Physiological Changes during Pregnancy with Oral Manifestations in Dentistry: A Review

Manu R. Goel,[1] Supriya Dombre,[1] Chandrashekhar R. Bande,[1] Ajit Joshi,[2] Sanjeev Singh[3]

[1] Department of oral and maxillofacial surgery, Swargiya Dadasaheb Kalmegh Smruti Dental College and Hospital, Nagpur, Maharashtra, India.

[2] Department of Dentistry, Government Medical College and Hospital, Chandrapur, Maharashtra, India.

[3] Department of Prosthodontics, Maitri College of dentistry and research centre, Anjora, Durg, Chattisgarh, India.

Abstract

Oral diseases during pregnancy are common and significant health issue due to their prevalence and life course connections. Understanding normal changes is essential for providing quality care in pregnant women. Here the general principles that apply in pregnancy, followed by the relevant physiologic changes are evaluated. Also, the use and risks of various medications to the mother as well as to the fetus, appropriate timing of oral and maxillofacial surgery during pregnancy are discussed in this article. Thus to conclude it can be stated that the maternal oral health maintenance is vital as it is an important component of overall health and well-being though oral disease remains a silent feature. Thus unleashing all the possible oral manifestations and their conservative management is important during pregnancy.

Key words

Dental Office, Trimesters, Pregnancy, Pregnant Women, oral health, Oral Manifestations

Introduction

Pregnancy is a process that invites you to surrender to an unseen force in-universe. It is the most blessed phase for women. Apart from the marvelous joy of being pregnant, the woman is at risk of developing problems related to oral cavity such as dental caries, periodontal diseases, odontogenic abscess, and many more due to physiologic and hormonal changes rapidly altering the microflora of the oral cavity. These physiological changes guide the dental management of women during pregnancy. Oral health intervention during pregnancy has now become an attracted area for perinatal care in both maternal and child health. The primary concern of the obstetrician during pregnancy is the health of the mother and the protection of the developing fetus. The management of these patients may require alteration in the timing,

Pregnancy is a process that invit

type of treatment and moreover modification of the drugs to be prescribed.[1]

It is also the most significant period to promote and prevent oral diseases in children and also to deliver the oral-systemic connection between maternal health and behavioron children's oral health outcomes.This article intends to review the present guidelines and recommendations for treatment options available worldwide for oral diseases in pregnant patients. The emphasis is also given on the physiological changes predisposing to compromised oral health during pregnancy.

Trimesters of pregnancy[2]

First trimester (conception to 14th week): This period is an important time of active organogenesis, which occurs between the second and the eighth week of post-conception. Therefore, the greater the risk of susceptibility to stress and teratogens occurs during this time.

Second trimester (14th to 28th week): During this period organogenesis is completed and therefore the risk to the fetus is low. The ideal period for a complete dental treatment of a pregnant woman is the beginning of the second trimester (14-20 weeks of pregnancy).[2] At this stage, there is no risk of teratogenesis. Also, nausea and vomiting have subsided, and the uterus is not yet large enough to cause discomfort, thus dental treatments can be done safely.[3]

Third trimester (29th week until childbirth): There is further development of fetus during this trimester. The pregnant mother may experience an increased level of discomfort due to the increased size of uterus and changes in the physical state of women. Thus this period has its own discomfort level for dental treatment.[2]

Physiological Changes during pregnancy

1. **Cardiovascular System**

There are several changes that occur in the hemodynamic/ cardiovascular systems. Primarily, increased stroke volume is chiefly responsible for the early increase in cardiac output, due to increased left ventricular mass and blood volume. Cardiac output increases 30% to 50%, secondary to a 20% to 30% increase in heart rate as well as a 20% to 50% increase in stroke volume.[4]

There is a peripheral vasodilatation from circulating progesterone, prostaglandin, prostacyclin, and nitric oxide leading to decrease peripheral vascular resistance. Although the exact timing of all of these cardiovascular changes has not

been described thoroughly, but it is obvious from clinical studies that the cardiac output increases in the first trimester, plateaus in the second trimester, and minimally increases in the third trimester.[5]

During dental treatment in second and third trimesters, the patient may face supine hypotension syndrome characterized by hypotension, bradycardia, and syncope. This is because of a decrease in blood pressure and cardiac output whenthe patient is ina supine position. This attributes to the decreased venous return to the heart from the compression of the inferior vena cava by the uterus, resulting in a 14% reduction in cardiac output. Compression of the descending aorta can also occur, which may lead to decreased blood flow to the common iliac arteries. Placing the patient in a 5% to 15% tilt on her left lateral side can relieve supine hypotension.[6]

2. Hematologic System

Maternal plasma volume and red blood cell changes lead to an extensive increase in overall blood volume. Maternal blood volume increases about 25% to 52% and red blood cell mass increases 20% over normal values by late pregnancy. This leads to “hemodilution” or physiologic anemia of pregnancy that is maximal by approximately 30 to 32 weeks’ gestation.[5]

Pregnancy raises leukocyte count, leading to a physiologic leukocytosis. Increased circulation of catecholamines and cortisol lead to a de-margination of mature leukocytes from the endothelial lining, producing an increase in leucocytes by 5,000 to 10,000 cells than normal. During pregnancy, all coagulation factors are increased, except factors XI and XIII, which get reduced. Thrombin-mediated fibrin generation increases during the whole course of pregnancy, which, combines with the increased amount of clotting factors and increased hematocrit, leading to the hypercoagulable state in the blood[4] and increases the chance of thromboembolism 6-10 fold compared tonon-pregnant patient. Pulmonary embolism (PE) has been reported in 15% to 25% of patients with untreated deep venous thrombosis (DVT), resulting in a 12% to 15% mortality rate.[7]

The standard treatment of venous thromboembolism VTE in pregnancy is anticoagulation with low molecular weight heparin (LMWH), which does not cross the placenta and is not teratogenic. It has a negligible risk for heparin-induced thrombocytopenia and osteoporosis, better bioavailability, and a predictive dose-response. Depending on the severity of additional treatments including thrombolysis, thrombectomy, inferior vena

cava filter placement, or venous stenting may be used.[7]

Acute thromboembolism during pregnancy requires intravenous anticoagulation for 5 to 10 days, followed every 8 to 12 hours by subcutaneous injections to prolong the partial thromboplastin time at least to 1.5 times, controlled throughout the dosing interval. Treatment with heparin, aspirin, or intravenous immunoglobulin decreases the fetal loss rate.[2]

3. Respiratory System

Approximately 50% of pregnant women complained of dyspnea by gestation week 19, which increased to 75% by 31 weeks.[4] Enlarged uterus does not bound the movement of the thoracic cage instead it results in a 4 cm increase in the level of the diaphragm, with a 2.1 cm maximal increase in the transverse diameter of the chest. The subcostal angle increases progressively to 68.5 degrees in early pregnancy to 103.5 degrees in late pregnancy, which remains the maximal inspiratory and expiratory pressure, and compensates for the reduction in abdominal replacement. Hormonal changes in pregnancy also affects the upper respiratory tract and airway mucosa. An increase in estrogen during pregnancy causes airway mucosal hyperemia, edema and hypersecretion, and friability.[8]

Minute ventilation and oxygen consumption increase over time in pregnancy. In the initial stages of first trimester, following increases significantly:

- Oxygen consumption: 20 - 40%
- Tidal volume: 30 - 35% and
- Alveolar ventilation: 50 - 70%, with partial pressure of oxygen in arterial blood (PaO2) ranging from 100 to 110 mmHg.

In addition, physiological hyperventilation results in respiratory alkalosis, with the compensatory renal excretion of bicarbonate.[8]

The progressive increase in progesterone and estrogen during pregnancy is one of the key aspectsthat account for hyperventilation.[9] Progesterone acts as a trigger of the primary respiratory center by reducing the threshold and increasing the sensitivity of the respiratory center to CO2, while estrogen increases the number and sensitivity of progesterone receptors within the hypothalamus and medulla oblongata. In addition, progesterone and estrogen increase the sensitivity of the peripheral chemoreceptor to hypoxic conditions which in turnincreases oxygen demand.[5]

4. Gastrointestinal System

The gastrointestinal disorders in pregnancy are due to substantial displacement of the stomach by the enlarging uterus onto the spleen and liver. This displacement raises intragastric pressure. Simultaneously, due to inhibition of motilin by the increased amounts of progesterone, lower esophageal sphincter tone decreases. This results in heartburn in approximately 70% of all pregnant women, as well as increased gastric emptying time that is almost double compared with that of non-pregnant women.[4]

5. Genitourinary System

Approximately 6 to 8 L of body water is accumulated during pregnancy, with most of the fluid stored in the extracellular compartment. About 1,200 mL is distributed into the plasma volume. Passive elongation of the uterus enlarges causes an increase in urethral length by 4 to 7 mm. The bladder is drawn passively upward and anterior aspect. Increased estrogen levels cause' detrusor muscle hypertrophy. Both of these factors help increase bladder capacity.The most significant physiologic change is ureteral dilation. In almost 90% of pregnancies, Hydroureter is found by the third trimester. This is because of mechanical compression by growing ureter. Normal pregnancy is characterized by increases in renal plasma flow (RPF) and glomerular filtration rate. RPF increases to a peak of 60% to 80% above non-pregnant levels during the second trimester.[4]

6. Endocrine System

a. Progesterone

Progesterone is produced by the corpus luteum up till10 weeks of gestation. Also till the term of gestation, progesterone levels range from 100-200 ng/ml and the placenta produces about 250 mg/day.Progesterone has 2 important roles from the start of pregnancy till term: Firstly, progesterone prepares and maintains the endometrium to allow implantation. Secondly, it suppresses the maternal immunologic response to fetal antigens, hence preventing maternal rejection of the trophoblast.[10]

b. Estrogen

Estrogen plays a key role during pregnancy by modifying maternal metabolism and homeostasis. Estrogensare present in different forms like estrone, estradiol, estriol and estetrol. The primary site of estrogen production during pregnancy is the placenta. Estrone and estradiol increase 100-fold during pregnancy, whereas that of estriol increases 1,000-fold and accounts for more than 90% of the estrogen in the urine of pregnant women. In the parturition process, estrogen

opposes the actions of progesterone by encouraging biochemical and physical changes in the uterus and fetal membranes desirable for labor and delivery.[11]

c. Human chorionic gonadotropin

Human chorionic gonadotropin (hCG) is a trophoblast hormone product. This hormone is the earliest secreted productand also maintains progesterone secretion by the ovarian granulosa cells. During pregnancy, placental production of hCG is at its peak between 8th to 10th week of gestation.[10]

7. Oro-facial changes

Increased facial pigmentation is seen. This may be because of increased circulating estrogen, which causes increased capillary permeability, leading to gingivitis and gingival hyperplasia. It appears as mostly bilateral, brown patches (Melasma) on the cheek area and started to develop during the first trimester and can be seen in up to 73% of pregnant women. It normally resolves after parturition.[2]

8. Oral Cavity

The pregnant women presenting dental care require special consideration as various dental problems have their own impact on the general health of mother and fetus. Periodontitis is a very common and infectious disease caused mainly by anaerobic gram-negative bacteria, which can induce a variety of inflammatory mediators. Because of physioimmunological changes, pregnant women experience progression of periodontal diseases with increased vascular permeability, which can translocate periodontal pathogens and their by-products to the fetus through placenta or these potentially toxic substances may trigger systemic inflammatory response via blood circulation.[12]

a. Pregnancy Gingivitis

Gingivitis is defined as an inflammation of the gingiva. It is usually characterized by red, swollen gingival margins and loss of stippling. It is one of the most common dental condition which may progress in a pyogenic granuloma at the gingival margin (pregnancy epulis). These conditions typically arise after the second month and resolve on parturition.

Pregnancy gingivitis is an acute form of gingivitis that commonly affects pregnant women. It is characterized by erythema, edema, hyperplasia, and increased bleeding of the gingival tissue, and seen in approximately 30-75% of pregnant women and more regularly seen in pregnant women with plaque. The physiological cause of this particular disease are maternal immune and hormonal changes during pregnancy.

Changes in maternal immune-responsiveness, such as a decrease in T3, T4, and B-cells in peripheral blood and gingival tissue, decreased neutrophil chemotaxis, and depression of cell-mediated immunity and phagocytosis plays vital roles. Sex hormone concentrations in pregnancy also plays a chief role in the occurrence of pregnancy gingivitis. Gingiva acts as a targeted organ for estrogen and progesterone. High levels of both progesterone and estradiol stimulates localized inflammation by producing prostaglandins, E2. Progesterone also lowers glycosaminoglycans production and alters the pattern of collagen production.[13]

Conversely, estrogens stimulate matrix synthesis. It regulates cellular proliferation, differentiation, and keratinization. Also, circulating hormones were shown to be stimulatory to some bacterial species, including Bacteroides species and Prevotella intermedia, which are associated with gingival inflammation.[14]

b. Pregnancy Tumor

It is the most common and salient oral lesion in pregnant women. It is a tumor-like growth, benign hyperplastic in nature, appearing mostly on the gingiva between the anterior maxillary region. The most common site involved is gingiva followed by the tongue, lips and palate. The lesion usually grows rapidly and prone to bleed. It mostly appears in the second or third month of pregnancy.

The pregnancy tumor usually resolves spontaneously after delivery; therefore, surgical treatment is not required, as most of the time the lesion is asymptomatic. A strict oral hygiene protocol is to be maintained, including both scaling and maintenance of oral hygiene(13).

Pericoronitis and third molar impaction should be given proper attention. All elective dental procedures should be postponed until postpartum. If required, in emergency, these treatments are best carried out during the second trimester.[1]

c. Periodontal diseases

Periodontal disease is associated with a chronic Gram-negative infection of the periodontal tissues which results in long-term local elevation of pro-inflammatory prostaglandins and cytokines (Page and Kornman, 1997) and an increase in the systemic levels of some of these inflammatory mediators (Page, 1991).[15]

Offenbacher et al. were the first to report that pregnant women with severe periodontal disease more often delivered low weight and preterm babies.

A high prevalence of elevated fetal IgM to Campylobacter rectus among premature infants raises the possibility that

this specific maternal oral pathogen might serve as a prime fetal infectious agent eliciting prematurity. Moreover, periodontal therapy significantly reduced the rates of PLBW in a population of women with periodontal disease.[13]

d. Dental Caries

Dental caries is an established chronic disease among pregnant patients. This may be because of changes in diet and oral hygiene practices, morning sickness or esophageal reflux which lead to tooth demineralization and caries.

American Academy of Pediatric Dentistry (2015), has already stated that although significant colonization of cariogenic bacteria (ie, mutans streptococci [MS]) occurs after the eruption of teeth, the colonization of these microorganisms may occur from the time of birth.

e. Ptyalism

It is defined as excessive secretion of saliva which occurs most often in women suffering from nausea. The presence of excessive saliva in the mouth also reflects the inability of women to swallow a normal amount of saliva due to nausea rather than a factual increase in its formation. In some cases, as much as 2 L of saliva per day can be produced. Reducing the consumption of complex carbohydrates may improve this condition.[16]

f. Infection

Odontogenic infection should be treated promptly at any time during pregnancy because of grave complications of infections as it is having the potential to develop rapidly into deep-space infections and can compromise the oral–pharyngeal airway. Abscess should be drained and the offending teeth to be treated to control infection. Obstetricians should be informed about the status of the patient and its treatment plan.[16]

Radiography in pregnancy

According to the American College of Radiology, no single diagnostic x-ray involves a radiation dose significant enough to pose a threat to the health of mother and child.[17] More recent shreds of evidence suggest that ionizing radiation at a dose of less than 5 rad does not increase the risk of malformation, growth retardation or miscarriage.[18]

For this reason, dental radiographs are considered safe to be given at any time that is deemed necessary during pregnancy, provided that the dentist, follows all the proper radiologic practices, i.e., using a radiation protective apron with a thyroid

collar, using high-speed films, following the proper procedures in order to take the radiograph, and following the ALARA (As Low As Reasonably Achievable) principle.[17]

DRUGS IN PREGNANCY[3] (Table 1)

Caution should be taken while prescribing drugs toa pregnant woman. Certain drugs are known to causemiscarriage, teratogenicity, and low birth rate becausemost drugs cross the placental barrier by simple diffusion.

The US FDA has categorized drugs, the potential to cause birth defects, and has provided definitive guidelines for prescribing drugs during pregnancy (Table 1). They areas follows:

- Category A: Controlled human studies indicate noapparent risk to the fetus. The possibility of risk to the fetus is remote.
- Category B: Animal studies do not indicate fetal risk. Well-controlled human studies have failed to demonstrate a risk.
- Category C: Animal studies show an adverse effect on the fetus, but there are no controlled studies in humans. The benefits from the use of such drugs may be acceptable.
- Category D: Evidence of human risk, but in certain circumstances, the use of such a drug maybe acceptable in pregnant women despite its potential risk.
- Category X: Risk of use in pregnant women clearly out-weighs possible benefits.

As far as antibiotics are concerned, amoxicillin and penicillin V are the safest and the most commonly prescribed antibiotics. Tetracyclines are contraindicated during pregnancy because they accumulate in fetal dental tissue during the calcification stage, causing discoloration of teeth. The safest choice for painkillers is paracetamol.

Anesthesia

Regional anesthesia is always preferable to general anesthesia whenever possible during pregnancy. If general anesthesia is unavoidable, it is advantageous to wait until the second trimester and, preferably elective treatment should wait until post-partum. The major risk to the fetus is not congenital abnormalities but spontaneous abortion or growth restriction. Mild maternal hypoxemia may occur during general anesthesia, and in a prolonged state may cause fetal asphyxia and death. Table 1 shows drugs and local anesthetic agents that can be used in pregnancy.[19]

Acceptable and Unacceptable Drugs for Pregnant Women				
	Acceptable drugs for use during pregnancy	**Food & Drug Administration Category**	**Unacceptable drugs for use during pregnancy**	**Food & Drug Administration Category**
Antibiotics	• Penicillin • Amoxicillin • Cephalosporin • Clindamycin • Erytrhomycin (except for estolate form)	B B B B B	• Tetracyclines • Erythromycin (estolate form) • Quinolones • Clarithromycin	D D C C
Analgesics	• Acetaminophen • Acetaminophen withcodeine • Codeine • Oxycodone • Hydrocodone • Meperidine • Morphine	B C C B C B B	• Aspirin	C
Local anesthetics	• Lidocaine • Mepivicaine • Bupivicaine	C C C		
Adrenergic agent	• Epinephrine	C		
Inhalational agent	• Nitrous oxide	Controversial teratogenicity in first two trimesters		
Sedatives/ hypnotics	• Diazepam • Midazolam • Methohexital • Lorazepam	D D B D		
Antimicrobials	• Chlorhexidine	B		

Table 1:Acceptable and Unacceptable Drugs.

Guidelines followed in developed countries

Maryland guidelines (February 2018)(20)

1. Advise Pregnant Women About Oral Health -

- Assure women that there is no need to postpone or avoid oral health care during pregnancy. Oral health care, including the use of X-rays, pain medication, and local anesthesia, is safe, important, and covered by Medicaid throughout pregnancy.
- Encourage good oral health behaviors during pregnancy.
- Explain to women that caries-causing bacteria can be passed from mother to child after birth. Restoring active carious lesions before delivery may reduce the child's risk of dental caries.

2. Provide Oral Disease Management and Treatment to Pregnant Women -

- Provide emergency and routine oral health care at any time during pregnancy.
- Position women appropriately in the dental chair.
- Develop, discuss, and provide women with a comprehensive care plan that includes prevention, treatment, and maintenance throughout pregnancy.
- Use standard practice when placing restorative materials such as amalgam and composite. Although data are limited,the U.S. Food and Drug Administration concluded in 2008 that fetuses are not atrisk for adverse health effects from amalgam placement or removal during pregnancy.
- Use a rubber dam and high-speed evacuation during endodontic and restorative procedures.

Links

	https://www.mchoralhealth.org/PDFs/OralHealthPregnancyConsensus.pdf
	https://www.aapd.org/research/oral-health-policies--recommendations/oral-health-care-for-the-pregnant-adolescent/

Conclusion:

Pregnancy is the most delicate and important period of women's life thus it should be carefully handled with all the precautions. It is utmost important to know that treatment is being given to two patients, that is mother and the fetus. So to plan regarding any dental treatment, the patient's gynecologist to be consulted first. It is advised to avoid drugs and any dental therapy that would put a fetus at risk. It is important to consider the guidelines given to follow the oral health of pregnant patient. Active treatment is directed toward maintain

strict oral hygiene, thus improving maternal health while minimizing fetal risk.

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Declaration of interest

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Corresponding Author:
Dr. Manu Goel
Department of Oral and Maxillofacial Surgery, Swargiya Dadasaheb Kalmegh Smruti Dental College and Hospital, Nagpur, Maharashtra, India.
Email ID: mrimanster@gmail.com