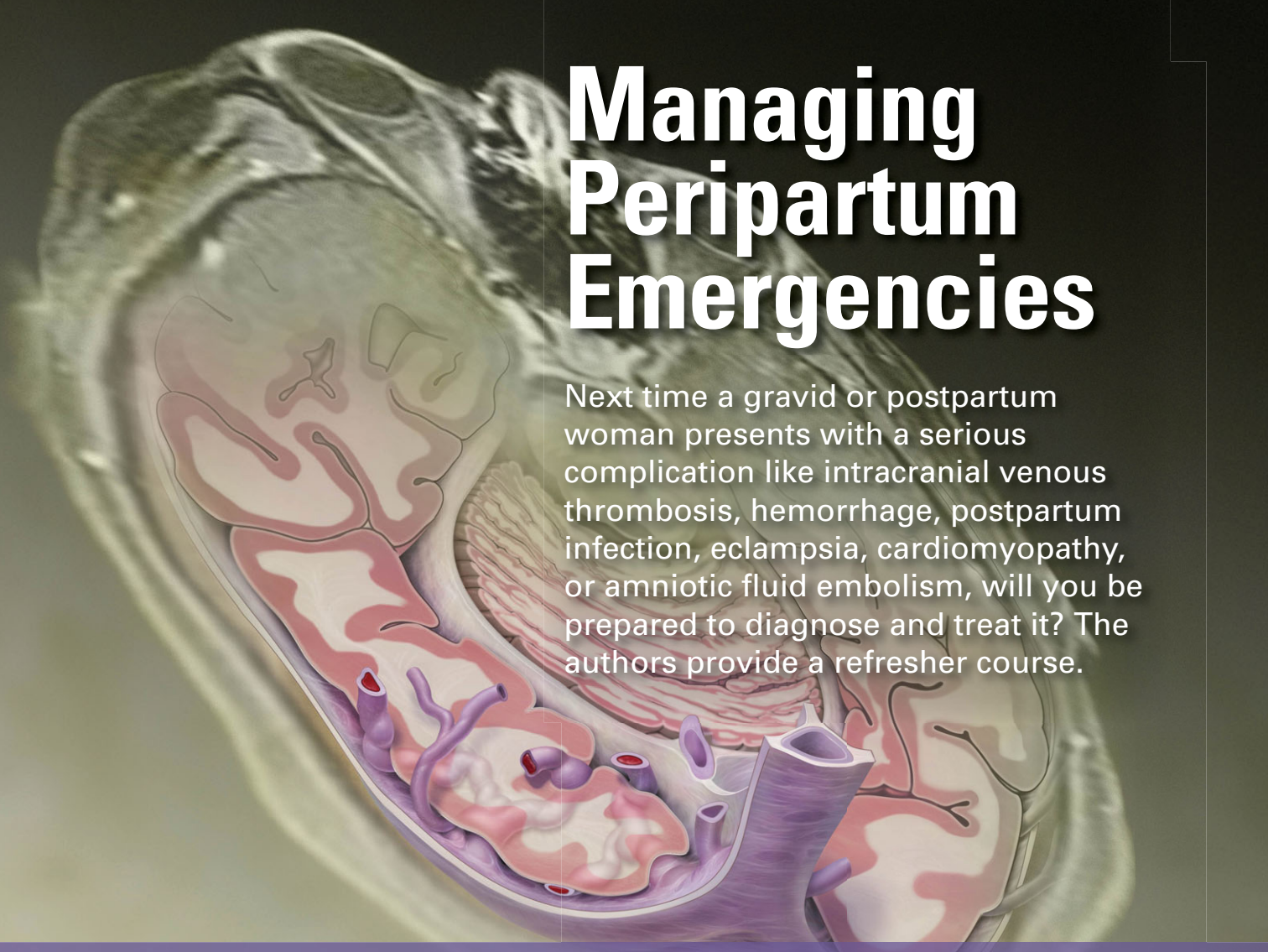

Managing Peripartum Emergencies

Next time a gravid or postpartum woman presents with a serious complication like intracranial venous thrombosis, hemorrhage, postpartum infection, eclampsia, cardiomyopathy, or amniotic fluid embolism, will you be prepared to diagnose and treat it? The authors provide a refresher course.

By Kirsten Pennell, MD, and Charles S. Graffeo, MD, FACEP

Peripartum emergencies vary widely in presentation and etiology. Many of the same disorders seen during pregnancy and delivery may occur in the postpartum period—in less recognizable form. Postpartum hemorrhage and postpartum infection are the most common complications encountered. Others include peripartum cardiomyopathy, thromboembolic disease, amniotic fluid embolism, preeclampsia, eclampsia, and HELLP syndrome. This article will highlight the key clinical considerations for recognizing and managing these often serious complications of pregnancy.

THROMBOEMBOLIC DISEASE

Thromboembolism during pregnancy and the postpartum period is one of the most common causes of maternal morbidity and mortality. Pregnancy raises the risk of thromboembolism by a factor of 5.[1] Pregnancy-associated physiologic changes, such as increased venous stasis and an increase in venous distensibility and capacity, predispose toward the development of thrombosis. As a result of compression by the gravid uterus, the lower venous systems of the legs are at highest risk for developing thrombosis (more so in the left leg, for unknown reasons). Additional risk factors include bed rest, multiparity, obesity, previous cesarean delivery, advanced maternal age, hemorrhage, and sepsis.[1,2]

Diagnosis of thromboembolic events requires a high index of suspicion along with a careful history and physical examination. Doppler venous ultrasound is the study of choice to diagnose lower leg and thigh deep vein thrombosis.

Magnetic resonance imaging and CT are useful diagnostic tools that are indicated when pelvic vein involvement such as iliac vein thrombosis is

Dr. Pennell is a resident and **Dr. Graffeo** is a professor of emergency medicine in the department of emergency medicine at Eastern Virginia Medical School in Norfolk, Virginia.

Illustration: Venous anatomy and thrombosis superimposed over an MRI.

suspected. Although dyspnea is a common concern during later stages of pregnancy, pulmonary embolism—which has the highest mortality of any peripartum complication[1]—should always be considered high in the differential diagnosis when concerns of chest pain, shortness of breath, or syncope occur at any time in the peripartum period. Computed tomography angiography is the study of choice and can be safely performed during pregnancy; the amount of fetal radiation exposure is considered to be within acceptable limits, considering that it is less than a ventilation-perfusion scan would deliver. This combined with ambiguities associated with the interpretation of V/Q scans has made CT-A the study of choice in most acute care settings.[1,2]

Treatment of deep vein thrombosis and pulmonary embolism is the same as for a nonpregnant patient. Heparin is the anticoagulant of choice. Warfarin is not recommended during pregnancy but is safe in the immediate postpartum period. Inferior vena cava filters are also used with no harmful effects on the fetus and have no long-term effect on maternal mortality. However, the long-term safety of inferior vena cava filters has not been determined. In addition, there have been reports of excessive recurrence of deep vein thrombosis and thrombosis at the filter site, although the cause of those problems is not yet known.

Thrombolytics can also be employed in treatment of pulmonary embolism, although they are reserved for premorbid cases of massive pulmonary embolism due to the presumed risk of hemorrhage and fetal loss.[3]

A rare thromboembolic event that is often catastrophic when it develops during the peripartum period (most often postpartum) is intracranial venous thrombosis. The clinical presentation may be relatively vague and nonspecific, with a wide range of symptoms and signs, but positional head pain mimicking a postepidural headache is a common symptom. This diagnosis can be missed if the physician fails to maintain a high level of suspicion in postpartum patients with concerns of headache. A poor outcome is likely if the condition goes unrecognized long enough to progress to focal neurologic symptoms, coma, and seizure. Secondary hemorrhagic infarct is discovered in about half of these cases. Magnetic resonance imaging or angiography is considered the gold-standard diagnostic test for intracranial venous thrombosis, which CT may miss in as many as two out of three instances. Management is primarily supportive, with thrombectomy and thrombolysis reserved for severe cases.[4]

POSTPARTUM HEMORRHAGE

Postpartum hemorrhage is one of the most common causes of maternal mortality. Typically, it occurs within the first 24 hours after delivery but can present days to weeks later. The early presentation is most commonly due to atony of a fatigued, overdistended, or obstructed uterus. Other etiologies include uterine inversion, uterine rupture, genital tract lacerations, placenta accreta, retained placental products, and coagulopathies.[5] Susceptibility to hemorrhage is increased in Asian and Hispanic patients and in those with a history of preeclampsia or previous postpartum hemorrhage. The most common coagulopathy is von Willebrand disease. The most common etiology of late postpartum hemorrhage is retained placental products.[5]

Management of postpartum hemorrhage should focus on stabilizing the patient and determining the etiology of the bleeding for appropriate treatment. A thorough history and physical examination should help elucidate the source, and an early consultation with an obstetrician is recommended. Laboratory studies should include a complete blood count, coagulation studies, and blood typing and crossmatching. A speculum examination should be performed to identify and repair any lacerations, but if this proves unsuccessful, the patient will require surgery. Vaginal packing can provide temporary hemostasis in the meantime.

A contracted, hard uterus should prompt a search for lacerations, retained parts (check the placenta for integrity), or both. In the case of retained products, blood may be seen coming from the cervical os and a malodorous discharge may be noted.[5] Uterine inversion or manual extraction of placenta should prompt the initiation of antibiotic prophylaxis. Emergent laparotomy will be necessary if the uterus is ruptured.

>>FAST TRACK<<

Susceptibility to hemorrhage is increased in Asian and Hispanic patients.

In the setting of uterine atony, the bimanual exam will reveal an enlarged, doughy uterus. Initially, this should be managed by uterine massage and, if needed, intravenous oxytocin or intramus-

cular methylergonovine. Failure of these measures requires urgent obstetric consultation and is likely to lead to surgical intervention.

Pelvic ultrasound is considered the most appropriate diagnostic tool in the hemodynamically stable patient with postpartum hemorrhage.

POSTPARTUM INFECTION

Infection, most commonly primary endometritis, continues to be one of the most prevalent postpartum emergencies, along with hemorrhage. Cesarean delivery increases the risk of endometritis by 13% to 90%, depending on the use of perioperative prophylactic antibiotics and concomitant risk factors such as prolonged rupture of membranes, extended labor, and multiple gestations. Pathogens are those that normally colonize the genital tract and bowel, including *Chlamydia trachomatis*, *Gardnerella vaginalis*, and group B streptococci. These infections are most often polymicrobial in nature.[6] Other possible infectious complications are postsurgical wound infections, perineal cellulitis, mastitis, respiratory complications of anesthesia, retained products, urinary tract infections, and septic phlebitis.

The clinical presentation of endometritis varies with the severity and location of the infection. Generally, the patient will be febrile with a temperature greater than 100.4°F. Some patients appear quite toxic. Abdominal tenderness and foul-smelling discharge are common, and rigors may be present in the setting of bacteremia. Group A beta-hemolytic streptococci are associated with scanty, odorless lochia. Uterine and adnexal tenderness are typically noted during the bimanual exam. Complications such as abscess, peritonitis, septic pelvic thrombophlebitis, and necrotizing fasciitis may delay the diagnosis.[6]

>>FAST TRACK<<

Preeclampsia complicates approximately 5% to 10% of pregnancies in the United States.

Septic pelvic thrombophlebitis should be high on the differential diagnosis if fever persists despite appropriate antibiotic therapy. Its etiology is not well understood, but is thought to result from vascular injury due to the spread of uterine infection or bacteremia. Clinical presentation is nonspecific with malaise, lower abdominal pain, and flank pain; tachycardia out of proportion to fever is classic. A rare, pathognomonic finding for septic pelvic thrombophlebitis is an abdominal mass that has been described as rope-like and tender to palpation. Pulmonary emboli have frequently been found in association with septic pelvic thrombophlebitis and should be considered. The diagnosis is confirmed by MRI or CT, which have been shown to be comparable in efficacy for this purpose.[7]

Treatment of postpartum infection primarily includes the use of broad-spectrum antibiotic therapy and drainage of any abscesses. Most patients will require hospital admission for these measures. Patients who undergo cesarean deliveries are given prophylactic antibiotics that have markedly decreased the incidence of postpartum endometritis.[6]

PREECLAMPSIA, ECLAMPSIA, AND HELLP SYNDROME

Preeclampsia, a multisystem disorder characterized by hypertension and proteinuria in the second half of pregnancy, is a major cause of maternal and fetal morbidity and mortality and the leading cause of premature delivery worldwide. It complicates approximately 5% to 10% of pregnancies in the United States. Fetal risks include intrauterine growth restriction, intrauterine hypoxia, premature birth and its complications, and death. Risks to the mother include cerebrovascular accident, seizures, renal failure, pulmonary edema, neurologic impairment, and death.[8]

The pathophysiology of preeclampsia has not been completely elucidated. It is thought that the trophoblast does not adequately invade the endometrium of the uterus, leading to placental insufficiency. Endothelial dysfunction, generalized inflammation, and immune system abnormalities also seem to be involved.[8] Inadequate antioxidant defense mechanisms may play a pathogenic role. What is clear is that by one pathway or another, a combination of vasospasm with endothelial dysfunction develops and causes elevated systemic vascular resistance.

There are no specific serum markers for preeclampsia and, therefore, no useful screening tests. Vigilant monitoring for elevated blood pressure and proteinuria is the approach used by obstetricians. African American patients are at increased risk; other risk factors for preeclampsia include nulliparity, extremes of age (under 20 or over 35 years), previous preeclampsia, chronic hypertension, diabetes, and obesity. Currently, it is a clinical diagnosis

based on elevated blood pressure and proteinuria, with or without excessive edema. Parameters for preeclampsia are blood pressure elevation (from baseline) of 30 mm Hg systolic and 15 mm Hg diastolic on two separate occasions and proteinuria of greater than 300 mg in a 24-hour urine collection. Generally, symptoms occur after 20 weeks' gestation and can present as late as 6 weeks postpartum, making a missed diagnosis of preeclampsia one of the pitfalls in evaluation of the postpartum patient presenting with hypertension or new-onset seizure.[9] The full range of possible signs, symptoms, and findings is listed in the Table.

Complications of preeclampsia include HELLP syndrome, spontaneous splenic and hepatic hemorrhage, placental abruption, and eclampsia. In HELLP (hemolysis, elevated liver enzymes, low platelets) syndrome, microangiopathic hemolytic anemia will be noted in the setting of normal findings for prothrombin time, partial thromboplastin time, and fibrinogen level.

Eclampsia is a catastrophic complication characterized by seizures or coma superimposed upon the multisystem syndrome of preeclampsia. Eclampsia, like preeclampsia, should remain in the differential diagnosis for new-onset seizures for 4 to 6 weeks postpartum.[9]

Patients with mild to moderate preeclampsia may be asymptomatic. Those with severe preeclampsia usually present with concerns related to end-organ damage, such as headache, visual disturbances, abdominal pain, dyspnea, altered mental status, or a sudden increase in edema (especially of the face and hands). Physical examination findings include elevated blood pressure, pulmonary edema, altered mental status, and epigastric or right upper quadrant tenderness. Additional concerns may include blurred vision, scotomata, and in severe cases, cortical or retinal blindness.[10]

Laboratory tests and imaging are not specific but may support the diagnosis and provide baseline values for comparison. The complete blood count may show microangiopathic hemolytic anemia or thrombocytopenia in HELLP syndrome. Results of liver function tests may be elevated in both preeclampsia and HELLP syndrome. Elevated creatinine values may be seen secondary to renal damage from increased systemic vascular resistance. Uric acid levels have been found to be increased in preeclampsia and are thought to roughly indicate disease progression. Electrolyte levels should be evaluated, especially in the setting of seizures. Head CT should be performed to rule out hemorrhage, cerebral venous thrombosis, or other intracranial pathology.[8,10]

Management varies based upon the clinical presentation. In mild preeclampsia, close follow-up should be arranged and baseline laboratory values provided. Patients with signs and symptoms of severe preeclampsia should be hospitalized for blood

TABLE. Range of Preeclampsia Symptoms, Signs, and Findings

- headache
- dyspnea
- altered mental status
- elevated blood pressure
- pulmonary edema
- severe, suddenly increased facial and hand edema
- abdominal pain or tenderness (epigastric, right upper quadrant, or both)
- visual disturbances
  - blurred vision
  - scotomata
  - acuity deficits
  - retinal hemorrhage
  - cortical blindness
  - retinal blindness
- hyperreflexia
- focal neurologic deficits
- lethargy
- cognitive dysfunction
- thrombocytopenia
- microangiopathic anemia
- creatinine elevation
- uric acid elevation
- proteinuria
- liver function test elevation
- electrolyte elevations or decreases

pressure control, prevention of seizures, and fetal monitoring. Blood pressure control, however, has not been shown to improve fetal morbidity and mortality; the definitive treatment of preeclampsia is delivery of the fetus, near full-term if possible. Medical management includes the use of antihypertensives such as hydralazine and labetalol. Seizures in eclampsia are treated with magnesium sulfate. Patients should be monitored closely for signs of hypermagnesemia, such as hyporeflexia and respiratory depression. Calcium gluconate has been shown to reverse the adverse effects of hypermagnesemia. Use of diuretics should be avoided in preeclampsia and eclampsia because the patient's intravascular volume is already contracted.[10]

PERIPARTUM CARDIOMYOPATHY

Peripartum cardiomyopathy is a dilated cardiomyopathy with a high mortality rate. It is rare, so other causes of pulmonary edema and systolic dysfunction should be ruled out. Peripartum cardiomyopathy is defined by the development of cardiac failure in the last month of pregnancy or within 5 months after delivery. In addition, there must be no identifiable cause of cardiac failure or history of heart disease before the last month of pregnancy, and echocardiographic findings should be consistent with left ventricular systolic dysfunction.[11]

The prevalence of peripartum cardiomyopathy in the United States is reported to be 1 in 1500 to 15,000 live births.[12] It appears to have a higher incidence in African American women, but occurs in all races. Mortality, usually resulting from cardiac arrhythmias, congestive heart failure, or embolic events, ranges from 9% to 56%. Risk factors include twin gestations, preeclampsia, multiparity, and use of tocolytic agents.[11]

>>FAST TRACK<<

Peripartum cardiomyopathy is rare, so other causes of pulmonary edema and systolic dysfunction should be ruled out.

There are several hypotheses about possible causes of peripartum cardiomyopathy. Some studies have suggested a connection to myocarditis, since myocardial abnormalities have been found on biopsy in as many as 62% of subjects with peripartum cardiomyopathy and are associated with a poorer prognosis. Autopsy findings have included a pale myocardium with a dilated heart, endocardial thickening, myocardial fibrosis, and lymphocytic infiltration.[13] Animal studies have suggested a connection between cardiomyopathy and viral infections with coxsackie and echoviruses. An autoimmune etiology has also been suggested by findings of autoantibodies to select cardiac tissue proteins that are specific to peripartum cardiomyopathy.[12] Nutritional abnormalities, such as those resulting from the traditional ingestion of *kanwa* (a natural sodium carbonate compound) by patients of Nigerian origin, have also been cited as a possible etiology.[14] Tocolytic agents such as terbutaline have also been associated with peripartum cardiomyopathy, but it is uncertain whether they are etiologic or simply agents that unmask preexisting cardiac conditions.

The clinical presentation of peripartum cardiomyopathy may be vague and similar to that of early heart failure or pregnancy, with symptoms such as fatigue, pedal edema, dyspnea, and dizziness.[13] It can also present as fulminant congestive heart failure with associated hypoxia. Urgent chest radiography, echocardiography, and cardiology consult are all indicated. In addition, a complete blood count and electrolyte, cardiac enzyme, B-type natriuretic peptide, and thyroid-stimulating hormone measurement, as well as liver function tests, urinalysis, and urine drug screen, will help to evaluate for other causes of systolic dysfunction.[12]

Management, like that of heart failure, involves inotropic agents as well as preload and afterload reduction. Most often, digoxin, loop diuretics, hydralazine, and nitrates are utilized. Angiotensin-converting enzyme inhibitors and angiotensin receptor blockers should be avoided if the patient is still pregnant, but these agents can be used safely in the postpartum period. Anticoagulation with heparin should be considered due to the high association of thromboembolic disease with peripartum cardiomyopathy.[15]

AMNIOTIC FLUID EMBOLISM

Amniotic fluid embolism is a rare, devastating event that typically occurs during labor and delivery or immediately thereafter, though there have been reports of cases developing during pregnancy and the postpartum period. The syndrome has significant maternal and neonatal morbidity and mortality. It was first described by Steiner and Lushbaugh in 1941 as a syndrome with a wide range of dysfunction; these

authors reported autopsy findings of fetal cellular elements in the maternal pulmonary vasculature of women who died suddenly during the third trimester or in labor.[16] Results of further studies led researchers to hypothesize that this fetal cellular material causes a type of anaphylactic allergic reaction.[16,17] However, circulating fetal material is not always present in patients with this disorder, and conversely, material of fetal origin is often found in women who do not develop it.

There are many inconsistencies in the epidemiology of amniotic fluid embolism, likely due to difficulty in identification and diagnosis of this syndrome. Since there are no specific or sensitive diagnostic tests, it remains a diagnosis of exclusion. Studies report an incidence of approximately 1 in 8000 to 83,000 births, with mortality ranging from 60% to 86% and half of all deaths occurring within an hour of initial presentation.[17] Approximately 10% of all maternal deaths are attributed to amniotic fluid embolism, with as many as 85% of the survivors having permanent neurologic deficits. Neonatal peripartum survival rates have been reported as 79%, but 50% of those survivors experience neurologic impairment.[16,17]

Clinical presentation varies widely. Classically, amniotic fluid embolism presents with abrupt, rapid, and profound cardiovascular collapse often followed by hemorrhage secondary to disseminated intravascular coagulation (DIC). Often, initial presentation includes respiratory distress and hypoxia. Seizures may also be the first presenting symptom, with constitutional symptoms such as fever, chills, nausea, and vomiting being less common.[18]

The pathophysiology of this complex syndrome has not been fully elucidated. Clark proposed a model in which there is an initial transient episode of pulmonary hypertension secondary to pulmonary vasospasm that results in right ventricular heart failure and hypoxia followed by left ventricular heart

failure.[18] It is uncertain whether the left ventricular heart failure is due to myocardial ischemia secondary to the hypoxia or to a direct blunting of myocardial function caused by a factor in the amniotic fluid.

Disseminated intravascular coagulation is reported in approximately 83% of patients with amniotic fluid embolism.[19] Half develop it within 4 hours of initial presentation. Whether it appears early or late, catastrophic hemorrhage results. The exact mechanisms and etiology of DIC in amniotic fluid embolism are not fully understood. The condition is thought to result primarily from a consumptive coagulopathy, but there is evidence of the possibility of massive fibrinolysis as well.[19]

Although amniotic fluid embolism is diagnosed clinically, results of certain tests support the diagnosis. An arterial blood gas analysis will assess the degree of hypoxemia. Cardiac enzyme measurement may reveal elevations secondary to myocardial ischemia and left ventricular failure. Echocardiography may indicate pulmonary hypertension, right ventricular dilatation, or left ventricular failure. Hematocrit and platelet levels may decrease. Prolonged partial thromboplastin time and decreased fibrinogen levels are also indicators of DIC.[18]

Management of amniotic fluid embolism is primarily supportive. Early intubation with ventilatory support is often necessary to ensure maximal oxygenation. Shock is multifactorial and is treated with fluid resuscitation, vasopressors, and inotropic agents. Disseminated intravascular coagulation is managed with red blood cell transfusions, platelets, and fresh frozen plasma as needed depending on the extent of hemorrhage. Recombinant factor VIIa has been studied in the treatment of DIC in this setting and has been found effective in some cases of massive hemorrhage.[20]

>>FAST TRACK<<

Disseminated intravascular coagulation is reported in approximately 83% of patients with amniotic fluid embolism.

AGGRESSIVE MANAGEMENT IS KEY

Aggressive management in the emergency department can avert many of the complications associated with postpartum emergencies and preclude the need to intervene surgically in those that do occur. The importance of maintaining high levels of suspicion, combined with a careful history and physical examination, cannot be overstated in light of the high potential for morbidity and mortality in these conditions. □

REFERENCES

1. de Swiet M, Fidler J, Howell R, Letsky E. Thromboembolism in pregnancy. In: Jewell D, ed. *Advanced Medicine*. London, England: Pitman Medical, 1981: 309-317.
2. Rutherford S, Montoro M, McGehee W, Strong T. Thromboembolic disease associated with pregnancy: an 11 year review. *Am J Obstet Gynecol*. 1991;164:286.
3. Wong V, Cheng CH, Chan KC. Fetal and neonatal outcome of exposure to anticoagulants during pregnancy. *Am J Med Genet*. 1993;45(1):17-21.
4. Lockhart EM. Baysinger CL. Intracranial venous thrombosis in the parturient. *Anesthesiology*. 2007;107(4):652-658.
5. Chichakli L, Atrash HK, MacKay AP, et al. Pregnancy-related mortality in the United States due to hemorrhage: 1979-1992. *Obstet Gynecol*. 1999;94(5 Pt 1):721-725.
6. Soper DE. Infections following cesarean section. *Curr Opin Obstet Gynecol*. 1993;5(4):517-520.
7. Garcia J, Aboujaoude R, Apuzzio J, Alvarez JR. Septic pelvic thrombophlebitis: diagnosis and management. *Infect Dis Obstet Gynecol*. 2006;2006:15614.
8. Roberts JM, Gammill HS. Preeclampsia: recent insights. *Hypertension*. 2005;46(6):1243-1249.
9. Sibai B, Dekker G, Kupferminc M. Preeclampsia. *Lancet*. 2005;365(9461):785-799.
10. Lipstein H, Lee CC, Crupi RS. A current concept of eclampsia. *Am J Emerg Med*. 2003;21(3):223-226.
11. Elkayam U, Akhter M, Singh H, et al. Pregnancy-associated cardiomyopathy: clinical characteristics and a comparison between early and late presentation. *Circulation*. 2005;111(16):2050-2055.
12. Pearson GD, Veille JC, Rahimtoola S, et al. Peripartum cardiomyopathy: National Heart, Lung, and Blood Institute and Office of Rare Diseases (National Institutes of Health) workshop recommendations and review. *JAMA*. 2000;283(9):1183-1188.
13. Felker G, Jaeger C, Klodas E, et al. Myocarditis and long-term survival in peripartum cardiomyopathy. *Am Heart J*. 2000;140(5):785-791.
14. Davidson NM, Trevitt L, Parry EH. Peripartum cardiac failure. An explanation for the observed geographic distribution in Nigeria. *Bull World Health Organ*. 1974;51(2):203-208.
15. Qasqas SA, McPherson C, Frishman W, et al. Cardiovascular pharmacotherapeutic considerations during pregnancy and lactation. *Cardiol Rev*. 2004;12(4):201-221.
16. Steiner PE, Lushbaugh CC. Landmark article, Oct. 1941: Maternal pulmonary embolism by amniotic fluid as the cause of obstetric shock and unexpected deaths in obstetrics. *JAMA*. 1986;255(16):2187-2203.
17. Tuffnell DJ. United kingdom amniotic fluid embolism register. *BJOG*. 2005;112(12):1625-1629.
18. Clark SL. New concepts of amniotic fluid embolism: a review. *Obstet Gynecol Surv*. 1990;45(6):360-368.
19. Harnett MJ, Hepner DL, Datta S, Kodali BS. Effect of amniotic fluid on coagulation and platelet function in pregnancy: an evaluation using thromboelastography. *Anaesthesia*. 2005;60(11):1068-1072.
20. Prosper SC, Goudge CS, Lupo VR. Recombinant factor VIIa to successfully manage disseminated intravascular coagulation from amniotic fluid embolism. *Obstet Gynecol*. 2007;109(2 pt 2):524-525.