

# Postpartum Hemorrhage

## *Emergency Management and Treatment*

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**Excessive bleeding in women following delivery must be promptly identified and managed to prevent a life-threatening complication of childbirth.**

**P**ostpartum hemorrhage (PPH) is the leading cause of maternal death worldwide. More than 140,000 women die annually as a result of PPH, which corresponds to approximately one maternal death every 4 minutes.<sup>1</sup> In developing countries, PPH accounts for 25% of all maternal deaths. However, even in developed or higher-income countries such as the United States, obstetric and postpartum hemorrhage accounts for approximately 8% of maternal deaths and is consistently among the top 3 causes for direct maternal mortality, following thromboembolism and hypertensive disorders.<sup>2</sup>

During pregnancy, the physiologic increases in plasma volume (40%) and red cell volume (25%) occurs in anticipation of an expected and acceptable blood loss during uncomplicated delivery. Unfortunately, the estimation of blood loss that is routinely evaluated by the clinicians' visual inspection following delivery is subjective, typically inaccurate, and underreported.

Lack of anticipation of expected blood loss, underestimation of blood loss, and maternity care in facilities poorly

equipped medically to deal with clinical decompensation of the mother often lead to hemodynamic compromise and ultimately increased morbidity and mortality.

### Diagnosis and Etiologies

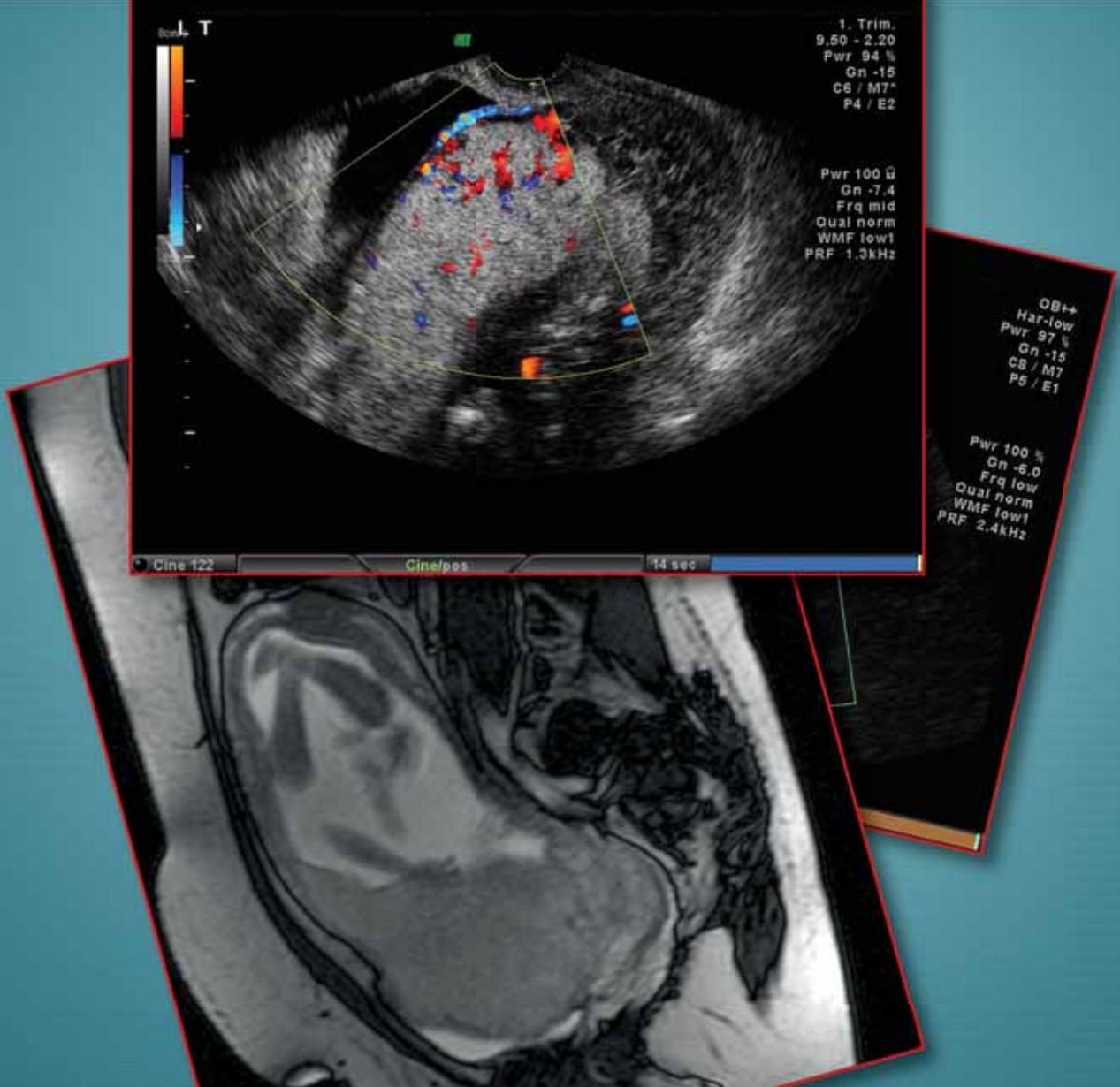
By definition, excessive obstetric or postpartum hemorrhage is defined as blood loss of 500 mL or more after a vaginal delivery or 1,000 mL or more after a cesarean delivery. PPH is further characterized as early or primary if the bleeding occurs within 24 hours after delivery and late or secondary when the bleeding occurs beyond 24 hours and up to 6 to 12 weeks postpartum. PPH can also be defined as a decline of 10% or more of the maternal baseline hematocrit (Hct) level. Because of the physiologic volume adjustment of pregnancy, blood loss at the time of delivery can often be masked. By the time the patient manifests early cardiovascular changes of shock, such as hypotension and tachycardia, an excess of 10% or more of the maternal blood volume has been lost.

Early or primary PPH occurs in 4% to 6% of pregnancies. The leading cause of early PPH is uterine atony, which accounts for 80% of all cases. Other causes for early PPH include lacerations of the genital tract, retained placental tissue, uterine rupture, uterine inversion, and disorders of blood coagulation. Causes for late or secondary PPH include retained

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placental products, subinvolution of the placental site, postpartum infection, and inheritable coagulation defects.

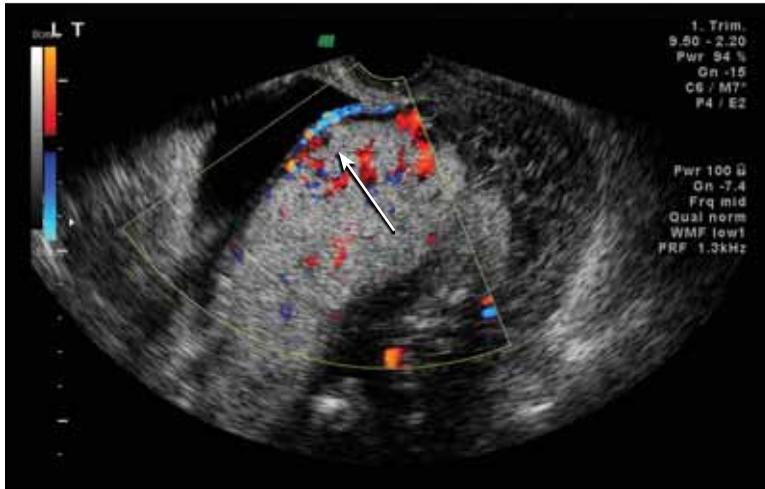
### Evaluation and Risk Assessment

Evaluation for PPH begins with an assessment of risk. Risk factors for PPH can be identified during the antepartum, intrapartum, and immediate postpartum periods. By identifying risk factors, prevention strategies can be implemented to lessen the risk for morbidity and mortality.

During the antepartum or prenatal period, any obstetric situation that leads to overstretching of the uterus places the mother at risk for excessive blood loss at the time of vaginal or cesarean delivery. These risks include multifetal gestations, hydramnios, history of PPH and/or retained placenta, induction of labor, and

prior cesarean delivery. During the intrapartum period additional risk factors include prolonged or rapid labor, prolonged use of oxytocin for induction or augmentation of labor, operative delivery, chorioamnionitis, fetal macrosomia, preeclampsia with or without HELLP (H, hemolysis; EL, elevated liver enzymes; LP, low platelet count) syndrome, use of magnesium sulfate for eclampsia prophylaxis or preterm labor, vaginal birth following a prior cesarean (VBAC), and retained placenta.

A US randomized trial identified birthweight, labor induction and augmentation, chorioamnionitis, magnesium sulfate use, and previous PPH as being associated with an increased risk for PPH.<sup>3</sup> A population-based study further identified retained placenta (odds ratio [OR], 3.4), failure to progress during the second



**FIGURE 1.** Ultrasound with color flow Doppler images of placenta increta showing with placental lacunae and loss of myometrial interface at level of bladder.

stage of labor (OR, 3.4), and macrosomia (OR, 1.9) and confirmed other risk factors as significant for PPH.<sup>4</sup>

With retained placenta the risk for uterine inversion is also increased. Uterine inversion is the descent of the uterine corpus through the uterine cervix. This condition needs prompt recognition and replacement of the uterus to the normal position, because hemorrhage can be pronounced. If the placenta is attached at the time of inversion, it should not be removed prior to replacement of the uterus, or more profound hemorrhage is likely to occur. Retained placenta might signal a placental invasion abnormality such as placental accreta, especially if the woman has had a prior cesarean.

Women with known placenta invasion abnormalities should have planned delivery that anticipates blood loss and thereby minimizes the risk for complications due to hemorrhage. The majority of women with placenta accreta have a significant risk for hemorrhage and require cesarean hysterectomy. With the widespread use of second-trimester ultrasound, most placental invasion abnormalities can be diagnosed prenatally with ultrasound or magnetic resonance imaging (MRI). Diagnostic sensitivity and specificity with ultrasound is 85% to 90%.<sup>5</sup>

The ultrasound criteria for placenta accreta are a loss of the normal hypoechoic

zone, thinning and disruption of the uterine serosa-bladder interface, focal exophytic masses within the placenta, and vascular lacunae (Figure 1). MRI can further define the extent of uterine invasion, especially when a placenta percreta is a concern or bladder involvement is suspected and in cases of posterior placentas (Figure 2).

Women with prior cesarean delivery are at increased risk for placenta previa and placenta invasion abnormalities. These patients should have a thorough second-trimester ultrasound evaluation with placental localization and use of color Doppler to evaluate the placental uterine interface.

A woman with VBAC requires special attention during the intrapartum period due to the estimated risk for uterine rupture or scar separation during labor. For the patient with a prior low transverse cesarean, the estimated risk for scar separation is approximately 0.5% to 1.0%. Women planning VBAC should be appropriately counseled with disclosure and documentation of risk.

**Management**

Typically, all women admitted to labor will have a baseline hemoglobin and blood type and screen performed. Women at risk for PPH need a baseline hemoglobin and hematocrit on admission to labor or planned cesarean and a type and screen, so that a timely crossmatch of blood products can be performed in the event that blood is needed. This is an essential component of the initial management and prevention strategies against morbidity and mortality. This is especially important for women with baseline anemia (Hct <30% or hemoglobin <10 g/dL), or those at risk for placental abruption and those with known placental invasion abnormalities. Women with known placental invasion disorders (eg, placenta accreta) are at significant risk for hemorrhage and peripartum hysterectomy.

Active management of the third stage of labor has been advocated as a prevention strategy for PPH due to uterine atony.<sup>6</sup> Active management includes a combination of uterotonics (oxytocin) administration immediately upon delivery of the infant,

early cord clamping and cutting, and gentle cord traction with uterine counter traction when the uterus is well contracted (Brandt-Andrews maneuver). The findings of Cochrane Database studies on active management suggest an approximately 60% reduction in the occurrence of PPH greater than 500 and 1,000 mL. The concern for retained placenta with active management was not supported in these trials, especially when oxytocin is the uterotonic.<sup>7</sup>

If uterine atony has been ruled out as a source of bleeding in the immediate postpartum woman or bleeding continues despite confirmed uterine tone by examination, then a careful inspection for other sources of bleeding, such as genital lacerations or retained placenta products, should be performed. Cervical or vaginal lacerations occur as a result of the fragility of genital tissue and can lead to significant bleeding. If lacerations are identified, prompt repair will typically lead to control of bleeding. This is more likely after operative vaginal delivery. It is good practice to completely visualize the entire cervix and vagina as a routine after operative vaginal delivery for evaluation of lacerations that might have occurred at the time of the procedure.

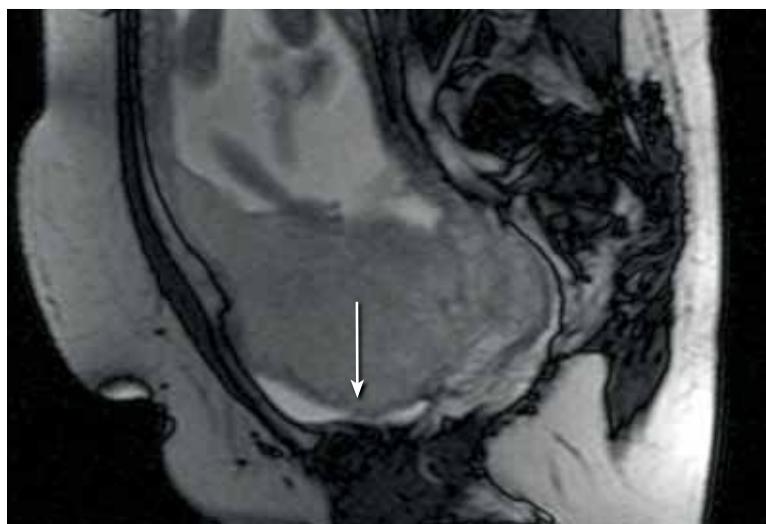
If the placenta does not appear to be intact when clinically inspected, manual exploration of the uterus may yield placenta fragments or allow removal of blood clots that have prohibited the uterus from achieving full contractility. Bedside transabdominal ultrasound is beneficial in locating the retained products and provides guidance in surgical evacuation of the products. With the use of ultrasound, complete evacuation is ensured and the risk for surgical complications such as uterine perforation is minimized.

### Maternal Resuscitation and Medical Management of PPH

The first line of defense against PPH is active management of the third stage of labor for vaginal delivery and administration of oxytocin and expression rather than manual removal of the placenta at the time of cesarean delivery.

When a hemorrhage occurs despite uterine massage and standard dosing of oxytocin, a team approach should be implemented to combat further maternal morbidity and mortality. Many facilities have adopted a hemorrhage protocol that outlines team mobilization and fluid and transfusion management. These protocols are designed for obstetric patients exhibiting life-threatening or profuse hemorrhage. Activation of the protocol is by any physician or nursing team member on the obstetric unit who identifies the life-threatening hemorrhage. That person then notifies the circulation nurse to activate the hemorrhage protocol.

The management starts with fluid resuscitation of mother, notification of the blood bank or transfusion services to crossmatch the screened maternal blood for possible transfusion, and alerting the anesthesia team to assist in the maternal resuscitation and to ready the patient for potential surgical intervention if medical management is unsuccessful. Fluid resuscitation begins by adding a second large-bore 14-gauge intravenous line for rapid fluid and blood delivery. The blood protocol provides a large volume of replacement red blood cell products and coagulation factors. The protocol kit should contain the appropriate paperwork, including ordering slips



**FIGURE 2.** MRI image of placenta increta with obliteration of the uterine wall bladder interface.

and sample blood tubes, which is maintained on the obstetric unit.

Medical management of PPH begins with administration of uterotonics, starting with oxytocin, 10 to 40 U/L of saline, or lactated Ringer solution infused continuously. Other second-line uterotonics that can be added include misoprostol (Cytotec) 800 to 1,000 mcg, given rectally because of ease of administration. Another drug is methylergonovine (Methergine) 0.2 mg intramuscularly (IM) every 2 to 4 hours; however, methylergonovine is contraindicated in hypertension.

Carboprost tromethamine (Hemabate) is a 15-methyl prostaglandin that should be readily available on all labor and delivery units for use in PPH. This drug can be given at a dose of 0.25 mg IM every 15 to 90 minutes, up to 8 doses. The drug should be avoided in women with asthma and is

normalities in PTT or INR suggest a coagulopathy and the need for replacement of coagulation factors in addition to packed red blood cells (RBCs).

Transfusion management is critical to avoiding maternal mortality from hemorrhagic shock. The blood bank should be notified immediately that the type and screen should be crossmatched for possible transfusion. A crossmatch of 4 to 6 units of packed RBCs should be requested. The first line of defense is transfusion with packed RBCs. Each unit of packed cells increases the hematocrit by 3% and hemoglobin by 1 g/dL. The transfusion management approach for massive hemorrhage at our institution is one-to-one RBCs and fresh frozen plasma.

The Table provides an example of the transfusion protocol for a patient with and without an in-date type and screen on the patient. This one-to-one approach lowers the risk for coagulopathy and continued bleeding. Fresh frozen plasma contains fibrinogen, antithrombin III, factor V, and factor VIII. Each unit of fresh frozen plasma increases the fibrinogen level by 10 mg/dL. Cryoprecipitate can also help with replacement of critical clotting factors. Cryoprecipitate contains fibrinogen, factors VIII and XIII, and von Willebrand factor. Each unit will increase fibrinogen by 10 mg/dL.

Recombinant activated factor VIIa can be given as a last line of defense against hemorrhage when other medical and surgical approaches have failed to control the hemorrhage and a coagulopathy has developed.<sup>8</sup> However, factor VIIa is ineffective unless vital clotted factors have been replaced. The drug is associated with thromboembolism. Synthetic fibrinogen (RiaSTAP<sup>®</sup>) is available in the United States and approved for congenital fibrinogen deficiency, but use of this drug for PPH is limited to a few case reports. Both factor VII and synthetic fibrinogen are expensive and associated with maternal morbidities.

#### Surgical Management

Persistent bleeding from uterine atony or from other causes requires surgical intervention to prevent further maternal

#### FOCUSPOINT

*Women who experience excessive bleeding following delivery should be assessed for the cause of bleeding.*

contraindicated in women with hepatic, renal, and cardiac conditions. Finally, dinoprostone (Prostin E2) can be given as 20-mg suppositories vaginally or rectally every 2 hours. If the vaginal bleeding is brisk, the use of vaginal suppositories is not likely to be effective. This drug should be avoided in severe hypotension, which may be the case in cardiovascular collapse and maternal shock.

Baseline reference laboratory studies must be obtained in the patient with hemorrhage. She should then have hemoglobin and hematocrit rechecked, and clotting studies such as platelet count, fibrinogen, partial thromboplastin time (PTT), and prothrombin time and/or international normalized ratio (INR) should be obtained. Excessive bleeding leads to depletion of vital clotting factors, which aggravate the cascade of hemorrhage. Ab-

morbidity and mortality. However, prior to laparotomy, balloon management should be considered for uterine atony as a temporizing measure if uterotonics have failed to provide uterine tone. The Bakri tamponade balloon and other balloons are designed for tamponade within the uterine cavity when uterine atony is the diagnosis.<sup>9</sup> Balloons are inserted and inflated with up to 500 cc of saline. Once the bleeding is controlled, the balloon can be deflated and removed. Blood loss can be monitored around the balloon, and if bleeding continues or vital signs continue to be unstable, surgical intervention is warranted. The International Federation of Gynecology and Obstetrics supports the use of balloon tamponade as a safe and inexpensive treatment for uterine atony when uterotonics have failed.<sup>10</sup>

While hysterectomy is the final resort to life-threatening hemorrhage, several surgical measures are available prior to resorting to hysterectomy, if the situation is appropriate. These methods are preferable to hysterectomy in an attempt to preserve fertility, especially in women of young age and low parity.

A number of surgical techniques have been shown to be effective in controlling bleeding from uterine atony. If the patient delivered vaginally, laparotomy is required to expose the uterus for possible removal, as a last resort. Also, it allows inspection for other sources of bleeding, such as lacerations or hematomas. If the patient had a cesarean delivery, then these surgical techniques can be employed immediately to assist with management of hemorrhage from atony.

The first-line surgical procedure to assist in controlling hemorrhage is bilateral uterine artery ligation using an "O'Leary" technique.<sup>11</sup> The uterine arteries provide approximately 90% of the uterine blood flow. This technique involves the use of a heavy absorbable suture to encircle the uterine vessels approximately 2 cm below the transverse lower uterine segment, including full thickness myometrium to anchor and occlude the uterine artery and veins. With this technique,

**TABLE. Duke University Obstetric Bleeding Emergency Transfusion Algorithm**

#### **Transfusion Management**

Patient with in-date type and screen available

- 4 units type-specific packed red blood cells (pRBCs)
- 4 units type-specific or AB thawed plasma
- 1 dose (10 units) of cryoprecipitate
- 1 unit of apheresis platelets

Patient with in-date type and screen not available

- 4 units of O negative pRBCs
- 4 units of thawed AB plasma
- 1 dose (10 units) of cryoprecipitate
- 1 unit of apheresis platelets

#### **Laboratory and Assessment**

- Hemostasis panel immediately and at 30-minute intervals until patient stable
- Obstetrician and anesthesiologist make joint assessment of cumulative estimated blood loss every 30 minutes
- Notify transfusion services when the emergency is over and patient stable
- Monitor laboratory every 4-6 hours for 24 hours to include hemoglobin, platelet count, prothrombin time, international normalized ratio, and fibrinogen

Acknowledgement: Evelyn Lockhart, MD, Duke Transfusion Services.

blood flow to the atonic uterus is significantly decreased. The utero-ovarian vessels may also be ligated but not cut.

The B-Lynch suture technique has become popular as a compression method for surgical management of uterine atony. This technique involves passing a suture through the posterior uterine wall and draping it over the uterus and tying anteriorly. One study reported more than 1,000 B-lynch procedures with only 7 failures.<sup>12</sup> Another uterine compression method is the multiple square suturing technique, which also eliminates space in the uterine cavity by suturing together the anterior and posterior uterine walls with absorbable suture.

Hypogastric artery ligation is rarely used in current practice as a uterine preservative measure for PPH. The technique is difficult and time consuming, and uterine artery ligation essentially accomplishes the same goals of decreasing blood flow

to the uterus with fewer complications. In addition, few generalist ObGyns are prepared to perform this procedure.

Uterine artery embolization can be used before or after hysterectomy to control persistent bleeding. The technique is helpful when vital signs have stabilized and there is persistent oozing for the incision sites and the pelvic tissues. This technique is one of the last uterine preservation measures that can be employed for persistent bleeding. As such, vascular radiology should be on alert that this lifesaving measure for uncontrollable hemorrhage might be necessary. If transfusion management with packed cells and fresh frozen plasma is begun early in the process of hemorrhage, thereby replacing blood and clotting factors with correction of coagulopathy, the need for embolization for persistent oozing or bleeding can be minimized. If the patient has the potential for significant bleeding, as might be the case with placental invasion abnormalities, balloon occlusion of the uterine vessels can be employed prophylactically to assist in controlling expected blood loss. Angiographic embolization as an adjunctive measure to control hemorrhage is not new and was first described more than 3 decades ago.<sup>13</sup>

### Summary

PPH is a life-threatening complication of childbirth. It is the leading cause for maternal mortality in the developing world. The clinician must be alerted to those women who pose a risk for PPH, especially uterine atony, and approach delivery and postpartum prepared to manage the mother with evidence-based approaches to reduce the incidence of severe hemorrhage and morbidity. It is critical that those women who experience excessive bleeding following delivery be assessed thoroughly for the cause of bleeding and that the source of bleeding be promptly identified and managed. With aggressive maternal resuscitation, medical and surgical intervention, and blood product replacement, maternal mortality can be significantly impacted worldwide.

*Dr Brown has done research with Cook Medical. Dr Smrka reports no actual or potential conflict of interest in relation to this article.*

### References

1. American College of Obstetricians and Gynecologists. ACOG Practice Bulletin: Clinical Management Guidelines for Obstetricians-Gynecologists Number 76, October 2006: postpartum hemorrhage. *Obstet Gynecol.* 2006;108(4):1039-1047.
2. Berg CJ, Chang J, Callaghan WM, Whitehead SJ. Pregnancy-related mortality in the United States, 1991-1997. *Obstet Gynecol.* 2003;101(2):289-296.
3. Jackson KW Jr, Allbert JR, Schemmer GK, Elliot M, Humphrey A, Taylor J. A randomized controlled trial comparing oxytocin administration before and after placental delivery in the prevention of postpartum hemorrhage. *Am J Obstet Gynecol.* 2001;185(4):873-877.
4. Sheiner E, Sarid L, Levy A, Seidman DS, Hallak M. Obstetric risk factors and outcome of pregnancies complicated with early postpartum hemorrhage: a population-based study. *J Matern Fetal Neonatal Med.* 2005;18(3):149-154.
5. Finberg HJ, Williams JW. Placenta accreta: prospective sonographic diagnosis in patients with placenta previa and prior cesarean section. *J Ultrasound Med.* 1992;11(7):333-343.
6. Prendiville WJ, Elbourne D, McDonald S. Active versus expectant management in the third stage of labour. *Cochrane Database Syst Rev.* 2000;(3):CD000007.
7. Elbourne DR, Prendiville WJ, Carroli G, Wood J, McDonald S. Prophylactic use of oxytocin in the third stage of labour. *Cochrane Database Syst Rev.* 2001;(4):CD001808.
8. Franchini M, Manzato F, Salvagno GL, Lippi G. Potential role of recombinant activated factor VII for the treatment of severe bleeding associated with disseminated intravascular coagulation: a systematic review. *Blood Coagul Fibrinolysis.* 2007;18(7):589-593.
9. Bakri YN, Amri A, Abdul Jabbar F. Tamponade-balloon for obstetrical bleeding. *Int J Gynaecol Obstet.* 2001;74(2):139-142.
10. International Confederation of Midwives/International Federation of Gynaecology and Obstetrics. Joint statement on the prevention and treatment of post-partum haemorrhage: new advances for low resource settings. November 2006. Available at: [www.pphprevention.org/files/FIGO-ICM\\_State ment\\_November2006\\_Final.pdf](http://www.pphprevention.org/files/FIGO-ICM_State%20ment_November2006_Final.pdf). Accessed April 21, 2011.
11. O'Leary JL, O'Leary JA. Uterine artery ligation in the control of intractable postpartum hemorrhage. *Am J Obstet Gynecol.* 1966;94(7):920-924.
12. Allam MS, B-Lynch C. The B-Lynch and other uterine compression suture techniques. *Int J Gynaecol Obstet.* 2005;89(3):236-241.
13. Vedantham S, Goodwin SC, McLucas B, Mohr G. Uterine artery embolization: an underused method of controlling pelvic hemorrhage. *Am J Obstet Gynecol.* 1997;176(4):938-948.