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# Clinical Evaluation During Postpartum Hemorrhage

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**Abstract:** Obstetric hemorrhage remains the most important cause of maternal mortality worldwide, accounting for 30% of all direct maternal deaths. As the method of management depends on multiple concurrent and sequential evaluations of the patient's status, it is helpful to have an evaluation strategy prepared for when a postpartum hemorrhage is encountered to facilitate interventions. This review describes an etiology-based approach to the clinical evaluation of postpartum hemorrhage and a suggested systems process that allows both a timely and appropriate evaluation of the hemorrhaging mother.

**Key words:** obstetric hemorrhage, maternal mortality, etiology, evaluation

## Introduction

Obstetric hemorrhage remains the most important cause of maternal mortality worldwide, accounting for 30% of all direct maternal deaths.<sup>1</sup> Primary postpartum hemorrhage (PPH), which occurs in

4% to 6% of all deliveries, is defined in general terms as excessive bleeding that occurs within the first 24 hours after delivery.<sup>2,3</sup> Nevertheless, the definition of PPH varies by mode of delivery and is estimated as greater than 500 mL after a vaginal delivery and as greater than 1000 mL after a cesarean delivery.<sup>4</sup> The World Health Organization has defined PPH blood loss as greater than 500 mL in the first 24 hours after delivery.<sup>5</sup> Some propose to define PPH as a decrease in hematocrit levels by at least 10%<sup>5</sup> or blood loss sufficient to cause significant symptoms in the mother (lightheadedness, syncope, low blood pressure, tachycardia, or low urine output). Although not the focus of this article, secondary PPH occurs between 24 hours and 6 weeks after delivery, complicates 1% to 3% of all deliveries and is most commonly owing to retained placental tissue.<sup>6</sup>

Regardless of the definition used, primary PPH is a clinical emergency requiring urgent evaluations and interventions

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that challenge the delivering clinician (whether obstetrician, family practitioner, or midwife), anesthesia personnel, nursing staff, operating room facilities, laboratory, and blood bank. As the method of management depends on multiple concurrent and sequential evaluations of the patient's status, it is helpful to have an evaluation strategy prepared for when a PPH is encountered to facilitate interventions. This is true whether the hemorrhage is at a vaginal or cesarean delivery or whether it is anticipated or unexpected. However, any evaluation strategy should be cognizant of the underlying etiology of the hemorrhage.

### ***Acute Evaluation of PPH - the Obstetrician's Approach***

The diagnosis of PPH should immediately prompt addressing the following: (1) the clinical circumstances surrounding the delivery, (2) a general assessment of the patient, (3) evaluation of vital signs and (4) detailed physical examination. Important questions include: Was the course of labor normal? Was labor long and/or was the delivery difficult? Is the patient cold, anxious? Is the patient hemodynamically stable?

PPH is usually caused by 1 of the 4 basic etiologies, defined as the 4 T's<sup>7</sup>:

- (1) Abnormal uterine contractility or atony (tone)
- (2) Lacerations or general shock trauma (trauma)
- (3) Retained products of conception (tissue)
- (4) Abnormalities of coagulation (thrombin)

For a patient who delivers vaginally, once the placenta is delivered, excessive bleeding should prompt careful exploration of the uterus, vagina, and cervix. This will usually allow an assessment of the first 3 etiologies, but a clinical examination may not be able to diagnose a coagulation abnormality. Uterine tone and

size are assessed by resting one hand on the fundus and palpating the anterior aspect of the uterus. A bimanual examination may facilitate this assessment. If the uterus is boggy to palpation, large in size, and excessive bleeding is noted, bleeding is likely explained by uterine atony. Risk factors for uterine atony include prolonged use of oxytocin, rapid or prolonged labor, overdistension (in cases such as multiple gestation, polyhydramnios, macrosomia), chorioamnionitis, grand multiparity, and use of uterine relaxing agents (magnesium sulfate, nitroglycerin, halogenated anesthetics). With atony, the uterus should be mobilized or pushed cephalad and massaged as the most important initial intervention. Uterine elevation stretches the uterine arteries, causing compression whereas the myometrium is stimulated to contract. If tone remains poor after several minutes despite vigorous massaging of the uterus, administration of ecbolics such as oxytocin, methylergonovine (in the absence of hypertension), or prostaglandin F<sub>2-α</sub> (in the absence of significant asthma) is indicated as described in other articles in this issue. The bladder should be emptied using intermittent or continuous catheterization for persistent bleeding as a full bladder may interfere with contraction of the lower uterine segment, even if the fundus appears firm.

Although most authorities suggest that the placenta should be promptly examined to determine if it is intact, it is often difficult for the clinician to divert attention away from a bleeding mother. In addition, membrane segments or cotyledon fragments may have detached without leaving clues in the main placental mass, so uterine exploration with adequate analgesia should be performed as part of an early initial assessment. Routine postpartum uterine manual exploration and/or sponge curettage after all vaginal deliveries for prevention of bleeding is not suggested.<sup>8</sup> Rather we prefer perform-

ing such exploration if bleeding persists despite adequate tone and massage to ensure there are no retained secundines. Uterine exploration will also make the diagnosis of placental invasion or uterine rupture, 2 uncommon, but life-threatening causes of PPH. If placental fragments are noted at the time of uterine exploration, manual extraction will assist in the removal of the products. If available, a bedside sonogram may be expeditiously performed to evaluate retained products by assessing an endometrial stripe (Fig. 1). But in an emergency situation, uterine exploration may be more informative and time efficient than performing a sonogram. Removal of retained products may require intervention in the operating room for evaluation under optimum anesthesia and possible curettage. A large Banjo curette should be used with gentle traction to decrease the risk of uterine perforation. Guidance with a transabdominal sonogram may assist the clinician with the removal of placental fragments. Uterine inversion is a rare event, may be complete or incomplete, and merits both rapid diagnosis and correction as profuse hemorrhage and shock may quickly occur.



**FIGURE 1.** Transabdominal view via sonogram of a normal postpartum uterine lining. A thin endometrial stripe is noted.

If bleeding persists despite a firm, well-contracted uterus, the source of bleeding is likely from lacerations.<sup>9</sup> Careful inspection of the vagina, cervix, and uterus is therefore essential. Isolated lacerations involving the middle or upper third of the vagina, although less common, may extend deep into the underlying tissues and thus give rise to significant hemorrhage. Bleeding from these lacerations is controlled by appropriate suturing. Deep cervical tears should be suspected in cases of excessive hemorrhage during and after the third stage of labor, particularly if the uterus is firm and well contracted. Adequate exposure and careful inspection of the cervix are key elements of this evaluation. An assistant should use right angle retractors or equivalent while the operator grasps the cervix with a ring forceps and evaluates any hemorrhaging lacerations. Lighting should be optimized and the patient may be moved to the operating room if necessary to ensure adequate anesthesia and/or availability of instruments. The cervix and vagina should also be examined for the presence of a hematoma that may require drainage. Anesthesia should be consulted as rapid blood loss may lead to rapid maternal decompensation. Intravenous lines should be adequate for access in case crystalloid volume expansion or transfusion of blood products become necessary.

If bleeding continues despite uterine massage, exploration, and administration of ecbolics (as described elsewhere), maternal hemodynamics should be evaluated. Although not precise, changes in the vital signs and clinical examination may provide information in estimating blood loss. Laboratory studies that should be obtained include hemoglobin/hematocrit, platelet count, coagulation factors (protime, partial thromboplastin time, International Normalized Ratio), and fibrinogen. The initial laboratory results may return normal but will serve as a baseline for the patient who continues to experience excessive bleeding

despite all efforts. With significant PPH, a hemorrhagic bleeding diathesis is common. The hospital's blood bank should receive a sample of blood for type and cross match. Blood products should be matched for the patient, including packed red blood cells, fresh frozen plasma, and cryoprecipitate.

In the meantime, as with any medical resuscitation, basic attention to airway, breathing, and circulation are crucial to avoid making a controlled effort uncontrolled. This includes:

- Adequate space to evaluate and manage the patient which may require the operating room
- Oxygen and airway support should general anesthesia be needed Please clarify the phrase "Access to oxygen and airway support..." as it seems unclear.
- Several large-bore intravenous catheters for fluids and possibly blood products
- Foley catheter placement to monitor urine output

Clinical indicators of maternal hemodynamic and coagulation status include blood pressure, pulse (may be more sensitive indicator of acute hypovolemia), peripheral pulse, cool extremities, hypothermia, pale conjunctiva/nail beds, and change in sensoria (Table 1).

Visual estimation of blood loss tends to be imprecise with the degree of inaccuracy higher with increasing amounts of blood loss. Regardless of a practitioner's experience level, estimated blood loss at the time

of a vaginal delivery is frequently underestimated by 30% to 50%.<sup>10</sup> In the setting of PPH, a method of quickly and more accurately estimating losses is needed instead of employing the usual "guesstimate."

Clinical symptoms can be used to assist in determining the acute blood loss. However, in a PPH which does not result in 40% to 50% loss of maternal blood (class 4), changes in clinical status may lag behind blood loss. This can lead to underestimation of the blood loss secondary to the time it takes for the body systems to equilibrate.

Immediate, more accurate, bedside estimations of blood loss can be made. Studies have shown a 16% underestimation with small losses and up to a 41% underestimation with large losses. One study showed that using a conical calibrated drape to collect blood loss decreased the inaccuracy of all volumes of blood loss to <15%.<sup>11</sup> In the event calibrated drapes are not available, other methods using equipment typically found in a labor room can be helpful. Blood can be collected or transferred into a calibrated basin for accurate measurement. 4 × 4 gauze sponges are typically included with delivery sets. These have been shown to have an average carrying capacity of 10 ± 2 mL.<sup>12</sup> Accounting for maternal blood in the placenta is also important. Approximately 150 mL resides in the placenta itself.<sup>10</sup>

**TABLE 1. Benedetti's Classification of Hemorrhage<sup>10</sup>**

Hemorrhage Class	Acute Blood Loss (mL)	Percent Loss	Symptoms
1	900	15	None, palpitations, dizziness, mild tachycardia
2	1200-1500	20-25	Mild tachycardia, tachypnea, diaphoresis, weakness
3	1800-2100	30-35	Overt hypotension, tachycardia (120-160 beats/min), tachypnea, restlessness, pallor, oliguria, Cold and clammy extremities
4	2400	40	Hypovolemic shock

A quick, more accurate bedside estimation of acute blood loss can be made using the following equation:

$$[\text{Number of soaked } 4 \times 4's] \times [10 \text{ mL}] +$$

150 mL maternal blood in the placenta +  
 amount of blood in the basins

Although it may take some time for the laboratory to provide results of coagulation studies, a simple bedside test can identify low levels of fibrinogen. A volume of 5 mL can be placed in an extra-red top tube (no preservative) and set aside. Individuals with normal coagulation function should form a stable clot in the tube within 8 to 10 minutes.<sup>13</sup> If the fibrinogen level is low (< 150 mg/dL), the blood will not clot, or if it does, it will partially or completely dissolve in 30 to 60 minutes. Coagulation replacement can thus be requested from the blood bank as empiric therapy if the blood fails to clot within 8 to 10 minutes.

After further evaluation, the decision to move toward more aggressive therapy is usually a judgment call; delays in intervention can have catastrophic consequences, so we recommend erring on the side of early comprehensive evaluation and therapy. A basic strategy for evaluation during a PPH at vaginal delivery is outlined in Figure 2.

Evaluation of PPH at the time of cesarean delivery requires the same organized etiology-based approach as described above. Interventions to address persistent bleeding despite conservative measures include arterial ligation, uterine suturing techniques (oversewing of a bleeding site, B-lynch suture placement, and multiple square suturing), packing, and hysterectomy. These techniques will be discussed elsewhere within this series of reviews. Excessive bleeding arising from cervical and/or vaginal extensions of the hysterectomy requires careful exploration, inspection, and prompt repair via suturing. Exposure

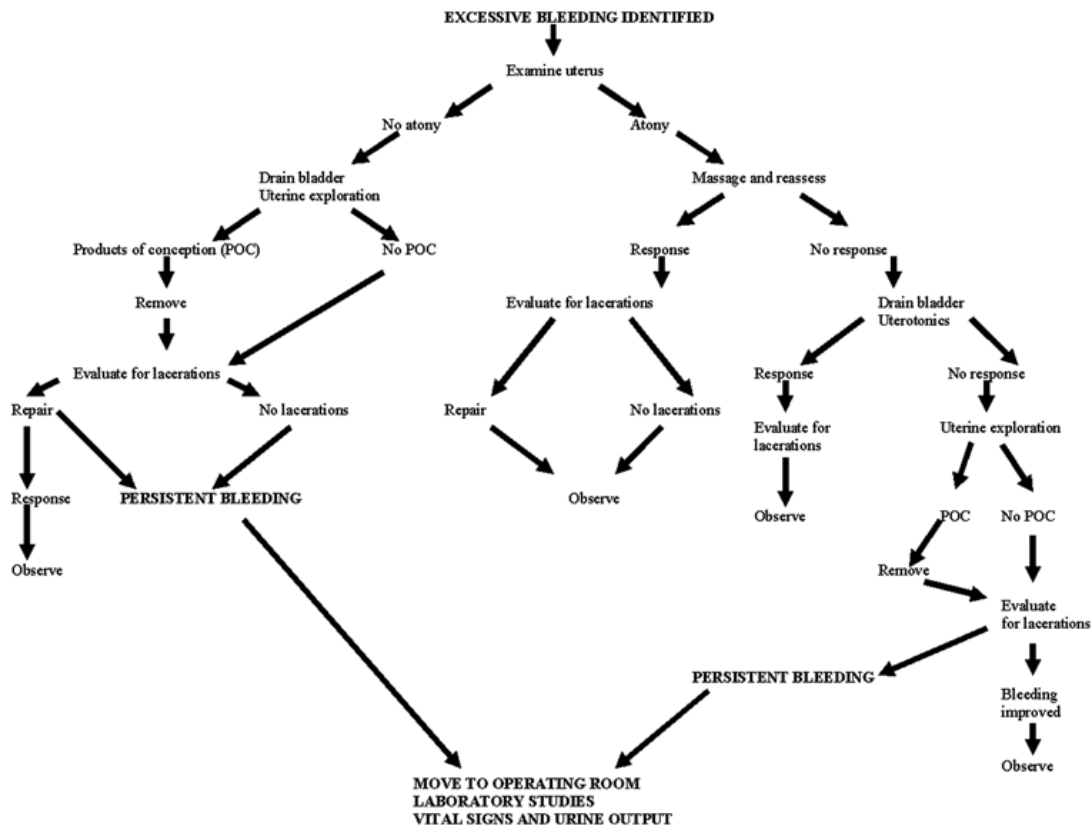
and visualization are key elements of this evaluation.

All of these evaluations need to be performed in an expeditious, efficient manner owing to the quick decompensation of women hemorrhaging after delivery. During an acute hemorrhage, performing a “workup” for possible coagulation disorders such as Von Willebrand disease or factor XI deficiency is not practical. However, for women with previous PPH, many authors consider such evaluation necessary between pregnancies.<sup>14,15</sup>

### ***Acute Evaluation of PPH - a Multidisciplinary Approach***

Owing to the significant morbidity and potential mortality associated with PPH, it is of utmost importance to develop effective evaluation strategies to assist with the management and treatment of the mother. Because emergency situations create opportunities for errors in care, it is essential that obstetricians/delivery providers and labor and delivery staff work together to develop systems within their units to address the coordinated management of acute hemorrhage and massive transfusion for the woman experiencing PPH. Although specifics of management and transfusion care are described in detail elsewhere in this issue, we present here an example of a systems process that allows timely and appropriate evaluation that is reproducible. At our institution, we refer to this process as a “Code Crimson.”<sup>16</sup>

A scheduled Code Crimson is a planned delivery that will potentially involve a massive transfusion situation, such as placental abruption, placenta previa, a suspicion for placenta accreta or suspected percreta. An unscheduled Code Crimson is an unexpected hemorrhage event requiring the massive transfusion protocol. A Code Crimson is activated either by the attending obstetrician or the attending anesthesiologist. A designee phones the



**FIGURE 2.** Suggested approach to the patient experiencing postpartum hemorrhage.

page operator and announces “Activate Code Crimson in Labor and Delivery.” Personnel expected to respond immediately to the Code Crimson include the 24 hour attending on call for obstetrics, the attending anesthesiologist, and certified nurse anesthetist covering obstetrics, all resident physicians assigned to the obstetrics service and pastoral care. Personnel expected to call back immediately include the Maternal Fetal Medicine physician on call, the Nursing Director of Labor and Delivery, Chief of Obstetrics, Interventional Radiology physician on call, Gynecologic Oncologist on call, the perfusionist on call at the discretion of Anesthesia, and the nursing supervisor. Both the Medical Director and manager of the blood bank are also notified of the Code Crimson.

This initial communication effort is important for timely management decisions and interventions, but is also critical for accurate evaluations of the patient throughout the bleeding episode. Each member of the team is assigned a role for evaluation, either of the patient or the ongoing process.

After obtaining adequate intravenous access, the patient is provided an active warming device (ie, Bair hugger) and temperature monitoring. Stat laboratories include type/cross match, complete blood count, protime, partial thromboplastin time, fibrinogen, fibrin split products, and metabolic profile.

As an important component of the evaluation of a hemorrhaging patient is the laboratory testing, special arrangements under a Code Crimson can facilitate

results. Specimens with label, patient identification, time, and operating room phone number are given to the designated Labor and Delivery nurse personnel who then sends the specimen to the blood bank and rapid response lab. We have been able to refine the process in our unit such that results are phoned to the operating room as soon as they are available—15 minutes for hemoglobin, hematocrit, and platelet count, 30 minutes for other Code Crimson laboratories. Once the initial specimens are sent, the obstetrician and anesthesiologist directing the case determine the need for subsequent studies and decide with blood bank personnel about the need for blood transfusion.

Staffing by nursing includes a circulator (the patient's primary care nurse), a scrub nurse, an additional coordinating nurse, a runner (additional person such as a nurse or a technical partner), and the charge nurse. The charge nurse (who can also activate the Code Crimson) designates staff to the various roles above. The charge nurse also prioritizes patient care needs on the other units and communicates unit status as indicated to the unit medical and nursing directors. The additional coordinating nurse (usually the labor and delivery rapid response nurse) should coordinate personnel, complete the Code Crimson records and receive Code Crimson pages. The runner calls the blood bank and rapid response laboratory to notify them about the Code Crimson as well as reports immediately to the blood bank to receive 4 units of packed red blood cells in cooler with ice. The runner also labels and sends patient specimens via the pneumatic tube and obtains additional supplies and/or blood products as needed. The administrative partner prints 40 chart labels, enters laboratory orders into the computer, and notifies bed management to arrange for a critical care bed.

As support details often delay appropriate evaluation and therapy, we have created a system of supplies readily available in case of a Code Crimson

including prepackaged laboratory tubes and requisition slips for blood bank and blood sampling as well as a surgical hemorrhage instrument tray.

Although all of these procedures optimize the evaluation and care of a patient with PPH and facilitate communication, no system will prevent all adverse outcomes.

### Summary

PPH occurs in a significant number of deliveries and can lead to acute decompensation of an otherwise healthy mother. Effective evaluation is critical to allow appropriate therapeutic interventions. An evaluation process should be organized around a step-wise approach that is implemented quickly and efficiently to allow effective care. A Code Crimson approach to significant hemorrhage scenarios assists in organizing the roles of physicians, nurses, and support staff to prioritize medical care and effectively manage resources.

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