16 weeks of gestation and the prevention of venous return to the inferior position of the pregnant woman in the supine position. Fetal hypoxia is usually caused by supine hypotension. In the third trimester, symptomatic hypotension (characterized by syncope, nausea, and vomiting) is seen in 10% of healthy pregnant women. In conclusion, after the 16th week, pregnant patients should be operated in left lateral inclination position to reduce venous and arterial pressure. Trendelenburg position can also be applied to ensure better vision. In order to prevent fetal risks, caesarean section can be considered in the same session or before surgery (AOG, 2017; Edward & Newton 2008).

Another important risk in surgical interventions during pregnancy is anesthesia. The risk of preterm labor due to anesthesia is reported as 4%–6% and the risk of fetal mortality is 1.8%–2%. Premedication and sedatives should not be given in the preoperative period. Only the aspiration prophylaxis with H₂ receptor antagonists and particle-free antacids is recommended. Heart rate, electrocardiography, blood pressure, peripheral oxygen saturation, body temperature, and end tidal carbon dioxide pressure are monitored in the mother according to the type of anesthesia chosen. However, if fetal monitoring is to be performed continuously under anesthesia remains a matter up for debate. The decision to perform intraoperative fetal monitoring should be individualized on a patient-by-patient basis. Each patient should be approached with a team understanding that considers the safety of both the mother and the baby (Cheek & Baird, 2009; Karuppiah, et al., 2021; Ravindra et al., 2018; Tolcher et al., 2018).

Postoperative Care and Conclusion

In the postoperative period, the mother and fetus should be closely monitored for increased risk of uterine activity and changes in the fetal heart rate. Vitals should be monitored frequently and the discharges should be evaluated in terms of color, smell, and quantity.

For the pre-viable fetus (>24 weeks), assessment of the fetus heart rate (FHR) using Doppler ultrasound in the pre- and postoperative time periods is sufficient to alleviate and reassure the mother. In the viable fetus (>24 weeks), a minimum of pre- and postoperative FHR and uterine contractions should be monitored to ensure fetal well-being and the absence of uterine contractions that would indicate preterm labor. Uterine contraction monitoring is done using a tocodynamometer and is associated via a graded response with the FHR as signs of contractions will correlate with a transient increase in FHR (Okeagu et al., 2020).

Distension control in the abdomen and monitoring the patient's gas passing are essential. In case of stomach distension, a nasogastric tube can be applied. Once the patient is no longer under the influence of anesthesia, she can be placed in reclining position. Especially following a cholecystitis surgery, the fat content in the patient's diet should be regulated according to the doctor's advice and the patient's

condition. A satisfactory calory intake is essential for pregnant patients. Also, pregnant patients should be encouraged to do breathing exercises (Bratzler et al., 2013; El-Messidi et al., 2018).

Note that prophylactic corticosteroid administration should be avoided in patients with systemic infections due to the subsequent impairment of the maternal immune system. Pregnancy is also associated with a hypercoagulable state secondary to the decrease in free protein S and fibrinolysis activities, and the increase in factor VII, VIII, and prothrombin. Therefore, pregnant women should undergo screening for venous thromboembolism risk and preferentially receive low-molecular-weight heparin for prophylaxis.

In the postoperative pain management of the pregnant patient, regional analgesia provides the best analgesia and minimal fetal heart rate variability. Adequate postoperative pain management is also important as inadequate pain management may precipitate premature labor. Opioids and acetaminophen can be used as treatment for mild to moderate pain; however, non-steroidal anti-inflammatory drugs should be avoided. Regional anesthesia via epidural, fascial plane, truncal blocks, and other peripheral nerve blocks for acute pain management may be considered if no contraindications are present.

After a general anesthesia during pregnancy, the postoperative analgesia provided is intravenous patient-controlled analgesia. And epidural patient-controlled analgesia is applied following an epidural anesthesia. Non-steroidal anti-inflammatory drugs should be avoided, as they may cause premature closure of the *ductus arteriosus* and the development of oligohydramnios. Short-term morphine or meperidine can be used in severe postoperative pain, but these should not be given during the recovery period, as they may suppress respiration in the fetus. Codeine is a drug that must be avoided in the postoperative analgesia of pregnant women. It is known to directly cause congenital anomalies. Care of the wound is essential in the postoperative period. Pregnant patients and family members should be informed and educated about the procedures to be performed before, during, and after surgery.

Considering the increased risk of trauma during pregnancy, trauma nurses should be aware of the anatomical and physiological changes that occur during pregnancy and be able to properly and timely determine the type of trauma and accordingly the response to trauma in the mother and fetus. The optimal treatment of the fetus after maternal trauma is rapid resuscitation and management of maternal injuries, followed by fetal assessment and monitoring according to gestational age (Okeagu et al., 2020).

The normal course of physiological and anatomical changes in pregnant women may complicate the diagnosis and treatment of medical conditions. Nurses and midwives have a critical role in maintaining the health of the pregnant patient and indirectly the fetus and in providing the required effective care on time. Nursing care standards should be

determined in the pregnant patient before, during, and after the operation, unnecessary practices should be avoided, and health professionals should be trained on the subject. In the surgical applications during pregnancy performed for reasons not related to pregnancy itself, it is not possible to eliminate all risks even when all factors supported and unsupported by evidence are considered. Late diagnosis brings along the risks of maternal morbidity, mortality, fetal loss, and premature birth. In conclusion, a multidisciplinary teamwork as well as preliminary evaluations and preparations are essential to ensure optimal safety for both the mother and the fetus.

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