

The pregnant patient: Considerations for dental management and drug use

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The pregnant woman who presents for dental care requires special consideration. This article reviews physiologic changes associated with pregnancy and current considerations for the dental treatment of pregnant dental patients, as well as for pregnant dental professionals. The limitations and safety of commonly used drugs and anesthetics are discussed. Recommendations for prenatal oral counseling are presented. (*Quintessence Int* 2007;38:171.e133–142)

Key words: dental treatment, drug use, pregnancy, pregnancy gingivitis, prenatal fluoride, risk factors

Overestimation of the risk of teratogenicity in the fetus resulting from medical and dental procedures or drugs may cause a clinician to avoid necessary treatment of the expectant mother. During pregnancy, dental treatment may be modified but need not be withheld, provided that the risk assessment is made properly for both the patient and the fetus. The present paper points out the alterations in physiology during pregnancy and reviews the current considerations for the pregnant dental patient, including safety of the drugs used in dental treatment, common dental procedures, and recommendations for maintaining oral health.

PHYSIOLOGIC CHANGES ASSOCIATED WITH PREGNANCY

Pregnancy causes profound and remarkable changes in all organ systems.¹ The dental team should be aware of the altered physiologic status of the pregnant patient to avoid

inappropriate interpretation of normal changes as pathologic.

With pregnancy, the most important changes take place in hematologic and cardiovascular systems as a result of altered hormonal activity. The increase in maternal serum mineralocorticoids induces sodium retention, which in turn leads to increased total body water content and an increase in plasma volume of 30% to 40%.^{2,3} Another factor contributing to the expansion of intravascular volume is the increase in red blood cell volume of 15% to 30%.^{1,2} However, the increase in plasma volume exceeds the increase in red cell volume, resulting in a relative dilutional anemia.^{4,5} The relative increase of plasma volume over red blood cell mass shows up as “hemodilution” or “physiologic anemia of pregnancy,” which reaches its maximum by 30 to 32 weeks of gestation.^{1,5}

During pregnancy, all coagulation factors are increased, except factors XI and XIII, which are decreased.^{1,6} Thrombin-mediated fibrin generation increases during pregnancy, which, combined with the increased amount of clotting factors and increased hematocrit, leads to the hypercoagulable state of pregnancy. All these factors, along with surgery, point to the clinically important predisposition of deep venous thrombosis (DVT) and pulmonary edema (PE) in pregnant women.^{1,7,8} However, there is no pub-

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lished report about an increased incidence of DVT/PE in pregnant women during any kind of dental treatment.

In pregnant women, the heart compensates for the elevation in blood volume as well. The 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.^{1,9,10} The majority of this increase occurs by the 10th week of gestation. There is a gradual, further increase up to 24 weeks and then the output plateaus.¹ During the second and third trimesters, a decrease in blood pressure and cardiac output can occur while the patient is in a supine position. This has been attributed to the decreased venous return to the heart due to the compression of the inferior vena cava by the gravid uterus, which can result in a 14% reduction of cardiac output.^{5,11} The condition is known as *supine hypotensive syndrome* and is manifested by light-headedness, hypotension, tachycardia, and syncope.¹² Once it occurs, emergency care for the situation consists of rolling the patient onto her left side to lift the uterus off the vena cava and administering 100% oxygen.¹³ To avoid occurrence of supine hypotensive syndrome, pregnant patients may be positioned in a semireclining position. The ideal position of the pregnant women in the dental chair is reported to be the left lateral decubitus position with the right buttock and hip elevated 15 degrees.¹⁴

The respiratory system undergoes changes at all anatomic levels in pregnant women. The entire respiratory tract becomes edematous due to capillary engorgement. Mucosa in the upper airways may also become more edematous and friable.¹¹⁵ The functional residual capacity reduces by 20% because of the elevated diaphragm by the gravid uterus. Oxygen reserve diminishes with the decrease in functional residual capacity and increase in oxygen consumption.¹⁶

THE PREGNANT WOMAN AS A DENTAL PATIENT

The pregnant woman who presents for dental care requires special consideration. The management of these patients may require

alteration in the timing and type of dental treatment as well as modification of the drugs to be prescribed.¹³

Drug use in pregnancy

The major concern of drug administration during pregnancy is the potential of teratogenic adverse effects because most drugs cross the placenta by simple diffusion.¹⁷ Thus, the dental clinician must make a clear assessment of the risks and benefits prior to prescription of medications to pregnant patients. Drugs should be used in pregnancy when they offer a clear benefit to the mother, and the least potentially toxic drug should be selected when alternatives are available. The type and dose of the drug as well as the time of gestation should be evaluated carefully.¹⁸

In human pregnancy, the time from 2 to 4 weeks from the last menstrual period represents the predifferentiation period of the fetus. During this period, the human fetus is relatively resistant to teratogens. The period of maximum teratogenic risk is organogenesis, which occurs from the end of the predifferentiation period until the end of the 10th week after the last menstrual period.¹⁹

To determine the risks associated with the use of drugs in pregnancy, the United States Food and Drug Administration (FDA) has classified drugs based on the level of risk they pose to the fetus (Table 1). Accordingly, drugs in category A and category B are considered safe for use, whereas drugs in category C may be used only if the benefits outweigh the risks. Drugs in category D are avoided with some exceptional circumstances, while drugs in category X are strictly avoided in pregnant women.²⁰

In dentistry, local anesthetics and their vasoconstrictors, analgesics, antimicrobials, and sedatives are the most commonly used drugs. The local anesthetics and vasoconstrictors used in dentistry are safe to administer to the pregnant or lactating patient, provided that aspiration is performed to minimize the risk of intravascular injection.^{21,22} The use of local anesthetics enables definitive treatment and elimination of any source of pain, which may in turn allow the avoidance of prolonged use of systemic analgesics and antibiotics.²²

Category	Definition
A	Controlled studies in women fail to demonstrate a risk to the fetus in the first trimester (and there is no evidence of risk in later trimesters), and the possibility of fetal harm appears remote.
B	Either animal reproduction studies have not demonstrated a fetal risk but there are no controlled studies in pregnant women or animal reproduction studies have shown an adverse effect (other than a decrease in fertility) that was not confirmed in controlled studies in women in the first trimester (and there is no evidence of risk in later trimesters).
C	Either studies in animals have revealed adverse effects on the fetus (teratogenic, embryocidal, or other) and there are no controlled studies in women or studies in women and animals are not available. Drugs should be given only if the potential benefit justifies the potential risk to the fetus.
D	There is positive evidence of human fetal risk, but the benefits of use in pregnant women may be acceptable despite the risk (for example, if the drug is needed in a life-threatening situation or for a serious disease for which safer drugs cannot be used or are ineffective).
X	Studies in animals or human beings have demonstrated fetal abnormalities or there is evidence of fetal risk based on human experience, or both, and the risk of the use of the drug in pregnant women clearly outweighs any possible benefit. The drug is contraindicated in women who are or may become pregnant.

With respect to individual agents, lidocaine, prilocaine, and etidocaine have an FDA ranking of “B,” which appears to be the best-ranking among this group of drugs. As for all patients, the dose to be administered to a pregnant patient should be well below the maximum recommended amounts. When combined with vasoconstrictors, the maximum doses are as follows: lidocaine 500 mg, prilocaine 600 mg, articaine 500 mg, bupivacaine 90 mg, and etidocaine 400 mg.^{22,23}

When treating pregnant patients under local anesthesia, it should be considered that pregnancy may affect nerve sensitivity to local anesthetics. The time required for 50% depression of the action potential of A, B, and C vagal fibers from pregnant and non-pregnant animal models has been determined after the application of bupivacaine: The onset time for blockade of conduction in each type of nerve fiber was faster in fibers in pregnant animals than in nonpregnant animals, and the differences were highly significant.²⁴ Preliminary findings suggest a slowing of nerve conduction velocity in humans with the progression of pregnancy.²⁵

Among antibiotics, penicillin V and amoxicillin are the safest and most commonly prescribed drugs during pregnancy.^{26–28} Clindamycin, erythromycin, and metronidazole also appear to be safe, with the exception of the estolate form of erythromycin, which may produce cholestatic hepatitis.²⁹ Tetracyclines are

definitely contraindicated during pregnancy, because they are deposited in the dental tissue of the fetus during the calcification stage and cause tooth discoloration.³⁰

Among analgesics, acetaminophen is widely accepted for use during pregnancy since it has shown no evidence of teratogenicity. The absorption and disposition of acetaminophen in normal doses are not altered by pregnancy.³¹ The drug does not prolong bleeding time, unlike aspirin, and is nontoxic to the newborn.³² The use of nonsteroidal anti-inflammatory drugs (NSAIDs), however, is less favorable during pregnancy since drugs in this class have been shown to inhibit labor and to prolong the length of pregnancy.^{27,28,33} Despite being nonteratogenic, acetylsalicylic acid (ASA), it has been stated, may cause maternal and fetal hemorrhage, as well as prolonged labor, if given before parturition.^{34,35} It has also been stated that the use of aspirin during pregnancy, especially of chronic or intermittent high doses should be avoided especially in the second and third trimesters.²⁷

Table 2 provides a summary for drug use in the pregnant or lactating dental patient.

Prenatal fluoride

Although the efficacy of dietary fluoride supplementation to children for preventing dental caries has been well established,^{36,37} prenatal fluoride supplementation has been



Table 2 Drugs used in the pregnant or lactating dental patient*

Drug	FDA category	Use in pregnancy	Use while breast-feeding
Local anesthetics: Injectable			
Articaine	C	Yes	Yes
Bupivacaine	B	Yes	Yes
Lidocaine	B	Yes	Yes
Mepivacaine	C	Yes	Yes
Prilocaine	B	Yes	Yes
Local anesthetics: Topical			
Benzocaine	C	Yes	Yes
Dyclonine	C	Yes	Yes
Lidocaine	B	Yes	Yes
Tetracaine	C	Yes	Yes
Analgesics			
Acetaminophen	B	Yes	Yes
Aspirin	C/D*	Do not use in 3rd trimester	Use cautiously
Diffunisal	C/D*	Do not use in 3rd trimester	Use cautiously
Etodolac	B/D*	Do not use in 3rd trimester	Yes
Flurbiprofen	B/D*	Do not use in 3rd trimester	Yes
Ibuprofen	B/D*	Do not use in 3rd trimester	Yes
Ketorolac	B/D*	Do not use in 3rd trimester	Yes
Ketoprofen	B/D*	Do not use in 3rd trimester	Yes
Naproxen	B/D*	Do not use in 3rd trimester	Yes
Codeine	C	Low dose, short duration acceptable	Yes
Oxycodone	B	Low dose, short duration acceptable	Yes
Meperidine	B	Low dose, short duration acceptable	Use cautiously
Propoxyphene	C	Low dose, short duration acceptable	Use cautiously
Antimicrobials			
Penicillin	B	Yes	Yes
Amoxicillin	B	Yes	Yes
Amoxicillin + clavulonic acid	B	Yes	Yes
Cloxacillin	B	Yes	Yes
Cephalosporins	B	Yes	Yes
Erythromycins	B	Yes (do not use estolate)	Yes
Clindamycin	B	Yes	Yes
Clarithromycin	C	Use cautiously	Yes
Azithromycin	B	Yes	Yes
Tetracycline	D	No	Yes
Doxycycline	D	No	No
Metronidazole	B	Use cautiously	Use cautiously
Nystatin	B	Yes	Yes
Ketoconazole	C	Use cautiously	No
Fluconazole	C	Use cautiously	No
Chlorhexidine rinse	B	Yes	Yes

* Data compiled from Briggs et al²⁷ and Haas et al.²⁸

†The first category refers to the first and second trimesters; the second category refers to the third trimester.

controversial.³⁸ In theory, a mother can impart a caries-protective benefit to her unborn child by ingesting a fluoride supplement. On the other hand, although fluoride seems to pass through the placenta, the amount available to the fetus after maternal excretion and deposition of fluoride in the fetal skeleton is unknown.³⁹ The only legitimate study in the dental literature revealed that children born to mothers who received a

fluoride supplement of 1 mg/day during the last half of gestation had no better caries resistance than controls.⁴⁰ Because of the lack of supporting evidence, prenatal fluoride supplementation was discontinued in the United States in the late 1960s.⁴¹ Additionally, no studies were performed to investigate potential teratogenic effects of prenatal fluoride. As a result, fluoride use cannot be recommended to pregnant

women, since it seems ineffective and the scientific basis for its use is still lacking.³⁸

Routine dental treatments

Ideal timing for dental treatment. Although pregnancy is not a contraindication to dental treatments, the clinician should consult with the patient's physician to clarify individual treatment issues, especially when dental emergencies arise during the first trimester. Unless emergency treatment is required, it is advisable to defer elective treatment during the first trimester because of the potential vulnerability of the fetus.¹³

The second trimester is the safest time to perform routine dental care. In this period, treatment planning should include elimination of potential problems that could arise later in pregnancy or during the immediate postpartum period.^{13,42}

The early part of the third trimester is still a relatively good time to provide routine dental care. However, no elective dental treatment is advisable late in the third trimester.¹³ Extensive reconstructive procedures such as crowns and partial dentures should preferably not be performed at any time during pregnancy.¹³

Dental radiographs. As a result of modern features such as high-speed film, filtration, collimation, and use of lead aprons, dental radiography has been quite safe.⁴³ However, a concern may arise from taking dental radiographs of a pregnant patient. When taking a radiograph of a pregnant patient is inevitable, the dose of radiation to be given and the time of gestation are two important factors to consider.¹³ Animal and human data clearly support the conclusion that no increase in gross congenital anomalies occurs as a result of exposures totaling less than 0.05 to 0.1 Gy during pregnancy.^{13,44,45} The amount of radiation used in dental radiographs is well below the threshold dose. For comparison, 18 intraoral dental radiographs with a D film and a lead apron result in an estimated fetal embryonic dose of 0.0000001 Gy.¹³ Hence, there is no rationale to preclude a properly justified dental radiographic examination because of pregnancy. Dental radiographs are optimally taken in the second trimester and with the use of a lead apron.¹³

Amalgam restorations. The use of dental amalgam in pregnant women is controversial because it is recognized that amalgam restorations release mercury,^{46,47} 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 μg per day—is well below the toxic level (see Wahl⁴⁸ for a detailed review). It is well established that this amount is not high enough to produce any teratogenic effect.^{47,49} 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 precaution.⁵⁰

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 fetuses.⁵¹ 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.

Nitrous oxide sedation. Nitrous oxide use during pregnancy is controversial. The question is complicated by opinions based on concerns related to adverse effects associated with chronic exposure. The issue under consideration, however, is the use of nitrous oxide sedation during a single appointment. In animal studies, nitrous oxide has been shown to inhibit methionine synthase, which can effect DNA synthesis.⁵² The anomalies associated with nitrous oxide were previously thought to occur from inhibition of methionine synthase. Nevertheless, considerable evidence shows that this is not true for humans and the problem is probably multifactorial in origin.⁵³ Because short-term therapeutic exposure to nitrous oxide has not been proven to cause any adverse effects, it may be used in pregnant patients.^{53,54} However, until more information is available, it is still better to avoid administration of nitrous oxide, unless it is deemed necessary.^{55,56} It has been recommended that, if required, nitrous oxide is best administered in the sec-

ond and third trimesters. In any trimester, it should be administered for less than 30 minutes and with at least 50% oxygen.⁵⁷

Another issue is chronic exposure to nitrous oxide. The situation has been linked to infertility, spontaneous abortions, and congenital malformations, which are possible concerns for pregnant dental personnel.^{55,56,58} To prevent chronic nitrous oxide gas exposure in dental clinics, it is important to monitor nitrous oxide levels.⁵⁹ A threshold value of 50 ppm is recommended in the workplace.⁶⁰ Proper use of scavenging equipment, as well as checking all fittings for leaks and ensuring appropriate operatory ventilation, facilitates avoiding chronic exposure to nitrous oxide.

Periodontal aspects. According to studies using well-defined indices, a gingival change is noticeable in pregnant women from the second month of gestation, reaching a maximum in the eighth month.⁶¹ Specific oral complications of pregnancy are the exacerbation of preexisting gingivitis and the development of localized swellings (pregnancy epulis).^{61,62}

Pregnancy gingivitis is characterized by increased redness, edema, and higher tendency toward bleeding and inflammation. The condition occurs as a result of increased 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 women.⁶³ In the meantime, these hormones serve as essential growth factors for *Prevotella intermedia*, which shows a marked increase in the subgingival plaque during pregnancy.⁶⁴

Pregnancy epulis (pregnancy granuloma, pregnancy tumor) is another common periodontal problem for pregnant women. It is a pedunculated, soft, red lesion that grows interdentally and is seen mainly on the buccal mucosa of maxillary anterior teeth. It is thought that progesterone induces inhibition of collagenase, which causes an accumulation of collagen and allows for enlargement and increased vascularity.⁶⁵ The lesion usually arises during the second trimester, often showing rapid growth, though seldom becoming larger than 2 cm in diameter. The

covering epithelium is thin, and in areas of ulceration, a fibrin exudate covers the surface. Histologically, the appearance is a mass of vascular spaces within delicate, connective tissue stroma.⁶⁶ Any large lesions creating functional or esthetic problems can be removed under local anesthesia.⁶² However, 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.⁶²

Other than hormonal and physiologic changes, the periodontal condition in pregnancy is also related to other factors such as educational level and previous periodontal maintenance.^{67,68} Additionally, in some pregnant women, folate deficiency reduces resistance to infection, which may contribute to increased gingival inflammation and decreased gingival keratinization.⁶⁹

Recently, the effect of maternal periodontal health on prematurity and low birth weight has become of interest.⁷⁰⁻⁷³ A mother with significant loss of gingival attachment is more likely than a mother with healthy periodontium to give birth to a low-birth-weight infant.⁷³ Although the mechanisms by which periodontal diseases may cause preterm birth and/or low birth weight have not been elucidated, one proposed mechanism relates to the seeding of urinary tract infections with bacteria from periodontal disease in the mother.⁷² Another proposed mechanism is the nature of the periodontal disease per se. It is known that inflamed periodontal tissues produce significant amounts of proinflammatory cytokines, mainly interleukin 1 beta (IL-1 β), IL-6, prostaglandin E₂, and tumor necrosis factor alpha (TNF- α), which may have systemic effects on the host.⁷⁴ 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 decidua.^{75,76} At this point, the relationship of maternal periodontal disease with socioeconomic deprivation should not be overlooked, and the role of prenatal oral health counseling should not be underestimated.

Prenatal oral health counseling. Mutans streptococci (MS) are found in all children

Table 3 Essential elements of prenatal counseling for oral health³⁸

<p>Purpose</p> <ul style="list-style-type: none"> To educate parents about dental development of the child To educate parents about dental disease and prevention To provide a suitable environment for the child To strengthen and prepare the child and his or her dentition for life
<p>Methods</p> <ul style="list-style-type: none"> Education on development, prevention, and disease Demonstration of oral hygiene procedures Counseling to instill preventive attitudes and motivation Evaluation of parent's learning, acceptance, and needs
<p>Content</p> <p>Parent's oral health</p> <ul style="list-style-type: none"> Education of parents about dental disease processes and oral hygiene, to reduce bacterial load and effect of transmission and prematurity[Au: prematurity of what?] Motivation of parents for plaque removal and oral hygiene, to improve their own health (cardiovascular relationships) and to help their expected child Discuss changes in maternal oral health: changes in gingival health, risk of caries from carbohydrates, myths of pregnancy, and needed dental treatment, and when best to accomplish that treatment <p>Child's oral health</p> <ul style="list-style-type: none"> Child development, including aspects of oral, emotional, and general development affecting oral health and oral health delivery Effects of lifestyle on the child: habits, substance abuse, sugar intake, maternal disease, nutrition (including nutrient roles in tooth development), prenatal fluoride, breast-feeding Postnatal period: teething, tooth eruption patterns, nonnutritive sucking, timing of the first dental visit, bottle use

with early childhood caries,⁷⁷ and recent research demonstrates that transmission from mother to child is a common pathway for MS.⁷⁸ Reducing maternal microflora by preventive measures lowers the level of dental caries in their children.⁷⁹ In pregnant women with high levels of salivary MS, researchers encourage the use of chlorhexidine varnish and xylitol consumption after delivery.^{80,81} On the other hand, prenatal preventive programs are of utmost importance.^{79,82,83} Brambilla et al⁸² initiated a caries prevention program with 33 pregnant women that included dietary counseling, professional prophylaxis, oral hygiene instructions, systemic fluoride beginning at the end of the sixth month of gestation, and daily use of both 0.05% sodium fluoride and 0.12% chlorhexidine mouthrinses. They found significantly lower levels of MS in the mothers who participated in the intervention, as well as delayed colonization in their babies for up to 4 months, compared to controls.⁸²

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 toothbrushing, flossing,

and professional prophylaxis.^{82,83} The American College of Obstetricians and Gynecologists encourages women to see their dentist early in pregnancy and to continue flossing and brushing.⁸³

The primary goals of prenatal counseling in dentistry are to educate parents about their own oral health and to create behaviors that will ensure the oral health of their unborn child.³⁸ The contents and targets of prenatal counseling are presented in Table 3.

CONCLUSION

After consulting the patient's physician and assessing the potential risks of undergoing dental treatment during pregnancy, necessary treatment and drugs should not be withheld from the patient who requires them. Proper assessment, intervention, and patient education about dental problems during pregnancy can help to enhance pregnancy outcomes. Clinicians and oral hygienists can assume vital roles in maintaining oral health during pregnancy by prenatal oral health counseling.

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