10 Postpartum hemorrhage

Wade D. Schwendemann and William J. Watson

While the incidence of postpartum hemorrhage has not changed significantly in the past several years, the maternal mortality rate has decreased in developed countries because of better education regarding the issue and new treatment modalities (1,2). New therapies developed for the treatment of postpartum hemorrhage hold considerable promise in expanding the arsenal of the physician in conservatively treating cases refractory to standard therapy.

Developing countries still see a significant maternal mortality rate from this condition, enough to make hemorrhage the most common cause of maternal death worldwide (1,2). In addition to mortality, significant maternal morbidity can result.

DEFINITION AND EPIDEMIOLOGY

There are several different definitions of postpartum hemorrhage. The first is an estimated blood loss greater than 500 cc with vaginal delivery or greater than 1000 cc with a cesarean delivery (3). These definitions are the standard for most clinicians. However, obstetric texts quote a mean of 500 cc of blood loss for vaginal delivery and 1000 cc of blood loss for cesarean delivery. This confuses the issue, because the average blood loss cannot represent a pathologic condition. We believe that a more reasonable definition of a postpartum hemorrhage is 1000 cc or more with vaginal delivery or greater than 1500 cc with cesarean delivery.

A second definition is a 10% decrease in the hematocrit when comparing pre- and postdelivery blood counts. This definition has several limitations as well. In our current environment of medical cost containment, a predelivery hematocrit might not be obtained in low-risk cases. Furthermore, following acute blood loss, the hematocrit value may take hours to equilibrate.

These definitions also present a problem because clinicians have been shown to be very poor at estimating actual blood loss, consistently underestimating it (4–7). This difficulty is increased in the obstetric setting due to the presence of amniotic fluid at the time of delivery. Training and graded drapes have been shown to improve the accuracy of blood loss estimates (8,9) and should be implemented, particularly in areas where postpartum hemorrhage is more common.

Further subclassification of postpartum hemorrhage divides cases into early and late hemorrhage. Early postpartum hemorrhage is any hemorrhage that occurs up to 24 hours postdelivery. Postpartum hemorrhage that occurs from 24 hours to 12 weeks postdelivery is considered a late postpartum hemorrhage. This distinction is important to understand because the likelihood of a given diagnosis as a cause for the hemorrhage differs based on the timing.

The incidence of postpartum hemorrhage will vary based on the criteria used to define the condition. The best estimates available indicate that somewhere between 1% and 5% of deliveries will be complicated by postpartum hemorrhage (10).

DIFFERENTIAL DIAGNOSIS

The differential diagnosis of postpartum hemorrhage includes retained placental tissue, uterine atony, lacerations, uterine inversion, and defects in maternal coagulation. Women are at an increased risk of hemorrhage due to uterine atony if they have multiple gestation or polyhydramnios or have recently been administered any medications to reduce frequency of uterine contractions, such as terbutaline (11–14). Hemorrhage caused by laceration is increased in cases of operative vaginal delivery, large for gestational-age infants, and in women with a history of previous lacerations (11–14). Obstetric hemorrhage can also be the presenting symptom in women with a previously undiagnosed clotting disorder (15). Women with the HELLP (hemolysis, elevated liver enzymes, low platelets) syndrome are also at an increased risk for blood loss due to coagulation defects (16).

ASSESSMENT OF BLOOD LOSS/COAGULATION STATUS

The initial assessment of the status of the patient is crucial. This involves clinical examination, including vital signs, urine output, and laboratory testing. The signs and symptoms of clinically significant blood loss include vertigo, tachycardia, and hypotension. Other vasovagal syndromes can also be confused based on symptomatology alone. Immediate postpartum hemorrhage is rarely misdiagnosed, but a late hemorrhage, particularly in the setting of a cesarean delivery, can be missed if the clinician does not have a high index of suspicion. Blood loss of approximately 10% to 15% of the circulating blood volume (500–1000 cc) can cause tachycardia, while it generally takes at least 25% to 35 % (1500–2000 cc) to cause hypotension (17). This is, of course, dependent on maternal body size and the rate of blood loss.

Changes in vital signs can provide some information regarding the degree of hemorrhage, but as the majority of obstetric patients are young and healthy, there can be a considerable amount of blood loss with compensation that can occur prior to a significant change in vital signs.

Initial laboratory evaluation should include a complete blood count (CBC) and coagulation studies including fibrinogen, prothrombin time, international normalized ratio, and activated partial thromboplastin time. It is important to remember that the initial CBC value may not reflect the true degree of anemia because it may not have yet equilibrated. In the delivery room, one method of rapid assessment of the maternal coagulation status is to collect a red top (non-heparinized) tube of the mother's blood. This blood should

clot within 6 minutes. If it does not, a diagnosis of a coagulation defect is suspected, and treatment can be instituted if clinically indicated without waiting for the results of a full coagulation panel.

Therapy

Initial treatment after all deliveries includes removal of placental tissue, either expectantly or through the use of the Crede maneuver (18), as well as fundal massage. This also allows for assessment of uterine contraction. A fundus that is not firm should be vigorously massaged both abdominally and vaginally to increase uterine tone.

Further initial prophylaxis involves treatment with oxytocin (19), either 20 units in one liter of IV fluid or 10 units intramuscularly. The timing of this therapy remains a matter of some debate, and local practice methods often govern whether it is administered after cord clamp or following delivery of the placenta (20–22).

Upon recognition of an immediate (early) postpartum hemorrhage, several factors must be assessed virtually simultaneously. To accomplish this, it is recommended that help be requested immediately. Initial assessment should include an evaluation of uterine tone through bimanual examination, evaluation of the placenta and membranes for any evidence of incomplete removal, and inspection of the cervix, vagina, perineum, and rectum to evaluate for laceration.

Treatment for atony involves uterine massage, IV fluid resuscitation, and administration of uterotonic agents. In addition to the oxytocin recommended for prophylaxis, further oxytocin can be given. Doubling the previously mentioned dose is a recommended first step. Other medications can be provided as well. These are summarized in Table 1.

Treatment for retained placenta involves extraction of remaining placental tissue. This can be accomplished either through manual exploration or through surgical intervention. Prior to either intervention, care should be taken to ensure adequate anesthesia for the patient. Either IV narcotic medications or re-dosage of a previously placed epidural catheter can be safely performed in the patient with postpartum hemorrhage. Manual exploration and removal of retained placental tissue through curettage with a banjo curette can be safely performed in the delivery room. Bedside ultrasound can be invaluable in this clinical situation. Real-time ultrasound is used to assess for retained tissue and as a

guide for surgical procedures. In curettage for suspected retained placenta, the clinician should select the largest curette that can be safely passed through the cervix in order to minimize the risk of uterine perforation. Generally, a banjo curette can be easily passed through the dilated cervix in the immediate postpartum period.

A thorough inspection of all vaginal, cervical, and perineal tissues should be performed as quickly as possible. Lacerations should be repaired with absorbable suture, typically in a running, locked fashion. Repair of lacerations should be performed only under excellent visualization. Such visualization may require transport to an operating room for better lighting and equipment. Transfer to the operating suite should not be delayed due to hemorrhage. In addition, inspection can reveal the presence of a vaginal hematoma. Unless this hematoma is large, or expanding, it should not be opened and inspected due to the possibility of significant blood loss with the minimal chance for identification of a discrete source.

Rare causes of postpartum hemorrhage should not be discounted. During the pelvic examination following delivery, uterine inversion can be diagnosed. This condition often presents as a beefy-red mass at the introitus. Failure to visualize the cervix around this mass should arouse the clinical suspicion for this condition. The clinician may mistake this for a prolapsed leiomyoma. Once inversion is recognized, attempts at manual replacement should be made first (23,24). Should this fail to alleviate the problem, IV nitroglycerine can be administered in hopes of relaxing the uterus. If attempts at medical therapy also fail, a laparotomy should be performed; the uterus can then be reverted by progressive traction on the round ligaments or, if this fails, by incising the uterine contraction ring posteriorly. The vertical incision should then be repaired in layers, similar to the repair of any other vertical uterine incision (25).

If rare causes of postpartum hemorrhage have been ruled out and standard medical therapies have failed to relieve the bleeding, further intervention is required. Which method one chooses will be largely based on the method of delivery. In a vaginal delivery, if the patient has not been transported to the operating suite, this should be done. The room should be prepared for the possibility of an emergent laparotomy. Consideration should be given to the idea of uterine tamponade prior to surgical intervention. Packing of the uterus is one method (26–28), although newer techniques

Table 1 Medications Commonly used in the Treatment of Postpartum Hemorrhage Due to Uterine Atony, Including Dosage and Contraindications

Medication	Dosage and route of administration	Contraindicated in patients with
Pitocin (oxytocin)	20–40 Units IV Or 10 Units IM (including uterine injection during C/S or laparotomy)	
Methergine (methylergonovine)	0.2 mg IM (including uterine injection during C/S or laparotomy) every 2–4 hours	Hypertension
Hemabate (15-methyl prostaglandin F2α)	0.25 mg IM (including uterine injection during C/S or laparotomy) every 15–90 minutes	Asthma
Cytotec (misoprostol, prostaglandin E1)	Protocols vary, 800 mcg PR hourly	None, but monitor for maternal fever
Recombinant factor VIIA	Doses of 20–90 mcg/kg IV	Used for refractory coagulopathy. No known contraindication, but cost is a factor

have replaced it to a large extent. The Bakri balloon was developed specifically for this purpose (29). The balloon must be inserted completely into the uterine cavity and inflated with 300 to 500 cc of saline. Care should be taken to ensure that the balloon does not cross the cervical os, as this placement will not be effective and could cause cervical trauma.

In the clinical setting of ongoing bleeding refractory to standard medical therapy, after lacerations have been repaired and retained products ruled out, factor VIIa may be a useful adjunct to therapy. It has been shown to be effective in approximately 80% of cases during one recent review (30). Other case reports have also demonstrated its effectiveness as an adjunct therapy (31–34). There is not a known method to measure the effectiveness of factor VIIa therapy.

Some institutions will have the ability to perform a rapid arterial embolization for emergent treatment of postpartum hemorrhage. Embolization may be most appropriate for cases of postpartum hemorrhage secondary to laceration, if blood loss is ongoing. If an interventional radiologist is available and the patient is stable, she can be transferred to the radiology suite for evaluation and treatment as an acceptable alternative (35–37). Occasionally, a discrete vessel can be identified and embolized. Angiography of both uterine arteries can be performed and an embolization of a feeder vessel can be performed. The availability of this technique is limited, and its use should not delay definitive therapy in cases where the patient is not stable for transport. It is not a standard therapy for cases in which uterine atony is the primary cause of bleeding. Patients with high risk of bleeding, such as those with a suspected accreta or known previa with previous cesarean section, could have catheter sheaths placed prophylactically prior to a scheduled procedure to facilitate the embolization should it become necessary.

Should tamponade fail, and interventional radiology either fail or be unavailable, the next step is laparotomy. Subsequent steps can also be performed to treat hemorrhage at the time of cesarean section. Hemorrhage can be treated by ligature of the vessels supplying the uterus. First to be secured should be the uterine arteries bilaterally. Originally described by O'Leary (38–40), this involves placing an absorbable suture into the lateral aspect of the lower segment of the uterine corpus, then around the uterine vessels and secured lateral to these vessels. Care must be taken to identify and avoid the ureter. This procedure should be completed bilaterally. If this procedure does not completely cease bleeding, additional sutures can be placed to secure the uterine branches supplied by the ovarian arteries (41). The purpose of these therapies is to decrease the pulse pressure through their respective vessels and to decrease overall flow to the affected area in hopes of controlling the hemorrhage.

If these therapies are unsuccessful, the anterior division of the internal iliac (hypogastric) artery can be ligated (38,42–45). This dissection is considerably more complicated than either of the previous two described above. This procedure will ideally be performed with the assistance of a surgeon experienced in operating in the retro peritoneum. Care should be taken to avoid injury to local structures, particularly the ureter and the hypogastric veins.

Given the technical difficulties associated with ligature of the hypogastric arteries, techniques have been developed to treat uterine atony with compression rather than via decreased blood flow (46–49). The B-Lynch suture provides a degree of

compression similar to that done manually. This allows the practitioner to determine its effectiveness prior to placement. If manual compression does not decrease the bleeding to an acceptable level, then the suture is unlikely to do so. If manual compression does provide adequate hemostatic control, then the suture can be placed with a reasonable chance of success. Placement of the suture involves use of chromic gut placed entering the body of the uterus inferior to the hysterotomy and exiting superior to the incision. The suture is carried to the posterior aspect of the uterus (over the fundus) where it enters on one side of the lower uterine segment and exits on the other side. It is then carried over the fundus once more and entered into the uterus superior to the incision, then exits parallel to the initial suture placement. The suture is secured to compress the uterus (46–49). This is made considerably easier with surgical assistance. Case reports of pregnancy following compression sutures have been published, although there are no data to suggest any subfertility or increased rate of spontaneous pregnancy loss (49–51).

Hysterectomy should be employed only as a last resort, but should not be delayed in cases where it is necessary. The blood loss from a delay can result in significant maternal morbidity or even mortality and definitive treatment should be readily available. The technique does not differ significantly from the nonpregnant patient, but distortion of the normal anatomy of the pelvis presents challenges. The gravid uterus obstructs the operative view, and the increased blood flow to the area represents a potential for further blood loss. Physiologic dilation of the ureter can make this structure more difficult to avoid. The soft consistency of the cervix and its effacement can also make identification of the cervix more difficult and result in excess vaginal tissue being removed, leading to a foreshortening of the vagina. These changes, and others, make the procedure one fraught with morbidity (52). Surgeons with experience in this procedure should be consulted for assistance whenever available.

Late postpartum hemorrhage is much more likely to be related to retained products of conception than to any other cause (53). Ultrasound of the uterus can often identify these products (54,55). Curettage should be performed once these products are identified. Endomyometritis can also cause a delayed postpartum hemorrhage. In these cases, bleeding should be treated as necessary, primarily with medical therapy, but antibiotic therapy should be instituted once the diagnosis is made.

BLOOD AND BLOOD PRODUCT REPLACEMENT

The clinician must also pay continued attention to the hematologic status of the patient. Initial efforts at control should not be withheld during the attempts to obtain laboratory analysis on the patient, but once available, these laboratory values, particularly any abnormalities, must be addressed quickly. First among concerns in the bleeding patient is the red blood cell transfusion. Patients should receive two units of packed red blood cells as soon as deemed clinically appropriate by the attending clinician. Ideally this blood will be typed and crossmatched to the patient, but in cases where hemorrhage was not expected, uncrossmatched O negative blood may need to be infused. The degree of bleeding that

Table 2 Expected Results from Blood Product Transfusion

Blood product	Contains	Expected result
Packed red blood cells (1 unit = 200–250 mL)	Red blood cells only	Increase of 1 gm/dL hemoglobin or 3% hematocrit
Platelets (1 unit = 50 mL)	Platelets only	Increase of 5–10,000/dL
Fresh frozen plasma (1 unit = 200–300 mL)	All clotting factors	Increase fibrinogen 7–10 mg/dL
Cryoprecipitate (1 unit = 10–15 mL)	Fibrinogen, factors V, VIII, XIII, and vWF	Increase fibrinogen ~7 mg/dL

would necessitate the transfusion of uncrossmatched units depends upon the assessment of the patient and the timing of the availability of type-specific crossmatched blood. Clinicians should consider red cell transfusion in cases where the estimated blood loss exceeds 1000 cc during a vaginal delivery or 1500 cc during a cesarean delivery. The transfusion of one unit of packed red blood cells can be expected to raise the hemoglobin concentration by 1 gm/dL or the hematocrit by 3%. The decision to transfuse a patient depends on the amount of blood loss, any maternal comorbidities, and the risk of recurrent bleeding (Table 2).

During the initial treatment of hemorrhage, infusion of intravenous fluids should not be overlooked. Approximately 3 liters of IV fluid is required to replace 1 liter of blood loss. This fluid does not contain the necessary clotting factors or the oxygen-carrying capacity of the blood lost, so treatment with fluid does not replace treatment with blood products.

Once coagulation studies are available, or sooner if there is an abnormal clot tube, or if clinically indicated, clotting factors should be replaced as well. In order to replace platelets, platelet transfusion is performed. Most conventional blood banks will perform transfusion in terms of units of platelets, but some will still use the term “six pack,” which refers to six units of platelets. Transfusion of each unit of platelets can be expected to raise the platelet count by 5 to 10 K/dL. Correction of the underlying cause of platelet consumption is critical or these platelets may undergo the same consumption that initially caused the thrombocytopenia.

Fibrinogen should be replaced to keep the level above 100 mg/dL (56). Hemostasis can generally be achieved when the activity of coagulation factors is at least 25% of normal, and when the level of fibrinogen is 100 mg/dL. Since the plasma volume in adults is approximately 40 mL/kg, 10–15 mL/kg of fresh frozen plasma may be needed. This dose is approximately three to five units of FFP for adult patients with BMI in the normal range, and may lead to volume overload. Replacement of fibrinogen can be accomplished in two ways. Transfusion of FFP, one unit (200–300 mL), can be expected to increase the fibrinogen level 7 to 10 mg/dL. FFP also has the advantage of containing virtually all clotting factors, making its administration ideal in the treatment of disseminated intravascular coagulation. Cryoprecipitate contains fibrinogen as well as factors V, VIII, XIII, and vWF. One bag of cryoprecipitate will raise the fibrinogen of the patient by 7 mg/dL. The advantage of cryoprecipitate is the smaller volume that must be infused. This presents an advantage in patients where fluid overload is a concern, such as those with severe pre-eclampsia/HELLP syndrome.

In addition to the above, care must be taken to pay particular attention to the electrolyte component of blood loss. Replacement of four units of packed red blood cells should be

accompanied by one ampule of calcium intravenously to prevent derangements in calcium balance, particularly as it relates to the citrate binding of calcium and the potential for metabolic acidosis due to the citrate. Hepatic function should also be considered, as liver derangements common in pre-eclampsia may result in a decreased ability to process the citrate, leading to a greater risk for hypocalcemia in these patients. Older blood may contain a higher percentage of lysed red blood cells, and care must be taken to follow the patient's potassium level in such cases and hyperkalemia should be treated if necessary. Transfused blood and blood products should be warmed to prevent hypothermia.

RECURRENCE

Risks for recurrent postpartum hemorrhage may be as high as 10%, depending on the previous cause (57). Patients with a history of postpartum hemorrhage should have a type and screen performed prior to scheduled induction of labor or cesarean delivery, and all obstetric team members should be aware of the patient's history and should be prepared in case of a recurrent bleeding.

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