



Adolescent Pregnancy: A Review of Dental Treatment Guidelines

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Abstract

More than 6% of adolescent females become pregnant in the United States per year, yet there is no concise guide for their dental treatment. The principles for medical management of these patients are not unlike those used for adult females, but the higher incidence of complications coupled with social and consent issues make their overall management more complex.

Whether treating a pregnant adolescent or an adult, the primary goal is to maintain a safe environment for both the fetus and mother. Untreated dental disease can compromise the health of the mother and unborn child; therefore, dental treatment should not be withheld. In complicated pregnancies, dental practitioners should contact the patient's obstetrician prior to providing treatment or prescribing medication. With proper technique, dental radiographs do not place the fetus at risk and should be taken if they are of potential benefit. Preventive care should be delivered throughout pregnancy, and elective routine care is best delivered during the second trimester. (*Pediatr Dent.* 2003; 25:459-467)

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At present, there is no concise guide to the dental treatment of pregnant adolescents. Adolescence is the period of life "beginning with the appearance of secondary sexual characteristics and terminating with the cessation of somatic growth," or from approximately 11 to 19 years of age.¹ Although the principles of medical management are not unlike those of adult pregnancies, pregnant adolescents are at a higher risk for complications,²⁻⁷ and pediatric dentists may have limited experience and training in the treatment of pregnant patients. Other issues such as consent for the treatment of a minor (if the patient is under 18 years) and psychosocial factors are important. This article will review information necessary for the delivery of dental care to pregnant adolescents.

Legal, social, and medical issues unique to pregnant adolescents

In the United States, more than 6% of adolescent females become pregnant each year.² Of these pregnancies, 55% end in live births, 29% in abortion, and 15% in miscarriages or stillbirths.⁸ Although adolescent birth rates have

decreased since their 20-year high in 1991, the United States continued to have the highest prevalence of adolescent pregnancies among developed countries in 2001.^{2,8}

Adolescent pregnancies are at an increased risk for medical complications. Deliveries to pregnant adolescents are approximately twice as likely to be of low birth weight (<2,500 g) and to be born prematurely (<37 weeks gestation).^{2,3,7} The neonatal death rate (within 28 days of birth) of deliveries to adolescents is almost triple that of deliveries to adults, while the adolescent maternal mortality rate is double the adult rate.² These problems may be related to the higher incidence of poor maternal weight gain, pregnancy-induced hypertension, gestational diabetes, anemia, sexually transmitted diseases, and lack of proper prenatal care.^{2,4,6,9}

Irregular menstrual cycles and poor maternal weight gain are common in adolescents.¹⁰ Many who become pregnant may be in denial or simply not recognize the pregnancy until as late as the second and third trimesters. As a result, dental practitioners may be treating patients who are unaware that they are pregnant.

Other psychosocial factors beyond denial complicate many pregnant adolescent's lives. They are likely to have an interruption of school, to live in persistent poverty resulting in limited vocational opportunity and continued financial stress,¹¹ and are often separated from the fathers of their children. Many adolescent mothers and their infants reside with the grandmother who typically cares for the infant, and the adolescent is at an increased likelihood of again becoming pregnant. In fact, 40% to 50% of pregnant adolescents are pregnant again within 2 years, with 20% to 25% of these pregnancies resulting in live births.^{2,8}

Legal issues regarding consent for pregnant adolescents less than 18 years of age are complex. Generally, pregnant minors are afforded constitutional protection and are entitled to confidentiality regarding issues of health care surrounding the pregnancy. However, a gray area exists in cases where treatment is not directly related to the pregnancy. Usually, consent must be obtained from the parent or legal guardian who must be aware of the pregnancy to understand the risks and benefits of the proposed treatment. If the parent or guardian is unaware of the pregnancy, the provider has the responsibility to the patient of maintaining confidentiality.^{12,13} Although a recent search of legal databases found no reported cases involving dentists and breaches of confidentiality for pregnant adolescent patients, the patient should be encouraged to inform the parent herself. Treatment should not occur unless the parent is aware of the pregnancy; however, if emergency treatment is necessary, the obligation to maintain confidentiality should be weighed against the risk of harm to the fetus.^{12,13}

Consent laws vary by state, so practitioners should be familiar with the controlling laws in their own states. Some states recognize the "mature minor" doctrine, which was created to allow minors to consent for their own health care in circumstances where a provider deems the minor "mature" enough to provide knowing intelligent informed consent. For example, states that recognize the "mature minor" doctrine allow unemancipated minor parents to provide informed consent for their own health care. In some states, however, the minor may only provide consent for her baby upon delivery, but not for herself.¹⁴ In some states, minors may also be "emancipated" by a court, which allows them to be recognized as adults for issues such as liability, binding contracts, and providing informed consent. Usually, this is limited to older minors who are either married, serving in the armed forces, financially independent, or in situations in which a court has determined emancipation to be in the best interest of the individual.¹⁴

When there is a reasonable suspicion of sexual abuse observed while within their professional capacity, dentists are obligated to report to the proper authorities. Previously, mandatory reporting laws in Connecticut required the reporting of only "perioral" signs, but dentists are now required by law to report any "reasonable suspicion" of abuse or neglect within their professional capacity.¹⁵ In the past, Connecticut state law also required mandatory report-

ing only when the event happened to the child while under the care of the primary caregiver, but this had recently changed to the care of anyone, due to the recent sexual abuse charges brought against several clergy.¹⁶ A guide to signs of sexual or physical abuse can be found in the Journal of the American Academy of Pediatrics¹⁷ or through the American Bar Association Web site.¹⁸

In some states, pediatric health care providers may be held liable for failing to report suspected abuse or neglect. In Connecticut, for example, failing to report a reasonable suspicion of abuse or neglect results in a monetary fine and/or mandatory attendance of a training seminar provided by the child welfare department but funded by the individual who failed to report.¹⁵ Recently, Connecticut authorities arrested 2 pediatricians for failing to report the suspected sexual abuse of a pregnant 11-year-old by the 75-year-old father of her unborn child. Although they had referred her to an abortion clinic, they had made no report to the proper authorities.¹⁹ The arrests were a warning to all health care providers, required to abide by such mandatory reporting laws,²⁰ to evaluate each case carefully and to take these laws more seriously.²¹

Maternal changes during pregnancy and common complications

During pregnancy, there is an increase in total blood volume, which, if not accompanied by an adequate compensatory increase in red cell mass, may result in a "dilutional anemia." Cardiac output also increases by 30% to 50% during the 16th to 28th weeks, often giving rise to functional systolic or "physiologic" murmurs. These murmurs generally do not require subacute bacterial endocarditis prophylaxis, but a consultation from the patient's physician is prudent.²²⁻²⁴ Increased cardiac output is also accompanied by an increase in maternal heart rate of approximately 10 beats per minute. The diastolic blood pressure usually decreases an average of 7 to 10 mm Hg early in gestation, with a rise toward prepregnancy levels in the third trimester.²⁵

Pregnant patients are prone to develop supine hypotensive syndrome, which occurs when the gravid uterus partially obstructs the patient's inferior vena cava. This can result in decreased cardiac return to the right side of the heart, hypotension, syncope, decreased placental perfusion, and fetal hypoxia.²⁶ Approximately 10% of pregnant females near term have shown signs of shock such as hypotension, pallor, and tachycardia when placed in a supine position. To avoid this during dental treatment, the patient should be positioned on her left side with her right hip elevated 10 to 12 cm (15 degrees) using a folded towel; a completely supine position should be avoided.²²

Hypertension during pregnancy is defined as:

1. systolic blood pressure \geq 140 mm Hg or diastolic blood pressure \geq 90 mm Hg; or
2. a systolic blood pressure increase of \geq 30 mm Hg or a diastolic blood pressure increase of \geq 15 mm Hg of prepregnancy values.²⁷

Unfortunately, adolescents may have a pathological rise in pre-pregnancy blood pressure levels that never reach 140/90. If their pre-pregnancy levels were never measured, their hypertension may then go undiagnosed.²⁵

Hypertension is seen in 7% to 10% of all pregnancies,^{25,28} but its management in obstetric practice is controversial. The ability to reduce the incidence and severity of complications in mild to moderate disease through pharmacologic treatment may not justify the possible endangerment to the fetus.²⁴ Several forms of "pregnancy-related" hypertension exist, including chronic hypertension, gestational hypertension, and pre-eclampsia. Chronic hypertension (hypertension before 20 weeks gestation) and gestational hypertension (hypertension after 20 weeks gestation without other signs of pre-eclampsia) are typically well tolerated, provided diastolic levels do not exceed 100 mm Hg, although the risk of complications is increased.^{25,27} The term "pregnancy-induced hypertension" includes both gestational hypertension and pre-eclampsia.²⁷

Patients with pre-eclampsia, in addition to being hypertensive after the 20th week of gestation, have other findings such as proteinuria and/or edema.^{24,25} Although the etiology of pre-eclampsia is unknown, it occurs in approximately 5% of all pregnancies.²⁴ It is more common in primagravidas, women with pre-existing hypertension (pre-eclampsia superimposed with chronic hypertension),^{24,27} diabetes, obesity, and in females less than 20 or over 35 years of age.^{28,29} Unlike gestational hypertension or chronic hypertension, the elevated blood pressure is not the pathogenic factor; rather, it is a disease marker that develops after 20 weeks of gestation. The pathophysiologic abnormalities include inadequate maternal vascular response to placenta development, endothelial dysfunction, generalized vasospasm, activation of platelets, and abnormal hemostasis. Maternal and perinatal mortality and morbidity is increased from the resultant decreased uteroplacental blood flow, separation of the placenta from the uterine wall, and preterm delivery. Delivery is the only cure, but treatment may include magnesium sulfate for seizure prophylaxis and hydralazine for blood pressure control. Untreated, pre-eclampsia can result in 2 life-threatening complications:

1. HELLP (hemolysis, elevated liver enzymes, low platelets);
2. progression to a convulsive phase, termed eclampsia.^{25,28,30}

Eclampsia is the presence of "convulsive seizures or coma without other etiology occurring in the same time period as pre-eclampsia."²⁴ More than 80% of those with eclampsia are young primagravidas.²⁴ It is the most life-threatening antepartum complication and can result in cerebral hemorrhage, aspiration pneumonia, hypoxia, encephalopathy, and thromboembolic events. Maternal death is commonly due to aspiration of gastric contents, while death of the fetus is due to hypoxia. Of the eclamptic seizures, 25% occur before labor, 50% during labor, and 25% up to 7 to 10

days postpartum.^{24,31} It is a medical emergency and usually requires immediate delivery.²⁵

Respiratory changes occur due to the larger abdominal content which displaces the diaphragm upward 3 to 4 cm, causes the ribs to flare out and the chest circumference to increase around 5 to 7 cm. Patients should not be placed completely supine, as abdominal contents may press on the diaphragm causing breathing difficulties. The pregnant patient has a decreased functional residual capacity of approximately 15% to 20%, and modest hypoxemia occurs in about 25% of pregnant females while supine.²²

Gestational diabetes occurs in 1% to 3% of all pregnancies,²⁴ but the incidence is greater in adolescents.⁶ Increased insulin requirements may result from the additional strain on carbohydrate metabolism and possibly from the placental release of human placental lactogen and insulinase. Disease management typically includes diet modifications, insulin therapy, and frequent glucose monitoring.²⁸

Nausea and vomiting ("morning sickness") during the first trimester occurs in 50% to 90% of all pregnancies and is associated with young age and low socioeconomic status.³² Although likely multifactorial in etiology, morning sickness has mainly been attributed to an increase in human chorionic gonadotropin and estrogen.²⁴ No drug is currently approved for morning sickness, although physicians sometimes prescribe anti-emetics, sedatives, or vitamins.²⁴ Patients with extreme nausea and vomiting (hyperemesis gravidarum) should be referred to an obstetrician.²⁴ Dental practitioners should recommend that patients rinse with a baking soda and water solution after vomiting in order to neutralize acidity of the saliva and prevent enamel erosion.

Other oral changes occur during pregnancy due to an increase in progesterone and estrogens. Pregnant patients have an increased sensitivity to bacterial irritants, which results in pregnancy gingivitis in 50% to 100% of all pregnancies.²² The gingivitis is usually identified around the second month and peaks during approximately the eighth month.²² Impeccable oral hygiene is necessary to reduce the plaque irritant and to prevent the exacerbation of any pre-existing periodontal disease. The myth, "a mother loses a tooth for every baby" is false. The loss of teeth simply continues the trend in oral disease that began prior to pregnancy.³³ Generalized tooth mobility, without evidence of periodontal disease, has been reported to occur in some pregnancies. This may be a result of mineral changes in the lamina dura, attachment apparatus, or underlying pathology and usually resolves spontaneously.³¹

Pregnancy tumors, called pyogenic granulomas, can also result from the increased hormone levels and are reported in nearly 5% of pregnant females. These gingival lesions are usually painless, appear in the second trimester, and resolve spontaneously upon delivery. If the patient is in pain, the granuloma can be removed.²²

Fetal health concerns and the delivery of dental care

Maintaining fetal health during the delivery of dental care is vital. Two major concerns are the induction of fetal hypoxia and the exposure of the fetus to teratogens. Fetal hypoxia may be evidenced by a decrease in fetal heart rate but can be typically avoided through correct patient positioning during dental treatment. A teratogen, by definition, can be "any agent that, when exposed to the fetus, causes permanent alteration in function or form."³¹ Some examples of teratogenic agents include drugs, ionizing radiation, and infections. They can result in anything from minor clefting of the alveolus to spontaneous abortion, and the effects vary due to genetic predisposition, developmental stage, and the route and level of exposure from the agent.

The developmental stage at the time of exposure is critical in determining the effect. After fertilization but prior to implantation, the ovum generally responds in an "all or none" fashion, either attaching or dying. Major organogenesis occurs during the embryonic period (2-8 weeks), and the developing embryo is most sensitive to the teratogenic insult. Major developmental disturbances result in classic congenital malformations such as anencephaly, heart/limb defects, etc. Later, during the fetal period (8 weeks until term), such insults may likely result in cleft lip and palate, poor fetal growth, and more subtle developmental disturbances.¹⁰

Maternal oral infection (including periodontal disease) also may affect the maternal-fetal complex, possibly causing an increase in neonatal mortality, preterm birth, and low birth weight.^{34,37}

Such findings indicate it is important to provide dental treatment to pregnant mothers to promote a healthy pregnancy outcome. Unfortunately, many dentists are reluctant to treat pregnant patients even though a recent survey of general dentists and obstetricians found "no medical reason to justify the degree of difference in the treatment of pregnant women." Most of the physicians' remarks were "concerned with dentists' conservatism" resulting in "undertreatment of the pregnant patients."³⁸ In fact, in a search of computerized databases of all state appellate cases since 1945, only a single occurrence of litigation between a dentist and a pregnant patient regarding dental treatment was found. The case involved the removal of third molars during the third trimester. The fetus was later stillborn, and the husband sued both the dentist and the obstetrician. The court found in favor of the doctors, and the case was dismissed.³⁹

Another survey of obstetricians reported that they generally prefer to have the source of the dental problem resolved rather than delaying treatment. When asked to determine in which situations they would like to be consulted prior to treatment, only 9% stated they preferred to be consulted prior to "all routine treatment." Interestingly, 79% requested that the dentist consult with them prior to providing any treatment that could "induce a bacteremia,"⁴⁰ suggesting that many obstetricians do not realize that bacteremia is common during routine dental care.

Drug therapy

The Federal Drug Administration (FDA) has created a pregnancy risk classification, (PRC), for all approved drugs. These categories are as follows:

- A. The drug has been studied in humans; evidence supports its safe use; only remote possibility of fetal harm.
- B. Animal studies demonstrate no fetal risk; inadequate studies in pregnant women have been performed; a slightly increased fetal risk exists.
- C. Teratogenic risk cannot be ruled out; animal studies show potential adverse fetal effects; potential benefits may outweigh risks.
- D. The drug demonstrates risk in humans; potential benefits may outweigh risks.
- X. The drug demonstrates harm in the mother or fetus; the risk clearly outweighs any benefit.

PRCs A and B can be appropriately administered during pregnancy. PRC C drugs may be used, but with caution; PRC D and X drugs should be avoided. Unfortunately, less than 20% of all drugs classified by the FDA are in PRC A or B.⁴¹

It should be assumed that all drugs cross the placenta and affect the fetus, and that almost all drugs are secreted into the breast milk to some extent.⁴² If a systemic drug is required while the mother is breast-feeding, practitioners should avoid prescribing sustained-release formulas. The patient should also be advised to take the medication immediately after breast-feeding, if possible, to avoid peak levels at the time of nursing.⁴³

Antibiotics such as penicillin, cephalosporins, amoxicillin, clavulanic acid, erythromycin (base), and clindamycin are in PRC B and may be safely administered during pregnancy and lactation. Unfortunately, they may cause allergic reactions, candidiasis, diarrhea in the nursing infant, or interference with the interpretation of culture results if a fever workup is required.⁴² The estolate salt of erythromycin should not be prescribed, as it has been shown to cause maternal hepatotoxicity.⁴² Metronidazole, used to treat pericoronitis or acute necrotizing ulcerative gingivitis, is also in PRC B. However, its use is controversial due to some reports of midline facial defects in humans, mutagenic effects in bacteria, and carcinogenic effects in rodents.⁴² Tetracycline and doxycycline are in PRC D, because they chelate calcium orthophosphate, causing a hypoplastic matrix, tooth discoloration, and inhibition of bone development, and may result in maternal hepatotoxicity.⁴² The antimicrobial chlorhexidine rinse is also in PRC B and has shown no adverse effects in pregnancy or breast feeding.

Nystatin rinse is safe for the treatment of oral fungal infections in pregnancy and breast-feeding, as it is in PRC B and is poorly absorbed. Fluconazole and ketoconazole are in PRC C and should be avoided if possible. Their effects during lactation are also unknown and are, therefore, discouraged.⁴²

Acetaminophen, which is in PRC B, is the analgesic of choice for the short-term management of oral-facial pain in pregnant females. Aspirin is classified as PRC C until

Table 1. Drug Therapy

Generic	Brand	PRC	Breast-feeding
Antimicrobials			
Amoxicillin	Amoxil/Polymox	B	Yes
Cephalexin	Keflex	B	Yes
Clindamycin	Cleocin	B	Yes
Doxycycline	Doryx/Vibramycin Atridox/Periostat	D	No
Tetracycline	Actisite/Achromycin	D	No
Erythromycin base*	E-mycin	B	Yes
Metronidazole	Flagyl	B	Cautious
Penicillin V	Pen Vee K	B	Yes
Amoxicillin+ clavulanic acid	Augmentin	B	Yes
Azithromycin	Zithromax	B	Yes
Nystatin	Mycostatin	B	Yes
Ketoconazole	Nizoral	C	No
Fluconazole	Diflucan	C	No
Chlorhexidine	Peridex	B	Yes
Analgesics			
Acetaminophen	Tylenol	B	Yes
Aspirin	Bayer	C/D*	No
Ibuprofen	Advil/Motrin	B/D*	Yes
Cox ₂ inhibitors	Celecoxib/Rofecoxib	C/D*	Unknown
Naproxen	Aleve/Anaprox	B/D*	Unknown
Codeine	Various combinations	C/D†	Yes
Hydrocodone	Various combinations	C/D†	Caution
Oxycodone	Various combinations	B/D†	Caution

the third trimester (at which time it is considered a PRC D drug); it should be avoided, especially late in pregnancy, due to its inhibition of prostaglandin synthesis, which may result in delivery complications, premature closure of the fetal ductus arteriosus, and antepartum/postpartum maternal/fetal hemorrhage. High doses may be related to increased perinatal mortality, intrauterine growth retardation, and teratogenic effects, while chronic use may cause maternal anemia. During breast-feeding, aspirin can interfere with the infant's platelet function.⁴²

Other nonsteroidal anti-inflammatory drugs, such as ibuprofen and naproxen, are PRC B drugs, while COX₂ inhibitors are classified as PRC C drugs. All are classified as PRC D drugs in the third trimester. They should also be avoided for their similar effects to aspirin of premature closure of the fetal ductus arteriosus and prolonged delivery as well as their possible association with spontaneous abortions. COX₂ inhibitors also should be avoided during breast-feeding due to their long half-lives; however, ibuprofen is considered safe for use during this time.⁴²

Opioids are centrally acting analgesics and should only be used with caution, when indicated, and after proper

Sedatives			
Hydroxyzine	Atarax/Vistaril	C	Unknown
Midazolam	Versed	D	No
Diazepam	Valium	D	No
Lorazepam	Ativan	D	No
Triazolam	Halcion	X	No
Chloral hydrate		C	Yes
Nitrous oxide		None	Controversial
Local anesthetics			
Lidocaine	Xylocaine	B	Yes
Etidocaine	Duranest	B	Yes
Prilocaine	Citanest	B	Yes
Mepivacaine	Carbocaine	C	Yes
Bupivacaine	Marcaine	C	Yes
Articaine	Septocaine	C	Unknown
Vasoconstrictors			
Epinephrine 1:100,000/ 1:200,000		C‡	Yes
Levonordephrin 1:20,000	Neo-cobefrin	None	Yes
Topical anesthetics			
Benzocaine	Anbesol/Hurricane	C	Yes
Lidocaine	Xylocaine/Dentipatch	B	Yes
Tetracaine	Pontocaine	C	Yes

Note: Chart compiled from references 26, 42, 43, 44, and 47. Trade names listed are examples only and are not exclusive.

*Depicts PRC D during the third trimester.

†Depicts PRC D in high doses at term or for prolonged use.

‡Depicts PRC C in high doses.

consultation with the patient's obstetrician. Practitioners also should be alert for signs of potential drug abuse. Their chronic use can result in fetal physical dependence, fetal central nervous system and respiratory depression, premature delivery, and growth retardation. Obstetricians often recommend acetaminophen with codeine (Tylenol#3) for the short-term management of acute pain; however, there is a possible association between codeine use and multiple congenital defects including heart and circulatory defects and cleft lip and palate. Combinations of acetaminophen and hydrocodone (Vicodin) are classified as PRC C unless used in high doses at term or chronically, at which point they are classified as PRC D drugs.⁴² Combinations of acetaminophen with oxycodone (Percocet) may be a good choice for the short-term management of acute pain; they are considered PRC B drugs unless used in high doses at term or chronically, at which point they become PRC D drugs.⁴² Other opioid-containing drugs such as Percodan, Vicoprofen, Empirin, Talwin, Darvocet, and Demerol should be avoided.⁴²

Although all local anesthetics do cross the placenta,⁴⁴ local anesthetic is the method of choice for dental anesthe-

sia. Doses should be kept to a minimum to reduce the chances of maternal seizures or hypoxia. Etidocaine and lidocaine are categorized as PRC B drugs, but lidocaine is the recommended local anesthetic for use whenever possible. Prilocaine is also a PRC B drug, although it is an ester and has been associated with methemoglobinemia-induced maternal and fetal hypoxia. Articaine (Septocaine) is a fairly new local anesthetic in the United States and has been shown to offer many advantages over other commonly used local anesthetics.^{45,46} It has been placed in the PRC C drug category due to its limited studies in pregnant females. It may also result in methemoglobinemia at high doses,⁴⁷ although studies in pregnant rats and rabbits showed no ill effects to the mother or the fetus, even at doses considered toxic to the parent animal.⁴⁵ Mepivacaine (Polocaine or Carbocaine) and bupivacaine (Marcaine) are PRC C drugs that can cause fetal bradycardia. Bupivacaine has been associated with embryocidal effects in rabbits at 5 times the maximum recommended daily dose and decreased survival in newborn rats at 9 times the maximum dose. Mepivacaine has very few animal reproduction studies available.⁴³

Epinephrine is a natural hormone and is considered safe in the low doses when used in dentistry without teratogenic effects. In healthy pregnant patients, epinephrine is beneficial to impede systemic absorption, prolonging the local anesthetic depth and duration while preventing its toxicity. It has the potential to compromise uterine blood flow and to stimulate cardiac function if injected intravenously. If used, aspiration and appropriate dosing are necessary, especially in cardiac patients.^{43,44}

Sedatives such as diazepam (Valium), midazolam (Versed), and lorazepam (Ativan) are in PRC D drug category; hydroxyzine (Vistaril) and chloral hydrate are PRC C drugs; and triazolam (Halcion) is a PRC X drug.⁴² They usually cross the placenta, may inhibit neuronal function, and are discouraged. Although sometimes prescribed by obstetricians for hyperemesis,²⁴ when used for prolonged periods of time, they may be associated with oral-facial clefts, cardiac defects, and inguinal hernias.⁴⁴ All except chloral hydrate also are discouraged during breast-feeding.⁴²

Nitrous oxide has no PRC classification, and it should not be used without prior consultation with the patient's obstetrician. Chronic exposure of nitrous oxide has been associated with spontaneous abortion and decreased fertility.⁴⁸⁻⁵⁰ Effects previously were thought to be due to the blockage of the enzyme methionine synthase, which affects DNA synthesis. More recently, however, considerable evidence has shown that the problem is instead multifactorial in origin. Because nitrous oxide is mildly sympathomimetic, it may also cause vasoconstriction, resulting in decreased uterine blood flow.⁴³ Treatment options should consider the early months of organogenesis and the final months of lowered oxygen tension level, as nitrous oxide crosses the placenta. It is possible that nitrous oxide could be unfairly blamed if fetal anomalies manifest; therefore, it is best to avoid the use of nitrous oxide in the first tri-

mester.^{44,51} It has been used in obstetrics for centuries, however, and several authors suggest that, after consultation with the obstetrician, it can be safely used during pregnancy for a single exposure, lasting 30 minutes maximum, in concert with at least 50% oxygen.^{23,43,51} There is no apparent concern with breast-feeding.⁴³

General anesthesia should be used only for life-threatening situations of medical necessity because of the severe risks to the fetus. In addition, intubation is more difficult in the pregnant patient, and the risk of airway obstruction and aspiration are increased.²³

Prenatal fluoride supplementation is controversial; evidence has not clearly demonstrated beneficial effects.^{52,53} Currently the American Dental Association does not recommend any supplementation prior to 6 months of age.^{54, 55} Refer to Table 1 for summary of drug therapy options.

Dental radiographs

As demonstrated in animal testing, atomic bomb survivors, and other irradiated human populations, the 2 major risks to a developing fetus, which can be caused by radiation exposure, are the induction of cancer and the development of mental retardation. It appears that 10 μ Sv of radiation is required for a significant risk of either effect to occur.⁵⁶ The fetus or embryo is the most sensitive to the neurogenic effects of radiation between the eighth and 15th weeks after conception, during which time there is neuronal migration and organogenesis.⁵⁷ However, proper radiographic techniques, such as rectangular collimation, lead shielding (abdominal and thyroid), use of the fastest available receptor (E/F speed film or digital), use of a long cone, and the avoidance of retakes, ensure that radiation exposure to the fetus is so low that it cannot be measured by conventional dosimetric techniques.⁵⁸

In a full-mouth series using E-speed film, the average gonadal dose to females is less than 0.005 μ Sv.⁵⁹ When compared to background radiation, a full-mouth series taken using E-speed film and a rectangular collimated beam results in a background equivalency of 1 day, and for the 4 bite wings, 7 hours.⁵⁷ Panoramic techniques have a background equivalency of 12 hours, though some newer machines are only 7 hours.⁶⁰ In 2000, F-speed film was introduced. It has been shown to be of comparable diagnostic quality to Ektaspeed Plus film, and the exposure level is only 77% of Ektaspeed Plus film.⁶¹ Digital imaging has recently gained popularity, and it also has been shown to decrease radiographic exposure by at least 50% of the fastest current film based images while offering comparable diagnostic quality.⁵⁹

When patients are reluctant to accept necessary radiographs, it should be explained that the risk of complications, such as mental retardation and cancer induction, is so low that it is almost impossible to measure. The risk of reaching a teratogenic threshold dosage of radiation related to dental radiographs is <0.1%. This is more than 1,000 times less than the anticipated risk of

spontaneous abortion and malformation.⁶² In fact, there may be more risk to the fetus associated with lack of dental care than in providing treatment that includes dental radiographs. Without radiographs, inaccurate diagnosis may lead to pain and infection, which could ultimately affect the fetus.³⁹ Practitioners should also remember that, when providing certain treatment such as extractions or root canal therapy, without radiographs, they may be providing substandard care. Therefore, dental radiographs are encouraged if they are of potential benefit.⁵⁶

Treatment timing

During the first trimester, the dental professional should assess the patient's current dental health, inform her of expected oral changes, and discuss how to avoid maternal dental problems. Objectives of treatment, with respect to the fetus, are to avoid fetal hypoxia, premature labor/abortion, and teratogenic effects. A thorough medical history should be taken, her blood pressure recorded, and those who are hypertensive referred to an obstetrician. If the patient is not currently under the care of an obstetrician, she should receive the proper referral. If there are no additional medical concerns, a thorough exam and dental prophylaxis should be performed. Necessary radiographs should be taken of teeth that are symptomatic or are suspected as having caries; however, in the absence of suspected dental disease, radiographs should be avoided. If a patient presents with an abscess or multiple large carious lesions, the source of the infection should be removed as soon as possible after consultation with her obstetrician. Often, this requires either endodontic therapy or extraction of the offending tooth.⁶²

There is no specific medical justification to defer elective treatment in a healthy pregnancy. However, as approximately 1 in 5 pregnancies end in spontaneous abortion³¹ and 85% occur in the first trimester,²⁴ delaying elective treatment other than prophylaxis and examinations to the second trimester may avoid a correlation being made between dental treatment and a spontaneous abortion.³⁸

During the second trimester, elective restorative and periodontal treatment should be performed to prevent dental infection or complications during the third trimester. This is in accordance with the treatment philosophy of most obstetricians.^{38,40} If the patient will not be returning during the third trimester, she should receive oral health counseling for her newborn. This should include information regarding the prevention of early childhood caries and the recommendation that the baby's first dental visit be with the eruption of the first tooth and no later than 1 year of age.⁵⁴ The mother should be encouraged to maintain her own dental health, as preschool children whose mothers have low or suppressed mutans streptococci levels may have significantly reduced caries experience.⁶³

During the third trimester, the patient should be seen for a second dental prophylaxis if there has been a lack of oral home care or if pregnancy gingivitis or a pregnancy

tumor has occurred. Typically, in the third trimester, pregnant females are in some form of generalized discomfort, and oral home care may not be at its best.⁶⁴

Emergencies

Syncope may be caused by hypotension, hypoglycemia, anemia, dehydration, or neurogenic disorders. The patient should be placed on her left side with her head at heart level and legs elevated. Oxygen should be administered and her vitals measured.⁶² If she does not respond to this treatment, this is a medical emergency and the Emergency Medical Service (EMS) should be activated.

Hyperventilation is most commonly seen in the first trimester and may result in respiratory alkalosis. The patient should breathe carbon dioxide by inhaling and exhaling into a paper bag. The dental procedure should be halted and rescheduled. If dyspnea or apnea should occur, the patient should be placed in a semireclined position and supported with oxygen, while her consciousness and vital signs are assessed and monitored. The EMS may need to be activated.⁶²

Seizures in pregnant patients are severe medical emergencies. The dental team should maintain the patient's airway, place the patient on her left side, administer oxygen, and suction the mouth. The staff should activate EMS immediately for her transport to the nearest hospital.^{5,22,62}

Hypoglycemic patients may present with nausea, transient weakness, or syncope with strong vital signs. The dental staff should monitor vital signs and administer either IV glucose or an oral glycemic source, such as orange juice or cake frosting. If glucose does not improve the situation, the patient may instead be hyperglycemic. The administered glucose is not likely to complicate the situation, but a dose of insulin may need to be administered by a physician or EMS. Emergency room evaluation is recommended.⁶²

Spontaneous abortion is considered the delivery or loss of conception products prior to the 20th week of pregnancy. Within this time, approximately 20% to 30% of all pregnant women have bleeding or cramping; almost half of these result in spontaneous abortion.²⁴ Preterm birth occurs between the 20th and 37th week.^{6,7} This is often characterized by discomfort, pelvic or abdominal pressure, or the passing of vaginal fluid. If miscarriage or preterm labor is suspected, the patient should be reclined and her vitals supported while EMS and her obstetrician are immediately contacted.^{24,62}

If a pregnant female is in cardiopulmonary arrest, cardiopulmonary resuscitation and advanced cardiac life support (ACLS) should be performed with modifications. A towel should be placed under her right hip (displacing the gravid uterus to the left) and ACLS algorithms followed, including defibrillation as necessary. When indicated, the American Heart Association does recommend chest compressions, although hand placement is slightly higher on the patient's sternum.⁶⁵

Conclusions

1. Adolescent pregnancies are at a higher risk for medical complications.
2. Issues regarding consent for the dental treatment of pregnant minors are complex and vary by state.
3. Routine dental care, including the use of dental radiographs, is safe and encouraged in healthy pregnancies.

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