TABLE 98-10 Antiemetics

Antiemetic	Brand Name	U.S. Food and Drug Administration Category	PO	PR	IV
Promethazine	Phenergan	C	12.5–25 milligrams every 4 h	12.5–25 milligrams every 4 h	IV administration is generally recommended against; 12.5–25 milligrams IM every 4 h
Prochlorperazine	Compazine	—	10 milligrams every 6–8 h	25 milligrams every 12 h	10 milligrams over 2 min Maximum of 40 milligrams every 24 h
Chlorpromazine	Thorazine	C	10–25 milligrams every 4–6 h	100 milligrams every 6–8 h	25 milligrams in 500 mL NS at 250 mL/h
Ondansetron	Zofran	B	4–8 milligrams every 8 h	—	8 milligrams IV over 5 min
Metoclopramide	Reglan	B	10 milligrams orally every 6–8 h	—	10 milligrams over 1–2 min every 6–8 h
Maintenance Therapy for Nausea and Vomiting					
Doxylamine with pyridoxine	Diclegis/ Diclectin	A	2 tablets every evening	—	—
Vitamin B_6	—	—	25 milligrams every 8 h	—	—
Ginger	—	—	500–1000 milligrams daily	—	—
Diphenhydramine	Benadryl	B	25–50 milligrams every 6 h	—	—

Abbreviation: NS = normal saline.

Source: Adapted with permission from Pearlman M, Tintinalli JE (eds): *Emergency Care of the Woman*. New York: McGraw-Hill, 1998.

peptic ulcer, pyelonephritis, ectopic pregnancy, fatty liver of pregnancy, and the syndrome of *h*emolysis, *e*levated *l*iver enzymes, and *l*ow *p*latelets (HELLP syndrome).

TREATMENT

Treatment consists of IV fluids containing 5% glucose in either lactated Ringer's solution or normal saline to replete volume and reverse ketonuria. A number of antiemetic drugs can be used (**Table 98-10**) for patients who remain nauseated or continue to vomit. Initially, the patient should be given nothing by mouth. Oral fluids should be started after the nausea and vomiting are controlled but before discharge.

DISPOSITION AND FOLLOW-UP

The patient may be discharged after reversal of ketonuria, correction of electrolyte imbalance, and a successful trial of oral fluids. Discharge with antiemetic medication is usually necessary. There is no clear drug of choice.

Phenothiazines can cause drowsiness or dystonic reactions in some patients. Ondansetron (Zofran®), 8 milligrams IV or 4 milligrams PO three times daily, can cause headache, constipation, diarrhea, or lightheadedness. It does not cause dystonia. Its chief disadvantage is cost. It is apparently no more effective than promethazine.[15] Doxylamine and pyridoxine (Bendectin®), a mainstay of therapy in the past, was discontinued due to fears of teratogenicity, but with new information, it does not represent an increase in fetal risk and has been reintroduced on the North America market as Diclegis/Diclectin (also put in trademark sign after Diclegis/Diclectin).[16,38]

Admission guidelines include uncertain diagnosis, intractable vomiting, persistent ketone or electrolyte abnormalities after volume repletion, and weight loss of >10% of prepregnancy weight.

REFERENCES

The complete reference list is available online at www.TintinalliEM.com.

CHAPTER 99

Comorbid Disorders in Pregnancy

Lori J. Whelan

INTRODUCTION

This chapter reviews the most common comorbid conditions encountered in pregnant women in the ED environment: diabetes and hypoglycemia; thyroid disorders; hypertensive disorders; cardiac arrhythmias; thromboembolism; asthma; renal disease; urinary tract infections; sickle cell disease; headache; seizures; substance abuse; and intimate partner violence. Drug risk during pregnancy, lactation, and fetal effects of radiation are summarized based on currently available data. Resuscitation is covered in chapter 25, "Resuscitation in Pregnancy."

DIABETES IN PREGNANCY

Maternal diabetes affects >8% of the 4 million live births annually in the United States.[1] Three fourths of pregnant patients with diabetes have either gestational diabetes or type 2 diabetes diagnosed through prenatal screening. Of the remaining 25%, 1% have preexisting type 1 diabetes, and the remaining are type 2 diabetics. Pregnant diabetic women are at increased risk for spontaneous abortion, particularly patients with poor glycemic control early in pregnancy, preexisting vascular disease, and pre-eclampsia. Pregnant diabetics are also at increased risk for several pregnancy complications, including pregnancy-induced hypertension, preterm labor, spontaneous abortion, pyelonephritis, and diabetic ketoacidosis (DKA). The goal of treatment during pregnancy is to prevent spontaneous abortions, hyperglycemia-induced congenital abnormalities and ketoacidosis, and hypoglycemia.

Oral hypoglycemic agents, such as metformin and glyburide, are occasionally used in select patients with gestational diabetes.[2] A significant portion of gestational diabetics can be managed with diet alone if they can maintain glycemic goals with frequent glucose monitoring.

The American College of Obstetricians and Gynecologists recommends the following goals for maintaining euglycemia in pregnant diabetic patients: a fasting blood glucose concentration of ≤95 milligrams/dL and a 2-hour postprandial glucose concentration

≤120 milligrams/dL.[3] Patients with gestational diabetes who are managed by diet alone rarely develop acute hyperglycemic complications because glucose values rarely reach levels consistent with DKA. Among patients with preexisting type 1 and type 2 diabetes, the need for insulin increases throughout the course of pregnancy. Historically, all type 2 diabetics were switched to insulin as soon as possible (even prior to conception) to ensure appropriate glycemic control and due to concerns over the safety of oral hypoglycemic agents in pregnancy. Recent studies in gestational diabetes have not shown metformin or glyburide to have any harmful fetal effects, but long-term studies are needed. Although metformin may be continued in select patients, there is no consensus on the use of these oral agents alone in the pregnant patient with type 2 diabetes.[2-5]

In general, during the first trimester, the initial insulin requirement is 0.7 units/kg/day. By late pregnancy, patients generally require 1 unit/kg/day.[6]

Neutral protamine Hagedorn (NPH)/regular insulin combinations are still first-line insulin therapy, but the long-acting analog insulin detemir (Levemir) is approved by the U.S. Food and Drug Administration for use in pregnancy and is category B. Compared to NPH, insulin detemir improves fasting plasma glucose and decreases hypoglycemic events. There is a strong evidence base to recommend insulin detemir in pregnancy, but the lack of definitive fetal benefit means that there is no pressing need to switch a woman whose diabetes is well controlled by NPH insulin to insulin detemir.

Insulin glargine (Lantus) is still category C. It is generally not initiated during pregnancy. However, it seems reasonable to continue insulin glargine when it was successful maintaining excellent glycemic control in a woman who is now pregnant.[7]

HYPOGLYCEMIA

Women with type 1 diabetes have three to five times more hypoglycemic episodes than the period prior to pregnancy.[8] Risk factors for severe hypoglycemia during pregnancy include a history of severe hypoglycemia in the year preceding pregnancy, impaired hypoglycemia awareness, long duration of diabetes, low HbA_{1c} in early pregnancy, fluctuating plasma glucose levels, and excessive use of insulin injections between meals.[8] Hypoglycemia generally presents as sweating, tremors, blurred or double vision, weakness, hunger, confusion, paraesthesias, anxiety, palpitations, nausea, headache, or stupor. Moderate and infrequent hypoglycemic episodes are generally well tolerated by the fetus.[4] Pregnant diabetic women should be educated about the symptoms and treatment of hypoglycemia. Treat mild hypoglycemia (i.e., a glucose level of <70 milligrams/dL in patients who are able to follow commands) by giving juice, glucose, or food by mouth. Provide standard treatment for more severe hypoglycemia, with IV glucose or PO glucose or glucagon 1 to 2 milligrams SC or IV (see chapters 223, "Type 1 Diabetes Mellitus" and 224, "Type 2 Diabetes Mellitus").

DIABETIC KETOACIDOSIS IN PREGNANCY

A pregnant diabetic who is ill appearing, has persistent nausea and vomiting, and/or has a blood glucose level ≥180 milligrams/dL should be screened for DKA with serum or urine ketones and a serum chemistry panel. Management guidelines for pregnant women with DKA are the same as for nonpregnant patients[9] (see chapter 225, "Diabetic Ketoacidosis"). In addition to the usual care, obtain fetal heart tones, administer oxygen, and for third-trimester patients, place in the left lateral decubitus position to displace the uterus and improve uterine blood flow. Most fetal heart rate abnormalities subside after correction of maternal hypovolemia and acidosis. Consult with the patient's physician, and admit the patient to the hospital.

The incidence of DKA in pregnancy decreases with early diagnosis of insulin-dependent diabetes, improved prenatal counseling, and care with an identifiable primary care provider.[10,11] DKA most commonly affects women in the second or third trimester or pregnant women with new-onset type 1 diabetes.[10,12]

Women who use continuous SC insulin infusions (the insulin pump) can develop DKA whether they are pregnant or not. DKA can develop very quickly and unexpectedly, especially in patients who have recently started using the pump.[13,14] Use of continuous insulin pumps during pregnancy is equivalent, but not superior, to scheduled injections. Management of DKA in a pregnant woman with an insulin pump is the same as the nonpregnant patient.

DKA is not an indication for delivery. Although fetal heart rate monitoring in maternal DKA may initially demonstrate a nonreassuring pattern, patterns usually improve as maternal ketoacidosis is corrected, and mother will tolerate delivery or cesarean section better once acidosis resolves.[10,15]

THYROID DISORDERS

TRANSIENT HYPERTHYROIDISM OF HYPEREMESIS GRAVIDARUM

Women in the first trimester with weight loss, tachycardia, and vomiting consistent with hyperemesis gravidarum may also demonstrate laboratory evidence of hyperthyroidism, or biochemical or transient hyperthyroidism. The most likely cause is thyrotropin receptor stimulation from high human chorionic gonadotropin serum concentrations. Women with transient hyperthyroidism have no previous history of thyroid disease, no palpable goiter, and except for tachycardia, no other symptoms or signs of hyperthyroidism. Test results for thyroid antibodies are negative. With transient hyperthyroidism of hyperemesis gravidarum, thyroid-stimulating hormone (TSH) may be suppressed and free thyroxine (T_4) elevated, but triiodothyronine (T_3) is **lower** than in true hyperthyroidism. With true hyperthyroidism, both free T_4 and T_3 are usually **elevated**. Only symptomatic treatment is suggested for transient hyperthyroidism, and antithyroid medication is not recommended.[16]

HYPERTHYROIDISM

True hyperthyroidism in pregnancy increases the risk of pre-eclampsia, low birth weight, and possibly congenital malformations. Symptoms of hyperthyroidism can mimic symptoms of normal pregnancy and may consist of nervousness, palpitations, heat intolerance, and inability to gain weight despite a good appetite. Methimazole and propylthiouracil (PTU) are equally efficacious in the treatment of pregnant women. However, methimazole has a possible association with congenital abnormalities during first-trimester organogenesis, and PTU can cause hepatotoxicity. Therefore, during the first trimester, hyperthyroidism in pregnancy is treated with PTU followed by methimazole during the second and third trimesters.[17-19] Agranulocytosis and aplastic anemia are rare but serious complications in patients treated with antithyroid drugs. If this occurs, immediately discontinue the medication and obtain obstetrical consultation.

THYROID STORM

Patients with thyroid storm develop fever, volume depletion, or high-output heart failure. Labor, cesarean section, and infection all may precipitate thyroid storm in a woman with a history of hyperthyroidism. Thyroid storm has been associated with a mortality rate of up to 25%. The principles of treatment are summarized in **Table 99-1** and are similar to those for nonpregnant patients (see chapter 229, "Hyperthyroidism").

HYPERTENSION

Hypertensive disorders are the most common medical complication of pregnancy. Hypertension in pregnancy can be divided into five categories: chronic hypertension in pregnancy, gestational hypertension, preeclampsia, HELLP syndrome, and eclampsia. Chronic hypertension is discussed below, and the other disorders are discussed in detail in chapter 100, "Emergencies after 20 Weeks of Pregnancy and the Postpartum Period."

TABLE 99-1 Principles of Treatment of Thyroid Storm during Pregnancy

Principle	Comment
Inhibit thyroid hormone release with thionamides (PTU is preferred over methimazole; also blocks conversion of T_4 to T_3)	**Propylthiouracil** (PTU) 600–1000 milligrams PO loading dose followed by 200–250 milligrams PO every 4 h (first trimester) or **Methimazole** 40 milligrams PO loading dose followed by 25 milligrams PO every 4 h (second and third trimesters)
Inhibit new thyroid hormone production (give at least 1 h after above step)	**Lugol solution** 8–10 drops every 6–8 h or **Potassium iodine** 5 drops PO every 6 h or **Iopanoic acid** 1 gram IV every 8 h **Do not use radioactive iodine because the fetus will concentrate iodine-131 after the 10th to 12th week of gestation, resulting in congenital hypothyroidism**
Block peripheral thyroid hormone effects	**Propranolol** 1–2 milligrams IV every 10–15 min and start **Propranolol** 40 milligrams PO every 6 h or **Esmolol** 500 micrograms/kg IV bolus, then 50 micrograms/kg/min maintenance Hold if evidence of heart failure is present
Prevent conversion of T_4 to T_3	**Hydrocortisone** 100 milligrams IV every 8 h or **Dexamethasone** 2 milligrams IV every 6 h
Supportive care	Left lateral decubitus position Oxygen Cooling blankets IV fluids Acetaminophen 650 milligrams PO every 4 h[20]

CHRONIC HYPERTENSION IN PREGNANCY

Chronic hypertension is sustained elevation of blood pressure to >140/90 mm Hg, measured on two separate occasions before 20 weeks of gestation or persistent beyond 12 weeks postpartum.[21,22] Patients with mild hypertension (140/90 mm Hg) and no evidence of renal disease should be counseled on lifestyle modifications and observed. Because there is no consensus that antihypertensives can reduce the risk of fetal death, growth restriction, abruption, or eclampsia, treatment with antihypertensive medication is **not** usually necessary unless renal disease develops.[23] Despite the lack of evidence supporting the benefit of antihypertensive therapy in women with blood pressure <180/110 mm Hg, there is a general consensus that pregnant women with hypertension in the blood pressure range of 150 to 160/100 to 110 mm Hg should be treated with antihypertensive therapy.[22-24] There is insufficient evidence to support or refute the theory that bed rest, either in the hospital or at home, improves outcomes.[25]

Maternal mortality in patients with chronic hypertension results from **severe** hypertension and associated congestive heart failure or stroke. Fetal perinatal outcome is associated most closely with pre-eclampsia or placental abruption.

Commonly used agents for the treatment of chronic hypertension in pregnancy are listed in **Table 99-2** and include labetalol, α-methyldopa (Aldomet), clonidine, and nifedipine. Based on the overall low rate of adverse effects and good efficacy, labetalol is a good option for first-line treatment of chronic hypertension in pregnancy.[22] Thiazide diuretics can be continued during pregnancy.[22] **Angiotensin-converting enzyme inhibitors and angiotensin receptor blockers are the only class of antihypertensive medications contraindicated in pregnancy.**[22]

CARDIAC ARRHYTHMIAS

Pregnancy can precipitate cardiac arrhythmias not previously present in seemingly well individuals. The risk of arrhythmias rises during labor and delivery. Factors that promote arrhythmias in pregnancy include the direct cardiac electrophysiologic effects of hormones, changes in hemodynamics or autonomic tone, hypokalemia, and underlying heart disease. Reduction of uterine blood flow during prolonged tachyarrhythmic episodes may adversely affect the fetus. The incidence of arrhythmias in pregnancy is rising due to increasing maternal age and pregnancies in women successfully treated for congenital heart disease.[26] **Just as in a nonpregnant patient, treat any hemodynamically unstable arrhythmia in pregnancy with direct-current cardioversion (50–200 J).**[27,28] Treat hemodynamically stable arrhythmias medically. The chronic use of β-blockers in pregnancy can influence fetal and newborn size, but only atenolol is singled out as being a Food and Drug Administration class D drug in this regard (some evidence for harm to the fetus). Other β-blockers are Food and Drug Administration class B (sotalol) or C. Digoxin, verapamil, diltiazem, and adenosine have their usual efficacy without adverse fetal affects.[26]

CARDIAC ARRHYTHMIA TREATMENT

Paroxysmal supraventricular tachycardia is the most common nonsinus tachycardia in women of childbearing age. The treatment of supraventricular tachycardia in pregnant women is the same as for nonpregnant women.[26] If vagal maneuvers are ineffective, give adenosine. Case reports show both efficacy and a lack of any direct adverse or teratogenic side effects to the fetus.[29] Additionally, acute treatment with β-blockers, verapamil, and diltiazem is safe in pregnancy when used in standard dosage.

The goal of management of **atrial fibrillation** in pregnancy is rate control or conversion to sinus rhythm. Use diltiazem, β-blockers, and/or digoxin, all of which are safe in pregnancy and with unchanged dosages.[29] Anticoagulation with unfractionated or low-molecular-weight heparin is safe in pregnancy and should be used if the patient meets criteria for anticoagulation described for nonpregnant patients.

Ventricular arrhythmias may occur during pregnancy, particularly in patients with congenital heart disease, cardiomyopathy, or valvular disease. **Amiodarone is categorized as class D** because its main metabolite (desethylamiodarone) and iodine cross the placenta. Chronic fetal exposure to amiodarone and its subsequent iodine overload are associated with neurotoxicity, fetal/neonatal hypothyroidism, and less frequently, goiter. Therefore, the use of amiodarone in pregnancy is limited to maternal/fetal tachyarrhythmias that are resistant to other drugs or are life threatening, because short-term use has not been linked to any harmful effects.[29]

The presence of an artificial pacemaker or implantable cardiac defibrillator does not affect the course of pregnancy.[30]

THROMBOEMBOLISM

A detailed discussion of clinical features, diagnosis, and treatment of thromboembolism in pregnancy is found in chapter 100.

The pregnancy-related changes that increase the risk of thromboembolism include physiologic alterations in coagulation and reduced venous return from the legs, with venous pooling and endothelial injury. The clinical assessment is difficult because many of the typical clinical signs and symptoms are seen in normal pregnancy, including leg edema, shortness of breath, and tachycardia. The Wells Score for deep venous thrombosis (see Table 56-4), the most validated clinical decision rule in the diagnosis of deep vein thrombosis, has not been validated in pregnant women.[31,32]

Obtain Doppler compression ultrasonography for diagnosis.[33] d-Dimer levels normally increase throughout pregnancy, and thromboembolism has been reported with normal d-dimer levels.[34,35] Imaging modalities for diagnosis are provided in Table 100-1.

Treatment is low-molecular-weight heparin (Table 100-2).[36] Do not use warfarin in pregnancy because it crosses the placenta and is

TABLE 99-2 Treatment of Hypertension in Pregnancy

Agent	For Existing Hypertension	Adjunct to Existing Treatment	Urgent Control of Acute Hypertension	Potential Adverse Effects (Maternal)
Hydralazine	N/A	50–300 milligrams daily in 2–4 divided doses; use with methyldopa or labetalol to prevent reflex tachycardia*	Loading dose of 5 milligrams IV or IM, maintenance dose thereafter of 5–10 milligrams every 20–40 min up to 300 milligrams; *or* constant infusion of 0.5–10 milligrams/h	Delayed hypotension
Hydrochlorothiazide	N/A	12.5–50 milligrams daily	N/A	Volume depletion and electrolyte disorders
Labetalol	200–2400 milligrams daily in 2–3 divided doses	N/A	Loading dose of 20 milligrams IV; maintenance dose of 20–80 milligrams up to 300 milligrams; *or* constant infusion of 1–2 milligrams/min	Headache
Nifedipine	30–120 milligrams daily as slow-release preparation	N/A	10–30 milligrams orally, repeated after 45 min if needed	Headache, interference with labor
Methyldopa	0.5–3.0 grams daily in 2–3 divided doses	N/A	N/A	Sedation, elevated liver function tests, depression

Abbreviation: N/A = not applicable.

*Risk of fetal bradycardia and neonatal thrombocytopenia.

associated with embryopathy in the first trimester; in the second and third trimesters, it may lead to CNS and ophthalmologic abnormalities. Protamine sulfate may be used safely in pregnancy for patients who require rapid reversal of heparin anticoagulation. Thrombolytics are not contraindicated and have been used successfully in multiple cases. Reported rates of maternal bleeding complications are between 1% and 6% with no maternal deaths, and rates of fetal loss are between 2% and 5%.[37-40]

ACUTE ASTHMA

Asthma is the most common medical disease in pregnancy and complicates between 3.7% and 8.4% of all pregnancies.[41] The clinical course may improve, remain unchanged, or worsen during pregnancy. Women with asthma have higher odds of pre-eclampsia, gestational diabetes, placental abruption, placenta previa, preterm delivery, low birth weight, maternal hemorrhage, pulmonary embolism, and intensive care unit admission.[42]

Symptoms of cough, wheezing, and dyspnea are the same as in nonpregnant patients. Initial assessment should include history of asthma exacerbations and intubation, peak expiratory flow rate measurements or forced expiratory volume in 1 second, physical examination, assessment of oxygen saturation, and a fetal assessment (if >20 weeks' gestation). Peak expiratory flow rate is not altered in pregnancy, with normal rates ranging between 380 and 550 L/min. Use peak expiratory flow rate as a guide to therapy. If the pregnancy has reached viability, apply continuous electronic fetal monitoring.

Treat rapidly and aggressively to reduce re-admission rates and improve fetal outcomes.[43] The principles of management are the same as in nonpregnant patients. Maintain oxygen saturation >95%, administer repetitive or continuous inhaled β_2-agonist (albuterol/salbutamol); give inhaled ipratropium and systemic corticosteroids; monitor maternal response to therapy; and monitor the fetus for signs of distress.[44] Terbutaline sulfate, 0.25 milligrams every 20 minutes, administered SC, may be used if needed. Avoid epinephrine because concerns exist about epinephrine vasoconstriction of the uteroplacental circulation.

Admission and discharge criteria are the same as in the nonasthmatic patient. For discharged women, prescribe oral prednisone, 40 to 60 milligrams per day (or equivalent), for 5 to 10 days, and a short-acting rescue β-agonist. Inhaled corticosteroids reduce recurrence during pregnancy and decrease re-admission rates following a hospitalization for asthma.[45] Anticipate maternal hyperglycemia when systemic corticosteroids are given.

CHRONIC RENAL DISEASE

Maternal risks associated with renal disease are linked to the patient's degree of renal compromise. Patients with mild renal insufficiency and no hypertension tend to have good outcomes and preserved renal function. Patients with moderate or severe renal insufficiency are more prone to further decline in renal function and pre-eclampsia and preterm delivery. Patients with lupus nephropathy are at greatly increased risk for disease exacerbation and superimposed pre-eclampsia.

Angiotensin-converting enzyme inhibitors and angiotensin II receptor blockers, which are frequently used in patients with chronic renal failure, are teratogenic and should be stopped at the first indication of pregnancy.

ASYMPTOMATIC BACTERIURIA, CYSTITIS, AND PYELONEPHRITIS

Hormonal and mechanical changes of pregnancy increase the risk of urinary stasis and subsequent urinary tract infection. After mid-pregnancy, mild right-sided hydronephrosis is found in 75% of women, and mild left-sided hydronephrosis is found in 33%.

Asymptomatic bacteriuria is diagnosed by urine culture, demonstrating the presence of bacteria in the urine in the absence of maternal symptoms of urinary tract infection. Reagent strips have limited sensitivity, and use in screening depends on resources available, but in general, a positive leukocyte esterase or urinary nitrite should be treated and a negative specimen should be cultured.[46,47] Treatment reduces the incidence of pyelonephritis and low birth weight.[48]

Causative organisms of symptomatic cystitis and pyelonephritis are similar to those in the general population and include *Escherichia coli* (75%), *Klebsiella pneumoniae*, *Proteus*, and gram-positive organisms such as group B *Streptococcus*. Obtain a urinalysis and culture with drug sensitivities in pregnant women with urinary tract symptoms and also in those with hyperemesis. Urinary tract infections need prompt treatment because acute pyelonephritis can precipitate preterm labor, bacteremia, or septic shock.

Recurrent infections can occur as a result of bacteriuria, glycosuria, and mechanical compression of the ureter in the third trimester. Reflux nephropathy increases the risk of sudden escalating hypertension and worsening renal function.[49] Urolithiasis is associated with recurrent urinary tract infections.

Treat asymptomatic bacteriuria and simple cystitis with oral nitrofurantoin, 100 milligrams PO two times per day, or an oral cephalosporin. Recommendations on the length of treatment vary from 3 to 10 days. Trimethoprim-sulfamethoxazole is not a good choice in pregnancy.

Trimethoprim, a folate antagonist, can be used **after the first trimester**; sulfonamides can be taken during the first and second trimesters **but not during the third trimester** because sulfonamides can cause kernicterus in the infant. Do not use fluoroquinolones and tetracyclines during pregnancy because of possible toxic effects on the fetus.

Pregnant women with pyelonephritis are generally hospitalized, aggressively hydrated, and treated with parenteral antibiotics. The antibiotic of choice is a second- or third-generation cephalosporin. Continue IV antibiotics until the patient is afebrile for at least 48 hours and costovertebral angle tenderness has resolved. The most common reason for treatment failure is antibiotic resistance. Patients discharged after hospitalization need to complete a 10-day course of therapy. Many providers choose to continue women with an episode of pyelonephritis on antibiotic suppression for the remainder of pregnancy. Nitrofurantoin, 50 to 100 milligrams PO once per day, is a common treatment.

SICKLE CELL DISEASE

Women with sickle cell disease, including sickle cell trait, are at increased risk for miscarriage, preterm labor, and other complications due to impaired oxygen supply and sickling infarcts in the placental circulation. Maternal complications are more common in the third trimester and postpartum period and include cerebral vein thrombosis, pneumonia, sepsis, and pyelonephritis.

Presentation and treatment of painful crises in pregnancy are similar in pregnant women and nonpregnant patients (see chapter 237, "Acquired Hemolytic Anemia"). Cornerstones of management are oxygen, aggressive hydration, PO or IV narcotics, and evaluation and treatment of the precipitating cause. Place the woman in the left lateral decubitus position, if in the third trimester. Avoid nonsteroidal anti-inflammatory drugs, particularly after 32 weeks of gestation, because these drugs cross the placenta. In early pregnancy, nonsteroidal anti-inflammatory drugs are associated with miscarriage and neonatal defects. In later pregnancy, nonsteroidal anti-inflammatory drugs are associated with risk of oligohydramnios and premature closure of the fetal ductus arteriosus. Blood transfusions are reserved for sickle cell crises when conservative measures have not improved maternal or fetal status.[50] Indications for transfusion include severe anemia with a hemoglobin level <5 milligrams/dL, preeclampsia, hypoxemia, acute chest syndrome, new-onset neurologic event, or anticipation of surgical intervention or angiographic dye load.[51]

Institute fetal monitoring and consult with an obstetrician if the fetus is potentially viable. Fetal heart rate patterns should normalize as the crisis resolves. Consult with an obstetrician for emergency delivery in the face of ongoing fetal distress.

HEADACHE AND STROKE SYNDROMES IN PREGNANCY

In pregnant women, headaches can be a symptom of a variety of neurologic or systemic disorders. **Table 99-3** lists the differential diagnosis of headaches in pregnancy (see chapter 165, "Headache").

TABLE 99-3 Causes of Headaches in Pregnancy

Life threatening
Subarachnoid hemorrhage
Intraparenchymal hemorrhage
Central venous thrombosis
Ischemic stroke
CNS tumor or infection
Pre-eclampsia/eclampsia
Non–life threatening
Tension headache
Migraine
Sinus headache
Benign intracranial hypertension (pseudotumor cerebri)

TABLE 99-4 Warning Symptoms and Signs of Headaches

New-onset headaches in pregnancy
Postpartum headaches
Need to exclude cerebral vein thrombosis
Headaches with different characteristics from previous headaches
Worst headache of life
Focal neurologic deficit
Meningismus
Fever
Altered consciousness
Papilledema or other signs of increased intracranial pressure
Retinal hemorrhages
Increased blood pressure (may herald pre-eclampsia or eclampsia)

Warning symptoms and signs of a potentially life-threatening disease are important to elicit during the initial evaluation and are listed in **Table 99-4**.

Obtain imaging studies if concerning signs or symptoms are encountered. CT scan of the brain can be safely performed with appropriate shielding of the fetus. CT scan is best to evaluate acute intracranial or subarachnoid hemorrhage, whereas MRI is superior for evaluation of cerebral infarct, tumor, infection, or cerebral vein thrombosis.

INTRACEREBRAL HEMORRHAGE

In pregnancy, the incidence of intracerebral hemorrhage ranges from 0.01% to 0.05 % but is the cause for 5% to 12% of all maternal deaths.[52] The risk of cerebral hemorrhage extends from pregnancy through the **6-week postpartum period**.[52] Risk factors include older maternal age, African American race, and alcohol or cocaine use. The most common cause for spontaneous intracerebral hemorrhage is **hypertension**. If there is no history of hypertension, then consider other causes such as neoplasm, hemorrhagic disorder, and vascular malformation.

Presenting symptoms vary with the location and extent of hemorrhage, so consider cerebral hemorrhage in a woman with an abrupt neurologic change. For diagnosis, obtain CT/MRI and consult the neurosurgeon. Treatment is blood pressure control and correction of coagulopathy.

SUBARACHNOID HEMORRHAGE

Subarachnoid hemorrhage during pregnancy is the third most common cause of nonobstetric maternal death, and more than half of cases occur **postpartum.**[52] Causes include hypertension,[53] aneurysm, vascular malformation, tumors, and venous thrombosis.

Independent risk factors for subarachnoid hemorrhage from all etiologies include advancing age; African American race; Hispanic ethnicity; hypertensive disorders; coagulopathy; tobacco, drug, or alcohol abuse; intracranial venous thrombosis; sickle cell disease; and hypercoagulability.

Suspect subarachnoid hemorrhage in a woman with severe headache, nausea, vomiting, decreased level of consciousness, or seizure. Diagnosis is by CT/MRI and/or lumbar puncture. In general, pregnant women should be treated the same as nonpregnant patients with bed rest, analgesia, sedation, neurologic monitoring, and control of blood pressure.[52]

STROKE

Pregnancy is associated with an increased risk of ischemic and hemorrhagic stroke, and stroke contributes to more than 12% of all maternal deaths, with the majority occurring in the **third trimester or puerperium**.[54] Arterial occlusion is the most common cause of pregnancy-related stroke.[54] Risk factors include hypertension, heart disease, smoking, diabetes, lupus, sickle cell disease, African American heritage, substance abuse, and cesarean delivery. Consider stroke in women with neurologic deterioration or new focal neurologic deficits.

Once hemorrhage and eclampsia are excluded, consider thrombolytic therapy after consultation with neurology and obstetrics. To date, there are no randomized controlled trials of thrombolytics for stroke in pregnancy; however, recombinant tissue plasminogen activator (risk category C) does not cross the placenta, and there is no evidence of teratogenicity in animal studies.[55] There are more than 200 reports in the literature of pregnant women who have received thrombolytic therapy for various indications including myocardial infarction, pulmonary embolism, superior vena cava syndrome, and ischemic stroke.[54] Use of thrombolytics in pregnancy is not without its risks, although the overall maternal mortality and fetal loss is relatively low at 1% and 6%, respectively.[54]

CENTRAL VENOUS THROMBOSIS

Central venous thrombosis usually presents in the second and third trimesters and may occur up to 4 weeks postpartum. Symptoms include severe headache, focal neurologic deficit, vomiting, or seizure, depending on which veins are occluded. Venous thrombosis increases venous pressure and cerebral blood volume, elevating dural sinus pressure and leading to rupture of small cortical veins.[56] Treatment is low-molecular-weight heparin, unless there is associated intracranial hemorrhage. Once the patient has been stabilized and hemorrhage from an aneurysm is excluded, the mainstay of treatment for the underlying thrombosis is still anticoagulation for the duration of the pregnancy.[56]

MIGRAINE HEADACHE

Although the ergot alkaloids are contraindicated in pregnancy, acute migraine headaches can be successfully treated in pregnancy with the same first-line antiemetics that are used in nonpregnant patients. Metoclopramide (Reglan) is class B, and prochlorperazine (Compazine), promethazine (Phenergan), and droperidol (Inapsine) are all class C. Avoid nonsteroidal anti-inflammatory drugs. Sumatriptans (class C) do not appear to increase fetal malformations, and if already prescribed by the obstetrician or primary physician during pregnancy, sumatriptans can be continued as an outpatient.[57]

GI DISORDERS IN PREGNANCY

GASTROESOPHAGEAL REFLUX DISEASE

Gastroesophageal reflux disease (GERD) is extremely common in pregnancy and is characterized by epigastric pain or burning radiating into the chest and neck, pain with recumbency, and pain exacerbated by acidic foods. Symptoms increase in the second trimester and peak in the third trimester due to loosening of the lower esophageal sphincter and delayed gastric emptying from pregnancy-related hormones. Treat mild symptoms with H_2 antagonists such as cimetidine or ranitidine. Moderate to severe symptoms can be treated with sucralfate and proton pump inhibitors. Both H_2 antagonists and proton pump inhibitors have been extensively studied for teratogenic effects, and no significant abnormal findings have been associated with their use in pregnancy.[58,59]

HEMORRHOIDS

Hemorrhoids are common during pregnancy and are caused by a combination of constipation due to slowed bowel transit from progesterone effects in the last trimester and elevated pressure in the veins below the level of the enlarged uterus. Most symptoms are mild and can be treated with prevention of constipation with increased fluids and high-fiber intake and topical medications including witch hazel compresses, suppositories, corticosteroids, or topically applied anesthetics.[60] Do not use agents containing epinephrine or phenylephrine. Proctofoam has specifically been studied and is safe.[61] Consider surgical or obstetric referral for prolapsed, bleeding, or incarcerated hemorrhoids or when conservative measures fail. There are no studies of the risks/benefits of ED excision of a thrombosed clot in pregnancy. Risks include hemorrhage and recurrence.

CHOLECYSTITIS

During pregnancy, approximately 1 in 1000 women will develop cholecystitis. Pregnancy-related hormones affect gallbladder contractility and increase residual gallbladder volume and sludge, which in turn can lead to gallstone formation. Many women ultimately require cholecystectomy during pregnancy for persistent symptoms. It is preferable to wait until the second trimester if the patient's condition allows, as surgery during the first trimester carries a risk of spontaneous miscarriage, and cholecystectomy in the third trimester is technically difficult and can result in preterm labor.[62]

APPENDICITIS

Appendicitis occurs about once in every 500 to 2000 pregnancies and is the most common extrauterine condition requiring abdominal operation in pregnancy. The diagnosis is often missed or delayed because mild abdominal discomfort, nausea, and vomiting occur frequently in normal pregnancies. Additionally, the appendix shifts in location from the right lower quadrant to the right upper quadrant during the second and third trimesters. The diagnosis is best made with US, which is 80% accurate with experienced technicians. However, if perforation has occurred, US accuracy decreases to 30%.[63,64] Adequate visualization of the appendix is more difficult later in pregnancy. If US is not available or is inadequate, obtain an MRI.[65] If CT is used to make the diagnosis, focal appendiceal CT provides less radiation to the fetus than full abdominopelvic CT. However, focal abdominal imaging may limit discovery of an alternate diagnosis. An abdomen/pelvis CT confers about 30 mGy of radiation, and 50 mGy of radiation is generally accepted to be safe in pregnancy.[66]

OVARIAN TORSION

Torsion of the ovary is a true gynecologic emergency, and up to one fifth of ovarian torsion occurs during pregnancy. Torsion can occur in any trimester, although it is most common in the first trimester.[67] Infertility treatment is a risk factor. Ovarian torsion can recur in the same pregnancy, in particular in enlarged multicystic ovaries.[68] The corpus luteal cyst and enlarged ovaries stemming from the pregnancy hormones are thought to increase the risk. Tissue necrosis can occur rapidly, so timely diagnosis is essential to preserve ovarian function and the pregnancy. The diagnosis is often missed due to the vague clinical presentation of moderate unilateral lower abdominal pain, which may also be intermittent or constant. US may show an enlarged or edematous ovary with absent or decreased blood flow. **However, the presence of ovarian blood flow does not exclude the diagnosis of torsion if symptoms are suggestive**.[69] Therefore, consult an obstetrician/gynecologist as soon as the diagnosis is clinically suspected.

SEIZURE DISORDERS

Seizure frequency can increase in pregnancy because of the increased volume of distribution and plasma clearance of antiepileptic drugs in pregnancy or because of poor medication compliance.

Most of the antiepileptic drugs can cause a range of birth defects.[70] **Valproic acid, carbamazepine, and phenytoin are all class D and are teratogenic.** Yet, discontinuing these drugs can increase morbidity and mortality for both the mother and fetus.[71] Therefore, the risks and benefits of chronic treatment should be discussed and managed by the primary physician. Medication doses may need to be increased in pregnancy. Therapeutic serum target levels remain unchanged. **Monotherapy with levetiracetam or lamotrigine (both class C) should be used whenever possible.**[72]

Acute treatment of seizures in the pregnant woman is similar to that in the nonpregnant patient (see chapter 171, "Seizures"). Even though lorazepam and diazepam are class D medications, they are so categorized based on long-term use. **Use of benzodiazepines for an acute seizure outweighs any potential risk to the fetus.**[73]

If the seizure if self-limited, administer oxygen and position the patient in the left lateral decubitus position and provide supportive care. Fetal bradycardia lasting for up to 20 minutes may follow a single brief maternal seizure. **Status epilepticus** poses a real threat to both mother and the fetus, with a significant maternal and fetal mortality. Provide aggressive management, including intubation and ventilation, early in the management of pregnant women with status epilepticus (see chapter 171).

HUMAN IMMUNODEFICIENCY VIRUS INFECTION

Pregnancy does not appear to alter the natural course of human immunodeficiency virus (HIV) disease, nor do uninfected babies born to HIV-positive women appear to be at increased risk for neonatal complications when compared with appropriate control patients.

Some women may choose to delay initiation of antiretroviral therapy until after the first trimester, when the fetus is less susceptible to the potential teratogenic effects of medications. However, all pregnant HIV-infected patients beyond 12 weeks' gestation should be on a highly active antiretroviral therapy three-drug regimen that includes zidovudine. Use of zidovudine has reduced the vertical transmission rate of HIV to <2% in the United States.[74] There are many combinations of three-drug regimens that can be used in pregnancy. However, several of the medications used in the highly active antiretroviral therapy regimen are potentially harmful when used during pregnancy. For example, the combination of didanosine and stavudine can cause a potentially fatal lactic acidosis in pregnant women. Nevirapine can cause severe hepatotoxicity.[75]

Recommended regimens as of this writing are as follows: **for a treatment-naïve HIV-infected pregnant female,** zidovudine *plus* lamivudine *plus* lopinavir/ritonavir *or* atazanavir/ritonavir; **for a treatment-naïve HIV-infected pregnant female with hepatitis B coinfection:** tenofovir *plus* lamivudine *or* emtricitabine *plus* lopinavir/ritonavir *or* atazanavir/ritonavir.[76]

Prophylaxis for opportunistic infections is similar to that for nonpregnant patients. Patients with CD4+ T-cell counts of <200/μL should be maintained on prophylaxis for *Pneumocystis jiroveci* pneumonia using trimethoprim-sulfamethoxazole. Weigh the risks and benefits of trimethoprim-sulfamethoxazole therapy during the first trimester. Folate supplementation may be added, but it is unclear whether folate supplementation lowers risk. Alternatively, aerosolized pentamidine may be used in the first trimester, as it is minimally systemically absorbed.[77]

Treatment of overt opportunistic infections in HIV-infected pregnant women is addressed in the same way as in nonpregnant women. Early intubation to reverse hypoxemia may be necessary to improve maternal-fetal outcome in women with respiratory infections.

SUBSTANCE ABUSE DURING PREGNANCY

Substance abuse in pregnancy results in approximately 225,000 infants yearly with prenatal exposure.[78] Refer pregnant women identified in the ED as substance abusers to a high-risk obstetrics clinic and offer them substance abuse counseling.

COCAINE

Cocaine use is associated with placental abruption, fetal death in utero, intrauterine growth restriction, preterm labor, premature rupture of membranes, spontaneous abortion, and cerebral infarcts in the fetus. Maternal complications of cocaine use include myocardial infarction, hypertension (which can result in aortic dissection), pulmonary edema, and cardiac dysrhythmias. Subarachnoid hemorrhage, ruptured aneurysms, and strokes are reported in cocaine users and are most likely related to transient hypertension. Treatment of the pregnant woman with acute cocaine intoxication is handled in the same manner as in the nonpregnant patient (see chapter 187, "Cocaine and Amphetamines").

OPIOIDS

Although acute opioid withdrawal poses minimal maternal risk, there is significant risk to the fetus, including meconium, hypoxia, preterm labor, and fetal demise.[79] Illicit opioid use can cause intermittent fetal withdrawal when there is maternal lack of access to the drug.

Therefore, it is standard to refer opioid-addicted pregnant patients for supervised methadone or buprenorphine therapy for the duration of the pregnancy. Even though methadone/buprenorphine will cause neonatal abstinence syndrome (opioid withdrawal) after birth, this is a treatable condition and carries less harm to the infant than acute opioid withdrawal in utero. Maternal detoxification from opioids should be done in a supervised inpatient setting, and only for select patients, as the relapse rate is very high.[79]

Maternal mild opioid withdrawal can be treated with clonidine 0.1 to 0.2 milligrams every hour until the signs of withdrawal resolve. Severe maternal opioid withdrawal may require administration of an opioid agonist and admission for fetal monitoring and induction of methadone therapy.[79,80]

ALCOHOL

Alcohol consumption during pregnancy is a risk factor for fetal alcohol syndrome, birth defects, and low birth weight. Binge drinking is particularly harmful to fetal neurodevelopment.

In the United States, the prevalence of fetal alcohol syndrome is estimated at 0.5 to 2.0 cases per 1000 births, but other fetal alcohol spectrum disorders are believed to occur approximately three times as often as fetal alcohol syndrome.[81]

Pregnant women who present in coma due to acute alcohol intoxication or in alcohol withdrawal are managed in the same way as nonpregnant patients. **Disulfiram (Antabuse) is a potential teratogen. Do not prescribe in pregnancy.**

INTIMATE PARTNER VIOLENCE

Between 4% and 20% of pregnant women are victims of intimate partner violence.[82] Factors associated with intimate partner violence during pregnancy are late entry into prenatal care, unintended pregnancy, drug and alcohol use, depression, and housing problems. Violence increases the risk for preterm labor, placental abruption, fetal fractures, uterine rupture, chorioamnionitis, delivering a low-birth-weight infant, and homicide. The American College of Obstetricians and Gynecologists recommends routine screening for intimate partner violence during pregnancy.[83]

Pregnant women with injuries should be treated according to usual trauma protocols. Institute fetal monitoring for direct or indirect blunt abdominal trauma and major multiple trauma. Administer Rh immunoglobulin to Rh-negative women with blunt abdominal trauma (see chapter 25, "Resuscitation in Pregnancy").

MEDICATIONS IN PREGNANCY AND LACTATION

The classic teratogenic period is 2 to 15 weeks of gestation. During this critical time, organs are forming, and teratogens may cause malformation. Administration of drugs early in the period of organogenesis affects the organs developing at that specific time, such as the heart or neural tube. Teratogens given closer to the end of the classic teratogenic period will affect the ear and palate. Before week 2, exposure to a teratogen produces an all-or-none effect (i.e., the conceptus either does not survive or survives without anomalies). If the organism remains viable after exposure before week 2, organ-specific anomalies do not develop because repair or replacement permits normal development. A similar insult at a later stage of development may produce organ-specific defects.

The U.S. Food and Drug Administration lists five categories of labeling for drug use in pregnancy (**Table 99-5**).

Some therapeutic agents that should not be used during pregnancy are listed in **Table 99-6**. The National Library of Medicine provides a detailed reference list in the Developmental and Reproductive Toxicology Database (see Useful Web Resources below).

Table 99-7 lists some general cautions for using drugs during lactation. When prescribing, check each drug individually. Because information can change, we recommend referring to the following sources for information about drug safety in lactation:

- Drugs and Lactation Database (LactMed), U.S. National Library of Medicine—http://toxnet.nlm.nih.gov/cgi-bin/sis/htmlgen?LACT (accessed December 31, 2013)
- World Health Organization, Breastfeeding and Maternal Medication (last updated 2003)—http://whqlibdoc.who.int/hq/2002/55732.pdf (accessed December 31, 2013)
- Hale Tomas, Medications and Mothers' Milk, ISBN-13 (978-0984774630), Hale Publishing, May, 2012, 15th ed.

TABLE 99-5 U.S. Food and Drug Administration Categorization of Drug Risk in Pregnancy

Drug Category	Risk during Pregnancy
A	Controlled studies show no fetal risk in any trimester, and so the possibility of fetal harm is remote.
B	Animal studies show no fetal risk, but there are no controlled human studies. Or Animal studies have shown an adverse effect that was not confirmed in controlled human studies in women in the first trimester (and there is no evidence of risk in later trimesters).
C	Animal studies have shown adverse fetal effects (teratogenic or embryocidal), and there are no controlled studies in humans. Or No human or animal studies are available. Drugs should only be used if the potential benefit justifies the potential fetal risk.
D	Evidence of human fetal risk exists, but the benefits of use in pregnant women may be acceptable despite the risk.
X	Studies in animals or humans have shown fetal risk, or there is evidence of fetal risk based on human experience. The risk of use in pregnancy clearly outweighs any possible benefit. Drugs are contraindicated for use in women who are or may become pregnant.

FETAL RADIATION EFFECTS

For radiation imaging during pregnancy, weigh the risks of exposure and subsequent fetal adverse effects against the risk of incorrect maternal diagnosis. The major factor determining the degree of risk to the fetus is the quantity of ionizing radiation exposure during imaging. **Fetal exposure to low-dose radiation, defined as <5 rads (<50 mGy), does not increase the risk of fetal or infant death, mental defects, or growth retardation.** More than 5 rads (>50 mGy) is considered the threshold for human teratogenesis.[66] The fetus is most vulnerable to teratogenicity between 3 and 15 weeks of gestation at doses >10 rads (>100 mGy) (**Table 99-8**). The risk and incidence of carcinogenesis are not known.[66]

The estimated radiation doses involved in procedures commonly used for ED diagnosis are listed in **Table 99-9**.[66,84-86]

TABLE 99-6 Drugs Used in Emergency Settings with Known Adverse Effects in Human Pregnancy

Drug	Effect
Angiotensin-converting enzyme inhibitors and angiotensin receptor blockers	Renal failure, oligohydramnios
Aminoglycosides	Ototoxicity (gentamicin class D, Black Box Warning)
Androgenic steroids	Masculinize female fetus
Anticonvulsants (carbamazepine, hydantoins, valproate)	Dysmorphic syndrome, anomalies, neural tube defects
Antithyroid agents	Fetal goiter
Aspirin (high doses)	Bleeding, antepartum and postpartum
Cytotoxic agents (e.g., methotrexate)	Multiple anomalies
Erythromycin estolate	Maternal hepatotoxicity
Fluoroquinolones	Fetal cartilage abnormality
Isotretinoin	Hydrocephalus, deafness, anomalies
Lithium	Congenital heart disease (Ebstein's anomaly)
Nonsteroidal anti-inflammatory drugs (prolonged use after 32 wk)	Oligohydramnios, constriction of fetal ductus arteriosus
Streptomycin	Fetal cranial nerve VIII damage
Sulfonamides	Fetal hemolysis, neonatal kernicterus (near term)
Tetracyclines	Fetal teeth and bone abnormalities
Trimethoprim, methotrexate	Folate antagonist (first trimester)
Thalidomide	Phocomelia
Warfarin	Embryopathy—nasal hypoplasia, optic atrophy

TABLE 99-7 World Health Organization General Cautions for Drugs and Breastfeeding

Guideline	Drugs
Breastfeeding contraindicated	Anticancer drugs, radioactive substances, nitrofurantoin (for <1 mo old, and for those with glucose-6-phosphate dehydrogenase deficiency)
Avoid unless absolutely necessary	Chloramphenicol, tetracyclines, metronidazole, fluoroquinolones
Monitor infant for drowsiness	Selected psychiatric and anticonvulsant agents
Monitor infant for jaundice	Sulfonamides, dapsone, sulfadoxine/pyrimethamine (Fansidar), mefloquine
May inhibit lactation; use alternative drug	Estrogens, thiazides

TABLE 99-8 Teratogenic Radiation Effects

Gestational Age	Effect of 5–10 rads (50–100 mGy)	Effect of >10 rads (>100 mGy)
0–2 wk	Probably none	Possible spontaneous abortion
3–8 wk	Unknown; probably none detectable	Possible malformations with increasing dose
9–15 wk	Unknown; probably none detectable	Possible mental development defects with increasing dose
≥16 wk	None	None detectable or none

TABLE 99-9 Radiation Exposure to the Uterus/Fetus

Procedure	Dosage in mGy
Threshold for human teratogenesis	100
Accepted as safe in pregnancy	**50**
Abdominal/pelvis CT	25–35
CT, kidney-ureter-bladder protocol (reduced radiation dose)	10
Lumbosacral spine series (three view)	1.6–3.5
Ventilation–perfusion scan (total)	2.1
Abdominal series (two view)	2
Lung **perfusion** scan with technetium	1.7
Normal background radiation over 9 months	**1**
Head CT	<0.5
Lung **ventilation** scan with xenon	0.4
Anteroposterior pelvis x-ray	0.4
Chest CT (10-mm slices, 10 slices), for standard or pulmonary embolism protocol	0.2
Cerebral angiography	0.1
Mammography—diagnostic for suspected breast cancers	0.07–0.2
Chest radiography (two view) with shielding of the maternal abdomen	<0.001
Cervical spine (two view)	<0.001

Note: 1 rad = 10 mGy = 10 mSv.

REFERENCES

The complete reference list is available online at www.TintinalliEM.com.

CHAPTER 100

Maternal Emergencies After 20 Weeks of Pregnancy and in the Postpartum Period

Janet Simmons Young

INTRODUCTION

This chapter examines the diagnosis and treatment of the most important maternal emergencies occurring after 20 weeks of pregnancy and during the postpartum period. The second half of pregnancy is often characterized as ≥20 weeks of gestation for simplicity, but until 24 weeks, the chances of fetal survival are less than 50%. The postpartum period is generally accepted as the 6 weeks after delivery. Vast physiologic shifts in maternal cardiovascular tone occur as pregnancy progresses, highlighting the need for maternal blood pressure recordings and fetal heart tones during any ED visit. Conditions discussed are thromboembolic disease; chest pain; disorders associated with elevated blood pressure (hypertension, preeclampsia and HELLP syndrome [hemolysis, elevated liver enzymes, and low platelet count], and eclampsia); vaginal bleeding in the second half of pregnancy; premature rupture of membranes; postpartum hemorrhage; amniotic fluid embolus; peripartum cardiomyopathy; and endometritis.

THROMBOEMBOLIC DISEASE OF PREGNANCY

Venous thromboembolism includes deep venous thrombosis (DVT) and pulmonary embolism (PE) and is the leading cause of maternal morbidity and mortality in industrialized nations. Compared with nonpregnant women, the risk of venous thromboembolism increases fivefold during pregnancy and is increased by 60-fold in the first 3 months after delivery.[1,2]

PATHOPHYSIOLOGY

Pregnancy-related hypercoagulability is due to increased levels of clotting factors, increased platelet and fibrin activation, and decreased fibrinolytic activity, all of which are adaptations to prevent maternal hemorrhage. Physiologic changes include venous stasis, decreased venous outflow, and uterine compression of the inferior vena cava and iliac veins (particularly the left common iliac and left leg veins). Clots tend to develop in the deep venous system of the legs and pelvis, which includes the internal iliac, femoral, greater saphenous, and popliteal veins. Up to 24% of DVTs are complicated by PE, so early DVT diagnosis is important.[1-6]

RISK FACTORS AND CLINICAL FEATURES

Physiologic signs and symptoms of thromboembolic disease, such as tachycardia, tachypnea, lower extremity edema, and dyspnea are nonspecific and also occur during normal pregnancy. Predictive scoring criteria, such as Wells criteria, have not been validated in pregnant women, but left leg symptoms, calf circumference difference ≥2 cm, and leg symptoms in the first trimester are associated with DVT. Iliac vein thrombosis often presents with unilateral swelling of the entire leg and groin or back pain.

A personal or family history of thrombosis is an important risk factor. Other major risk factors include thrombophilias (not identifiable at the first presentation), obesity, maternal age >35, smoking, sickle cell disease, diabetes, hypertension, immobility, in vitro fertilization (greater risk for twins than for singleton), and preeclampsia. Cesarean delivery and postpartum complications further increase the risk.[1,4,5]

DIAGNOSIS OF DEEP VENOUS THROMBOSIS

Compression or duplex US is the test of choice, with a reported sensitivity and specificity for detecting proximal DVT in nonpregnant patients of 89% to 96% and 94% to 99%, respectively.[7] Compression US is less accurate for isolated calf and iliac vein thrombosis. MRI, either with or without contrast venography, is highly sensitive and specific for the diagnosis of pelvic and iliac vein thrombosis. MRI without contrast is preferred with the addition of contrast only if absolutely needed.[8,9] Impedance plethysmography and CT scan of the pelvis are alternatives to diagnose iliac vein thrombosis if MRI is not available. Impedance plethysmography is not widely available and requires operator expertise. CT exposes the fetus to radiation, and iodinated contrast media may affect fetal thyroid tissue.[1] If imaging resources are limited, venography with pelvic shielding is another option.[10]

d-dimers are not useful to include or exclude DVT or PE because levels progressively increase throughout pregnancy, and venous thromboembolism has been reported with negative d-dimers.[11] See chapter 56, Venous Thromboembolism, for a detailed discussion of d-dimers.

DIAGNOSIS OF PULMONARY EMBOLISM

Pregnant women with symptoms suggestive of PE and compression US results positive for DVT should receive anticoagulation without waiting for further confirmatory diagnostic studies.

Women with normal findings on US with suspicion of PE require further diagnostic imaging. The major options for definitive imaging are chest CT–pulmonary angiography and pulmonary perfusion scanning. **As of this writing, the fetal and maternal radiation dose with either modality is felt to be within acceptable limits.**[1,12] Typically, in most institutions, a consensus is obtained between emergency physicians, obstetricians, and radiologists in deciding the imaging steps. **Table 100-1** lists advantages and disadvantages of different imaging modalities.

TABLE 100-1 Imaging Modalities for Diagnosis of Pulmonary Embolism in Pregnancy

	Radiation	Limitations	Disadvantages	Advantages	Lactation
Chest Radiograph	Minimal	Nonspecific and nonsensitive	Results determine next imaging study, requiring more time to diagnosis	May identify another cause of pulmonary symptoms	No change
CT-PA	High maternal breast radiation; lower fetal radiation than V/Q scan	Contrast allergy and renal insufficiency	Hyperdynamic state in pregnancy can affect interpretation	High sensitivity and specificity; needed if abnormal chest radiograph	No need to discard breast milk
V/Q scan	Low breast radiation but higher fetal radiation than CT-PA	Not useful if abnormal chest radiograph, asthma, COPD, underlying pulmonary disease	If negative or inconclusive and suspicion for PE remains, will need a CT-PA; limited availability and time for isotope preparation, which delays diagnosis	Negative perfusion study effectively rules out PE	Discard breast milk for 12 h
MRI/MRV	No radiation	Gadolinium safety for fetus is unknown; do not use in maternal renal insufficiency	Limited availability	Can detect pelvic and iliac thrombosis	No need to discard breast milk

Abbreviations: COPD = chronic obstructive pulmonary disease; CT-PA = chest CT–pulmonary angiography; V/Q scan = ventilation-perfusion scan; MRV = magnetic resonance venography.