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Abstract

The pregnant patient requires special attention for dental and surgical management owing to the inherent risk of harming both the mother and the unborn baby. During pregnancy, dental treatment may be modified but need not to be withheld, provided the risk assessment is made properly for both the patient and the fetus. This article discusses the different physiological and anatomic changes occurring during pregnancy and their proper evaluation and management during dental and oral surgical procedures.

Key Words Pregnant Patient, Dental and Surgical considerations.

INTRODUCTION

The pregnant patient requires special attention for dental and surgical management owing to the hormonal and anatomic changes during gestation resulting in alteration of the major organ system.^{1,2} Before embarking on a dental treatment, thorough history may reveal the possibility of early pregnancy state. It should always be considered in all female patients because claim can be made that organogenesis has been influenced by treatment stress, drugs and radiation exposure, though rate of spontaneous abortion in a gravid woman is 15% to 40%.² On the other hand overestimation of the risk of teratogenicity in the fetus resulting from dental and surgical procedures or drugs may also cause a doctor to avoid necessary treatment of the expectant mother. During pregnancy, dental treatment may be modified but need not to be withheld, provided the risk assessment is made properly for both the patient and the fetus. Most experts believe that elective surgical procedures should be delayed till after delivery. The pregnant patient, however, may present with a number of acute or subacute oral and dental diseases that routinely affects the normal population.

PHYSIOLOGY OF CHANGES

CARDIOVASCULAR SYSTEM

Adaptation of the cardiovascular system develops in short period and completely reversible postpartum. Total plasma volume increases by 40% and red cell masses increases upto 20% to 30% over the value of the nonpregnant patient^{2,3,4}. Mineralocorticoids induced sodium retention results in total body water content leading to increased plasma volume³. However, the increase in plasma volume exceeds the increase in red cell masses, resulting in a relative dilutional anaemia and decrease in plasma colloid osmotic pressure which reaches its maximum by 30 to 32 weeks of gestation². During the first trimester, the heart rate compensates for the increase in blood volume by increasing stroke volume to 30% and heart rate to 15%. This results in a cardiac output which is

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30% to 50% greater than the nonpregnant woman⁵.

Anatomic changes result in displacement of the heart superior, lateral and anterior to the chest wall. Another anatomic alteration seen in the supine position especially during late pregnancy where the enlarged gravid uterus compresses the vena cava and decreases venous return to the heart, thus reducing the cardiac output to a low 30%. Compression of the aorta in the supine position also markedly decreases blood flow to the common iliac arteries.

CLINICAL RELEVANCE

Dilutional anaemia allows a hematocrit of 31% to 33% and a hemoglobin level of 11g/dl to be in acceptable range and hemoglobin level below 11g/dl should alert one to the possibility of iron deficiency anaemia. Beyond the first trimester, pregnant patients should not be placed in the supine position for more than a few minutes. A decrease in cardiac output return and uteroplacental blood flow may result in the supine hypotension syndrome of pregnancy. Light headedness, hypotension, tachycardia and loss of consciousness may occur without immediate position change. Aorticaval patency is regained by placing the patient in the left lateral position with the right buttock and hip elevated to approximately 15 degrees¹.

RESPIRATORY SYSTEM

There is 3-4cm upper displacement of the maternal diaphragm by the gravid uterus. The functional residual capacity (FRC) declines to 18% of the nonpregnant patient. The decline in FRC coupled with a 15% increase in oxygen consumption in the gravid patient diminishes the oxygen reserve during gestation and supine position has also shown to decrease the arterial PO_2 ¹. Progesterone effect on respiratory centers, which creates a condition of physiologic hyperventilation in the first trimester and a 40% to 50% increase in resting minute volume develops leading to respiratory alkalosis.

CLINICAL RELEVANCE

The pregnant woman has an impaired ability to tolerate episodes of apnea, pulmonary congestion, or excess nasopharyngeal secretions. An arterial PCO_2 of 40mmHg, a normal value in nonpregnant woman, represents a significant hypoventilation in the gravid woman. To prevent hypoxia, it is recommended to allow adequate preoxygenation for 3-5 minutes of 100% O_2 or apply four vital capacity breaths of 100% O_2 in rapid sequence¹. The observation of a decreased arterial PO_2 in the supine position stresses the importance of proper patient positioning and repeated laryngoscopic attempt may result in compromise of the airway by increasing the laryngeal oedema.

HEMATOLOGIC SYSTEM

There exists a hypercoagulable condition (traditionally believed to continue in the postpartum period) with an increased risk of deep venous thrombosis (DVT) and pulmonary embolism (PE). There is an increase in clotting factors I, VIII, IX and X with an associated decrease in factors XI and XIII but platelet count remains normal. In addition, in late pregnancy the velocity of the venous blood flow to the lower limb is reduced 50% and is accompanied by a rise in venous pressure of 10mmHg^{1,2}. There is also reduction in fibrinolytic activity and current belief is that DVT and PE is one to five times higher in the first trimester than in the postpartum period³.

CLINICAL RELEVANCE

The pregnant woman's predisposition to thromboembolism combined with the risk of surgical procedure places the patient in a high-risk category. The supine position compression of the vena cava increases venous stasis and enhances the risk of clot formation and pulmonary embolism.

GASTROINTESTINAL SYSTEM

Sex steroid (androgen and estrogen) alter the tone of the esophageal sphincter which falls during the last two trimesters which is further adversely affected by the enlarged uterus and increasing abdominal pressure. There is also decrease in gastric motility with associated delayed gastric emptying.

CLINICAL RELEVANCE

The pregnant woman is at high risk for esophageal incompetence and reflux esophagitis in the third trimester¹. During general anaesthesia, appropriate management involves prevention of gastric aspiration. After 20 weeks gestation, they should be maintained in a semi-seated position or a pillow should be placed underneath the right side of the body to allow left lateral uterine displacement off the vena cava. This positioning is generally comfortable and will help avoid hypotension, nausea, and aspiration. During general anaesthesia, appropriate management involves prevention of gastric aspiration.

RENAL CHANGES

Within the first trimester progesterone secretions result in dilation of the ureters, renal pelvis, and calyces. In addition there is an increase in glomerular filtration rate and renal plasma flow to levels of 30% to 50% above those in the nonpregnant woman^{1,2,3}.

CLINICAL RELEVANCE

Urinary stasis may help to explain why pregnant women with asymptomatic bacteriuria develop pyelonephritis. During late pregnancy the supine

position may decrease renal blood flow and lead to a marked decline in GFR and urine output. Increased renal hemodynamics may allow commonly used perioperative medications to undergo a more rapid excretion. Placement of urinary catheters should be avoided because this adds to the already increased risks of urinary tract infections⁵.

IMMUNOLOGIC CHANGES

The maternal response to the fetus is suppression of the immune system. Cellular changes seen are decreased chemotaxis and natural killer cells. In addition, a neutrophilic leukocytosis exists in pregnancy. This neutrophilia begins in the second month and disappears shortly after pregnancy⁵.

CLINICAL RELEVANCE

A white blood cell count of 15000, which should indicate an ongoing infection in the nonpregnant patient, may be a perfectly normal value in the pregnant patient.

MATERNAL NUTRITION

In addition to increased demand for vitamin A, folic acid, vitamin D, calcium, phosphorus, iron, magnesium and zinc, the pregnant woman requires an extra 300 Kcal of energy and 30 g of protein daily. A daily supplement of 30-60 mg of elemental iron is recommended along with a daily allowance of 1200mg of calcium is recommended to meet fetal needs and to protect the maternal skeleton⁵. Inadequate folic acid intake can lead to megaloblastic anaemia and related toxicity¹.

CLINICAL RELEVANCE

The pregnant patient with maxillofacial infection and trauma that requires long-term management is in need of specialized nutritional support.

DIAGNOSTIC RADIATION

As a result of modern features such as high-speed film, filtration, collimation, and use of lead aprons, dental radiography has been quite safe⁶. The use of RVG helps further to reduce the radiation exposure. However, a concern may arise from taking dental radiographs of a pregnant patient. Radiation damage to the zygote during the first 2 weeks after conception has an all-or-none effect, resulting in spontaneous abortion or a normal infant^{7,8}. However, during early organogenesis, the embryo is sensitive to growth retardation, teratogenic, and lethal effects of radiation. There are also inconclusive findings that in utero exposure to a small amount of radiation may lead to childhood leukemia. Diagnostic radiographs that delivers less than 5 to 10 rad to the fetus during 1st trimester are not believed to be teratogenic. Head and neck diagnostic films with proper protection techniques deliver a relatively low dose to the female gonads. It is significant to note that virtually all common diagnostic radiation, including CT scan and radionuclide procedures, does not expose the fetus to more than 1rad^{7,8}. The estimate of female gonad exposures of commonly ordered radiographs by the oral and maxillofacial surgeon is shown below.

DRUGS DURING PREGNANCY

Classification of Medication with Respect to Potential Fetal Risk: (FDA Drugs Classification)

- **Category A:** controlled studies in women fail to demonstrate a fetal risk in the first trimester (and there is no evidence of risk in later trimester), and the possibility of fatal harm appears remote.
- **Category B:** Either animal reproduction studies have not demonstrated a fetal risk and there are no controlled studies in pregnant women, or animal reproduction studies have shown an adverse effect (other than decreased fertility) that was not confirmed in controlled studies on women in the first trimester (and there is no evidence of a risk in later trimesters).
- **Category C:** Either studies in animals have revealed adverse fetal effect and there are no controlled studies in human being, or studies in women and animals are not available. Drugs in this category should only be given if safer alternatives are not available and if the potential benefit justifies the known fetal risk or risks.
- **Category D:** Positive evidence of human fetal risk exists, but benefits for pregnant women may be acceptable despite the risks, as if life threatening or serious disease for which safer drugs cannot be used or are ineffective. An appropriate statement must appear in the "Warnings" section of the labeling of drugs in this category.
- **Category X:** Either studies in animal and human beings have demonstrated fetal abnormalities, or there is evidence of fetal risk based on human experience (or both), and the risk of using the drug in pregnant woman clearly outweighs any possible benefit. The drug is contraindicated in women who are or may become pregnant. An appropriate statement must appear in the "contraindications" section of the labeling of drugs in this category.

Display Box
Radiographs

dental <0.01 mrad
skull <0.01 mrad

cervical spine <0.01 mrad
chest <0.06 mrad

CT scan

head 0.1-0.3 mrad^{3,7,8}

MR imaging may provide an alternative to CT scan in minimizing fetal irradiation when imaging soft tissue. MR imaging provides greater soft-tissue sensitivity and provides no ionizing radiation³. Radionuclides should be avoided in the pregnancy when other options are available.

Ultrasonography has replaced radiographic examination of the abdomen and pelvic contents in the pregnancy⁵. Diagnostic ultrasound appears to be relatively safe.

LOCAL ANESTHETIC AGENTS

Local anesthetic agents, when usual precautions to prevent intravascular injections are applied, are safe to use during pregnancy. There is a more rapid onset and a longer duration of action after local anesthetic injection. Therefore, the pregnant patient has a reduced requirement for regional anesthetic agents. Epinephrine used in epidural anesthesia during delivery has been shown to decrease the total uteroplacental blood flow. Citanest should be avoided as the vasoconstrictor, octopressin may induce labour⁵.

Lidocaine plus adrenaline (epinephrine) is an appropriate anesthetic and some clinicians prefer to avoid prilocaine with felypressin, which may (in theory) have a mild oxytocic effect.

ANALGESIC AGENTS

Acetaminophen seems to be the drug of choice for short-term analgesia and antipyretic therapy. The absorption, metabolism, and renal clearance are similar in the pregnant and nonpregnant states. Toxic maternal level of acetaminophen may be associated with fetal liver toxicity.

Aspirin is contraindicated in the pregnant woman. Adverse effects are manifested by anemia, antepartum or postpartum hemorrhage, prolonged gestation, and labor. Codeine is associated with congenital anomalies and should be avoided. Chronic use of morphine and meperidine leads to poor maternal and fetal weight gain and neonatal addiction. Fentanyl, in contrast, is not linked to congenital defects or depression of the respiratory rate, heart rate, or blood pressure in the newborn. Pentazocine is not linked to congenital defects; however, severe neonatal respiratory depression has been reported.

ANTIBIOTICS

Drugs that present different risks to the fetus depending on when or how long they are used. The penicillins, cephalosporins, erythromycin, and clindamycin cross the placenta and have therapeutic effects on the fetus as well as the mother and are not associated with congenital defects. Aminoglycosides may produce fetal toxicity and nephrotoxicity².

Antibiotic Administration during Pregnancy

Drug	FDA Category	During Pregnancy	Risks
Penicillin	B	Yes	Diarrhea
Erythromycin	B	Yes, avoid estolate form	Intrahepatic Jaundice in mother
Clindamycin	B	Yes, with caution	Drug concentrated in fetal bone, spleen, lung, liver
Cephalosporins	B	Yes	Limited information
Tetracyclines	D	Avoid	Depression of bone growth, enamel hypoplasia, gray-brown tooth discoloration
Ciprofloxacin	C	Avoid	Possible developing cartilage erosion
Metronidazole	B	Avoid, controversial	Theoretic carcinogenic data in animals
Gentamicin	C	Caution, consult physician	Limited information, ototoxicity
Vancomycin	C	Caution, consult physician	Limited information
Clarithromycin	D	Avoid, use only if potential benefit justifies risk to fetus	Adverse effects on pregnancy, outcome, and embryo/fetal development in animals

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FDA Local Anesthetic Administration during Pregnancy

Local Anesthetic*	Pregnancy category	During Pregnancy
Articaine	B	Yes; no blocks
Bupivacaine	C	Use with caution, consult physician
Lidocaine	B	yes
Mepivacaine	C	Use with caution, consult physician
Prilocaine	B	yes
Etidocaine	B	Yes
Procaine	C	Use with caution, consult physician

*can use vasoconstrictors if necessary

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FDA Analgesic Administration during Pregnancy

Analgesic	FDA Category	During Pregnancy
Aspirin	B/D, Third trimester	Caution, avoid in 3 rd trimester
Acetaminophen	B	Yes
Ibuprofen	B/D, Third trimester	Caution, avoid in 3 rd trimester
Codeine*	C	Use with caution, consult physician
Hydrocodone*	B	Use with caution, consult physician
Oxycodone*	B	Use with caution, consult physician
Propoxyphene	C	Use with caution, consult physician

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Drug[5]	FDA Risk Factor Category	Crosses Placenta	First-Trimester Concerns	Second- and rd-Trimester Concerns
<i>Sedatives/hypnotic</i> diazepam	D	yes	yes, craniofacial defects may occur (ie, cleft lip and/or palate)	no, but neonatal depression can occur
midazolam	D	yes	yes, benzodiazepine-associated craniofacial defects may potentially occur (ie, cleft lip and/or palate)	no, but neonatal depression can occur
methotrexate	B	yes	no	no, but neonatal depression can occur
<i>Anticoagulant</i> heparin	C	yes	no	no
<i>Adrenergic agent</i> epinephrine	C	yes	yes, large doses may decrease uterine blood flow	yes, large doses may decrease uterine blood flow

ROUTINE DENTAL TREATMENTS

It may expose the pregnant patient to potentially harmful effects of ionizing radiation, drugs, and stress. If the patient is unsure about her pregnancy, treatment should be delayed and the patient should be referred to her physician to confirm her pregnancy. In case of an urgent situation in the need of treatment, an inquiry regarding the date of onset of the last menstrual cycle may be helpful. The risk of pregnancy during the first 10 days is small. There is never a safe period for the pregnant patient to undergo oral surgery treatment. Unless emergency treatment is required, it is advisable to defer elective treatment during the first trimester because of the potential vulnerability of the fetus¹⁰. The fetus is most susceptible to harmful effects of teratogens, carcinogens, and maternal stress during the first and third trimesters. With this in mind, certain procedures when clinically indicated should be deferred to the second trimester^{5,8}. Extensive reconstructive procedures such as crowns and partial dentures should preferably not be performed at any time during pregnancy.

It is generally accepted that dental radiographs and management of an urgent minor dentoalveolar problem under local anaesthesia expose the fetus to minimal risks⁸. Before initiating treatment, the patient's obstetrician should be consulted to determine any underlying medical problems or a high risk pregnancy that may require special considerations. The risk-benefit ratio of delaying treatment to the second trimester or after delivery is then made based on the time of presentation and on the estimate of the progression rate of the disease process. A local anesthetic agent in lieu of general anesthesia should be utilized. The supine position should be avoided, particularly during the third trimester, to avoid uterine compression of the inferior vena cava and the resultant condition known as the supine hypotensive syndrome of pregnancy. The most hemodynamically advantageous body position for the pregnant patient is upward 15 degrees^{5,8}.

AMALGAM RESTORATIONS

The use of dental amalgam in pregnant women is controversial because it is recognized that amalgam restorations release mercury^{11,12} and mercury is known to cause congenital malformations.

Recent data have confirmed that the amount of mercury vapor released from amalgam restorations-about 1 to 3 ug per day- is well below the toxic level. It is well established that this amount is not high enough to produce any teratogenic effect^{12,13}. However, although there is no evidence linking amalgam use and birth defects or stillbirths, clinicians are advised to approach the removal or placement of amalgam with precaution¹⁴.

Pregnant dental clinicians and dental assistants

are chronically exposed to mercury vapor in the workplace. It has been confirmed that pregnant dental staff who work in clinics with proper hygiene and disposal practices do not have an increased risk of mercury exposure to their fetuses¹⁵. Besides, with improved handling and hygiene procedures, and increased use of precautionary measures, such as rubber dam, mercury exposure of both dental personnel and patients decreases dramatically.

PERIODONTAL ASPECTS

According to studies using well-defined indices, a gingiva change is noticeable in pregnant woman from the second month of gestation, reaching a maximum in the eighth month¹⁶.

Pregnancy gingivitis is characterized by increased redness, edema, and higher tendency toward bleeding and inflammation. The condition occurs as a result of increase' circulating levels of progesterone and its effects on the microvasculature. Estradiol and progesterone can contribute to inflammation by stimulating prostaglandin synthesis in the gingiva of pregnant women¹⁷.

Pregnancy epulis is a pedunculated, soft, red lesion that grows interdentally and is seen mainly on the buccal mucosa of maxillary anterior teeth. The lesion usually arises during the second trimester. There is a risk of excessive hemorrhage due to the vascularity of the condition. The patient should be informed that recurrence is likely to occur during pregnancy, whereas regression is observed soon after delivery.

The periodontal condition in pregnancy is also related to other factors such as educational level and previous periodontal maintenance. Additionally, in some pregnant women, folate deficiency reduces resistance to infection¹⁸.

Recently, the effect of maternal periodontal health on prematurity and low birth weight has become of interest^{19,20}. Endotoxin derived from periodontal pathogens in pregnant women with periodontal disease might signal preterm labor through primed monocyte-macrophage activation in the peripheral blood and deciduas²¹.

PRENATAL ORAL HEALTH COUNSELING

Mutans streptococci (MS) are found in all children with early childhood caries, and recent research demonstrates that transmission from mother to child is a common pathway for MS²². Reducing maternal microflora by preventive measures lowers the level of dental caries in their children. In pregnant women with high levels of salivary MS, researchers encourage the use of chlorhexidine varnish and xylitol consumption after delivery²³ and prenatal dietary counseling, professional prophylaxis, oral hygiene instructions, systemic fluoride beginning at

Condition	Comments
Trauma	A larger volume of blood and fluid is needed for resuscitation attempts.
Hypertensive disorder	May increase the risk of bleeding and seizures during dental procedures
Diabetes	Increased chance of periodontal infection and associated complications like preeclampsia or congenital defects
Concurrent application of heparin	increases the risk for bleeding complications during dental procedures. Dental providers should consult with their patient's prenatal medical provider prior to dental treatment.

the end of the sixth month of gestation, and daily use of both 0.05% sodium fluoride and 0.12% chlorhexidine mouth rinses.

Establishing a healthy oral environment is the most important objective in planning the dental care of the pregnant patient. This objective is achieved by adequate plaque control, comprising tooth brushing, flossing and professional prophylaxis.

TRAUMA

Due to the 35-40% greater total blood volume in the pregnant woman, a larger volume of blood and fluid is needed for resuscitation attempts⁵.

HYPERTENSIVE DISORDERS AND PREGNANCY

Hypertensive disorders, including both preexisting or chronic hypertension and gestational hypertension, occur in of pregnant women⁵. Oral health professionals should be aware of hypertensive disorders in pregnancy. Uncontrolled severe hypertension may increase the risk of bleeding during dental procedures. Prenatal care providers should be consulted before initiating dental procedures in women with hypertension to classify the type and severity of hypertension and to rule out preeclampsia if indicated.

DIABETES AND PREGNANCY

Gestational diabetes occurs in pregnant women. It is usually diagnosed after 24 weeks of gestation. Any inflammatory process, including acute and chronic periodontal infection, can make diabetes control more difficult. Poorly controlled diabetes is associated with adverse pregnancy outcomes such as preeclampsia, congenital anomalies, and large-for-gestational age newborns. Meticulous control to avoid or minimize dental infection is important for pregnant women with diabetes. Controlling all sources of acute or chronic inflammation helps control diabetes.

HEPARIN AND PREGNANCY

A small number of pregnant women with the diagnosis of thrombophilia (a blood disorder) may be receiving daily injections of heparin to improve pregnancy outcome. Additionally, some women may be on low molecular weight heparin products (e.g. enoxaparin). Heparin increases the risk for bleeding complications during dental procedures. Dental providers should consult with their patient's prenatal medical provider prior to dental treatment.

CONCLUSION

Management of the gravid patient who presents with an acute dental and oral surgical problem may be executed safely in most instances with minimal risks to the mother and the fetus. Particular attention should be paid to obtaining a obstetric consultation and to understanding the physiologic changes that occur in gestation. All elective treatment should be delayed to the postpartum period.

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