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Perioperative Evaluation of Pregnant Surgical Patients: A Review

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ABSTRACT

Pregnant Females require special perioperative consideration as females react differently to treatment from physiologic and behavioural standpoints. Thus a standard perioperative assessment plays a crucial role for successful accomplishment of intraoperative and postoperative phase as well as to resist complications due to pregnancy. Each physiologic system is affected in such a way that may or may not have clinical significance for the surgeons. Thus affect of Pregnancy on cardiovascular, respiratory, gastrointestinal, renal and endocrinal system have been reviewed. Moreover to decrease the hazards to the developing child, impact of surgery/treatment on the fetus has also been discussed. It was concluded that the goal of the perioperative evaluation of pregnant females is to identify its physiological effects on various systems and provide for the best efficacious perioperative treatment algorithm that shall minimize the patient morbidity.

Keywords: Perioperative, Pregnant, Surgery

INTRODUCTION

Preoperative evaluation is defined as the process of defining those features of a patient's general condition that may affect the course of surgery adversely.[1] These medical conditions might be present in any patient and may lead to increased morbidity and mortality.[1, 2]

Preoperative evaluation of surgical patients and decision regarding choosing the appropriate and specific presurgical laboratory tests can be challenging task at times. Appropriate preoperative evaluation not only provides a successful intra- operative and postoperative management of the effects of anesthesia and surgery but it's also necessary for combating complications that may result from preexisting disease.[3] Thus Preoperative assessment standardization is warranted to assure that all relevant measures are considered.[2,3]

Care of the female patient requires a detailed understanding of the unique issues inherent to quality treatment. Females react differently to treatment from physiologic and behavioral standpoints.[4]

More obvious differences in physiology, especially the ability to become pregnant should be ascertained at every patient visit for every woman of childbearing. Lead shielding during radiographs should be used routinely on all women regardless of pregnancy status. Pregnancy status alters every decision for invasive procedures and choice of anesthetics.[5]

Women taking contraceptives who would undergo antibiotic therapy should be informed of the risk for pregnancy. For female patients undergoing antibiotic therapy, alternative birth control methods should be used. Oral contraceptives can also increase a woman's chance of experiencing a venous thrombosis or cerebro-vascular accident peri-operatively, and may increase blood pressure.[4,6] Moreover, women are more prone to osteoporosis than men, which has led to the wide use of bisphosphonates in women, usually those who are in the fourth decade of life and older. Bisphosphonates are shown to be important factors in the development of spontaneous osteonecrosis of the jaws and abnormal healing after oral surgery. Female patients are increasingly likely to experience and present with osteonecrosis of the jaws as a result of these drug interactions.

DISCUSSION

Many aspects of the evaluation and treatment of pregnant patients differ substantially from those who are not pregnant. Although many elective procedures may be delayed until the baby has been delivered, several circumstances exist in which care cannot be postponed, including those involving trauma, acute infections of the head and neck, erupting or impacted teeth that are causing problems and benign and malignant tumors.

From conception, a woman's body begins a remarkable transformation to allow another human to develop, grow and be delivered. Each physiologic system is affected in ways that may or may not have clinical significance for the oral and maxillofacial surgeon (table 1).

Table: 1. Normal hemodynamic and renal changes associated with pregnancy[4]
Cardiovascular
Increased cardiac output
Decreased vascular resistance
Modest decrease in blood pressure
Increased blood volume with relative anemia
Renal and electrolyte
Increase in glomerular filtration rate
Chronic partially compensated respiratory alkalosis
Hyponatremia
Decreased plasma concentration of blood urea nitrogen (BUN) and creatinine

Cardiovascular

Important hemodynamic changes that occur during pregnancy include increased cardiac output, reduced systemic vascular resistance and decreased systemic blood pressure. Also, expansion of intravascular volume occurs with resulting anemia. These changes begin early in pregnancy, peak during the second trimester, then plateau and remain until delivery. These changes contribute to the normal growth and devolvement of the fetus and help protect the mother from complications at delivery.[4]

During the first 8 weeks, the pregnant woman will be halfway to increasing her cardiac output by 30%- 50% above her baseline. By the first part of the second trimester, her cardiac output could be increased by 1.8 L/min. These changes remain constant until delivery. The surgeon must understand that the position of the patient and administration of drugs can greatly affect cardiac output during pregnancy.[4,7]

This increase in cardiac output becomes very sensitive to postural changes. A woman in her third trimester must lie in the left lateral decubitus position, or at least at a 30° left lateral tilt, rather than supine. Supine positioning leads to compression of the inferior vena cava with substantial reduction in venous return, accounting for a drop in cardiac output of up to 25% within 3 to 10 minutes (table 2). Furthermore, this position has been shown to compress the aorta, with a drop in blood flow in the common iliac arteries.[4,8]

Table: 2. Signs and symptoms of supine hypotensive syndrome in pregnancy [4]
Dizziness
Faintness
Nausea
Vomiting
Dyspnea
Pallor
Cyanosis
Hypotension
Headache
Tingling/numbness
Chest/abdominal pain

Both the mother and the fetal uteroplacental blood flow are affected by these phenomena, however, the fetus is more susceptible to these changes and does not show warning signs.

Preload, afterload and heart rate are important factors accounting for the increase in cardiac output. The preload is increased as total blood volume increases during pregnancy. Afterload is decreased because of a reduction in systemic vascular resistance. Finally, the maternal heart rate increases by 15 to 20 beats per minute. Early in pregnancy, stroke volume is the major factor accounting for the cardiac output, whereas heart rate accounts for it late in pregnancy and the ejection fraction remains at nonpregnant values.

A drop in systemic vascular resistance and blood pressure occurs early in pregnancy. A mean pressure of 105/ 60 mmhg by the second trimester is not abnormal. In the later part of pregnancy, pressures slowly return to prepregnant levels. Blood pressures that increase past normal levels should be followed- up because they could signal pregnancy-induced hypertension. Experts must understand the normal variation in blood pressures so they do not react to a presumed hypotension situation, or worse yet, miss signs of a more serious condition.[4,9]

Another clinically important change occurs in the coagulation pathway. Pregnancy produces a hyper coagulable state and causes a resistance to activated protein C in the second and third trimester. Protein S levels decrease. The levels of factors I, II, VII, VIII, X and XII all increase. Finally, the activity of fibrinolytic inhibitors PAI- 1 and PAI-2 increase. As a result, approximately 1 of 1000 women develops a venous thrombosis during pregnancy.[4]

Respiratory

Changes in the respiratory system can be classified by functional and anatomic changes. The anatomic changes are related to the pregnant uterus. The diaphragm is displaced upward by as much as 3 to 4 cm and the ribs flare out, creating a barrel- chest appearance. The overall excursion of the diaphragm remains the same, but may be impaired when the patient is in the supine position. Therefore, the total lung and vital capacities change very little. Functional residual capacity drops by 15% to 20%. Combined with the 20% increase in oxygen consumption**,** an overall decrease in the oxygen reserve occurs, which is important to remember during induction and maintenance of anesthesia.[4]

The rise in progesterone from 25 to 150 ng/ml over the course of pregnancy is responsible for an increase in respiratory drive and rate leading to a 50% increase in minute ventilation. The increase in respiratory rate and tidal volume alter the blood gases of a pregnant patient, corresponding to a Pco_2 of a 30mmHg and a Po_2 of 105 mmHg. The kidney helps offset this respiratory alkalosis by increasing bicarbonate excretion. Even with the compensation, the normal pH rises slightly to 7.44. Furthermore, these changes also leave the patient feeling dyspheic. Upto 70% of pregnant women complain of dyspnea and therefore physicians must differentiate between normal pregnancy hyperventilation and a more worrisome underlying cause, such as heart failure or pulmonary embolism, during the perioperative period.

Lastly, an increase in the blood flow and glandular activity of the mucosa occurs in the upper respiratory tract. The secretions also increase in amount and viscosity. These changes often cause women to complain of nasal stuffiness and epistaxis.[4,10]

Gastrointestinal

The changes that occur in the gastrointestinal tract during pregnancy, the most well known to oral and maxillofacial surgeons is undoubtedly pregnancy gingivitis and the epulis. Gingivitis is multi-factorial and is present in 50% to 100% of patients. The relationship between the hormonal effects and the increase in plasminogen activators, create an environment where local tissue inflammation blossoms. Therefore, meticulous oral hygiene is warranted to reduce the causes of inflammation. The epulis is consistent with pyogenic granuloma and can be treated with local hygiene measures. The gingivitis and epulis usually resolve past delivery. The epulis rarely must be removed surgically.

Gastric motility decreases and emptying times increase during pregnancy. The lower esophageal sphincter tone decreases and pressure on the stomach increases during pregnancy. These changes combine to increase the likelihood of gastro-esophageal reflux and dyspepsia. Positioning and anesthesia are important to consider during management. Sequence of induction, method of airway protection and other means to eliminate or reduce the chance for aspiration of gastric contents in the peri-operative period must be considered.

Lastly, nausea, vomiting and constipation are problems for many women during pregnancy and must be considered when prescribing medications. Care should also be taken when prescribing laxatives because they can impact sodium retention and stimulate uterine contractions and some are associated with teratogenic risk.

Renal

Plasma volume increases during pregnancy. This increase is party cause by sodium and water retention. The kidneys carefully regulate the sodium retention and further sodium retention seldom produces further volume expansion. Even with close regulation, pregnancy is associated with a chronic hyponatremia. A downward resetting of the osmostat is believed to be responsible for this. This change requires no intervention in a peri-operative setting.

The renal plasma flow and glomerular filtration rate rise dramatically during pregnancy. The GFR can increase by as much as 50%. This increase combined with the fact that neither creatinine nor urea nitrogen production changes, results in decreased plasma levels of creatinine and blood urea nitrogen. During pregnancy, normal creatinine and BUN levels are closer to 0.4 mg/dl and 8mg/dl respectively, compared with non pregnancy levels of 0.8mg/dl and 12mg/dl. These levels slowly reverse to pre pregnant levels during the end of the third trimester, but don not fully restore until about 3 months post delivery.

Changes in the urinary collecting system include dilation of the renal calyces, pelves and ureters. These changes are poorly understood but urinary stasis may develop which explains why asymptomatic bateriuria often leads to pyelonephritis during pregnancy. Therefore, peri-operative catheterization should be used prudently.[4]

Endocrine/ metabolic

Maternal endocrine adaptations during pregnancy involve the hypothalamus and pituitary, parathyroid, thyroid and adrenal glands. These alterations affect the circulating levels and actions of the associated hormones. Also, glucose and lipid metabolism are altered.

FETAL CONSIDERATIONS [11**]**

When dealing with pregnant women, surgeons must consider how treatment may impact the fetus. Interventions such as delivery of anesthesia, administration of medications, irradiation and surgery and maternal disease must be carefully managed to decrease the hazards to the developing child. Surgeons must have full knowledge of the teratogenic or other possible harmful effects of medication before prescribing or administering medication.

Anaesthesia

Preservation of maternal safety, avoidance of intrauterine fetal hypoxia and acidosis caused by decreased uterine blood flow, avoidance of teratogenic drugs and prevention of preterm labor are objectives when anaesthesia is administered to pregnant patients undergoing non-obstetrical procedures. Avoidance of maternal hypotension is the key to preventing fetal hypoxia and acidosis because uterine vessels are already somewhat dilated and cannot autoregulate to compensate. Furthermore, preventing arterial hypoxemia and excessive changes in the $Paco_2$ preserves uterine blood flow and fetal oxygenation. Measures effective in returning uteroplacental blood flow include administering fluids, elevating the patient's legs and placing the patient in the left lateral position. Administration of supplemental oxygen can increase maternal and fetal oxygen supply.

Medications

Any over-the-counter or prescription medication should be investigated before administration and the patient's obstetrician usually participates in any medication decisions. Whenever possible, category A drugs should be prescribed (table 3).

Table: 3. Food and Drug Administration drug classification[4]

Category A: No known risk in the first trimester or later in pregnancy
Category B: animal reproduction studies have not shown fetal risk; no controlled studies in pregnant women or animal reproduction studies have shown an adverse effect; human studies have not confirmed adverse effect
Category C: adverse effects are shown in animal studies but no controlled human studies are available.
Category D: evidence exists of human fetal risk but some use may be acceptable to preserve the health of the mother despite the risk of the fetus.
Category X: evidence exists of human fetal risk and the risk clearly outweighs any benefit in the pregnant mother

Diagnostic radiation

The use of diagnostic radiation for maxillofacial imaging has some safety advantages: it occurs outside the realm of the abdomen and lead shields can be used for protection. Despite these advantages, the risk/benefit ratio should always be carefully calculated before studies are ordered. Increased risk for leukaemia and other malignancies have been reported in children whose mothers underwent abdominal radiographs.

CONCLUSION

The ultimate goal of the preoperative evaluation and assessment of pregnant patients is to identify and provide for the best efficacious perioperative treatment algorithm that shall minimize the patient morbidity.

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