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# 2nd and 3rd Trimester Hemorrhage

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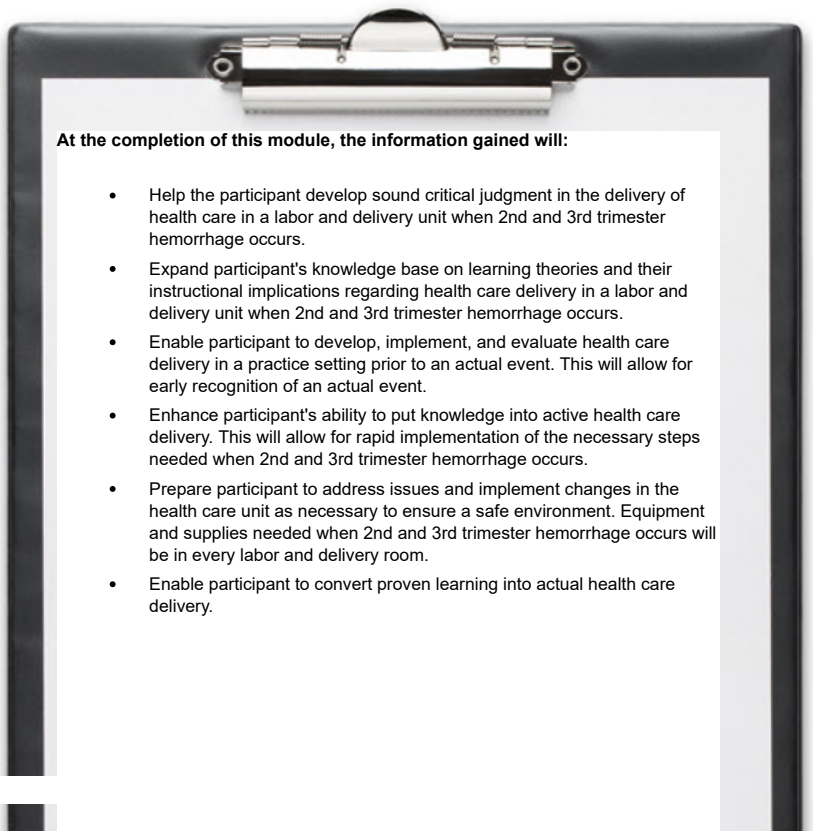
**Course Description:**

Second and third trimester hemorrhage is an event that is life threatening to both the mother and fetus. This course will help to gain understanding of the issues involved with hemorrhage. The participant will gain comfort to understand the examination in a woman with these signs and symptoms. The knowledge gained will help to communicate with other providers, the patient and her family.

**Approximate Time to Complete:** 45 minutes

***Click here to download a print version of this course.***



**At the completion of this module, the information gained will:**

- Help the participant develop sound critical judgment in the delivery of health care in a labor and delivery unit when 2nd and 3rd trimester hemorrhage occurs.
- Expand participant's knowledge base on learning theories and their instructional implications regarding health care delivery in a labor and delivery unit when 2nd and 3rd trimester hemorrhage occurs.
- Enable participant to develop, implement, and evaluate health care delivery in a practice setting prior to an actual event. This will allow for early recognition of an actual event.
- Enhance participant's ability to put knowledge into active health care delivery. This will allow for rapid implementation of the necessary steps needed when 2nd and 3rd trimester hemorrhage occurs.
- Prepare participant to address issues and implement changes in the health care unit as necessary to ensure a safe environment. Equipment and supplies needed when 2nd and 3rd trimester hemorrhage occurs will be in every labor and delivery room.
- Enable participant to convert proven learning into actual health care delivery.


**Antepartum hemorrhage**

*Genital bleeding during pregnancy from the 24th week (sometimes defined as from the 20th week) of gestational age to term.*

- *Reduced fetal birth weight may be associated with hemorrhage*

**Intrapartum hemorrhage**

*Genital bleeding during pregnancy from the period of onset of labor and the third stage of labor.*

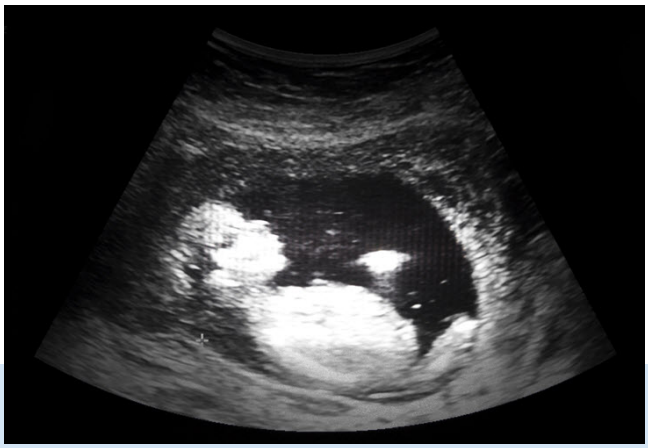
- Vaginal bleeding is common at all stages of pregnancy.
- Bleeding is generally maternal and not fetal.
- Bleeding may be caused by cervical or vaginal lesions or disruption of blood vessels in the decidua.
- The patient's gestational age, amount of bleeding, associated pain or painless, and intermittent or constant character of bleeding will help direct the health care provider to a clinical diagnosis.
- To confirm or revise the original diagnosis, the provider may use laboratory and imaging tests.
- The etiology and evaluation of vaginal bleeding in pregnant women will be reviewed in this module.
- The specific causes of bleeding and their management are beyond the scope of this program.

## Evaluation PRIOR to 20 weeks gestation

- An abdominal examination is performed to assess for pain or other abnormalities and uterine size.
- At 16 weeks of gestation, the uterine fundus is palpable about midway between the symphysis pubis and umbilicus, while at 20 weeks, it is palpable at about the level of the umbilicus.
- After the abdominal examination, the patient is placed in the lithotomy position. The external genitalia are examined and then a speculum is inserted into the vagina.
- Physical examination may reveal a nonpregnancy-related source of bleeding, such as cervical ectropion, an abnormal growth, a laceration, or sanguinous-purulent discharge.
- Direct visualization of a dilated cervix or fetal membranes may be sufficient to diagnose impending miscarriage if contractions are present, or cervical insufficiency in the absence of contractions.

## Evaluation PRIOR to 20 weeks gestation

- Transvaginal ultrasound is also essential in the evaluation of bleeding in pregnancy.
- The goals of ultrasound use is to determine whether:
- Placenta previa is present. (The placenta is covering the cervical os).
- Abruptio placenta is occurring. (Presence of decidual hemorrhage is present causing placental separation).
- The cervical length is short, cervix is dilated at the internal os, or there is prolapse of the fetal membranes through the cervical os.



## Differential Diagnosis - Prior to 20 weeks gestation

- Miscarriage
- Pathology of the cervix, vagina, or uterus
- Cervical insufficiency
  - Cervical insufficiency is a clinical diagnosis
  - In the second trimester, the presentation will include cervical dilation and effacement with the absence of uterine contractions. There may be fetal membranes seen at or through the external os of the cervix.
  - One or more of the following symptoms may also be present:
    - Pressure or a fullness type feeling in the vagina
    - Vaginal spotting or bleeding
    - Increased amount of watery, mucus, or brown vaginal discharge
    - An uncertain discomfort in the back or lower abdomen
- A shortened cervix may be present on the ultrasound in a woman with a history of a previous preterm birth who may be otherwise asymptomatic.

***Click here to see more information.***

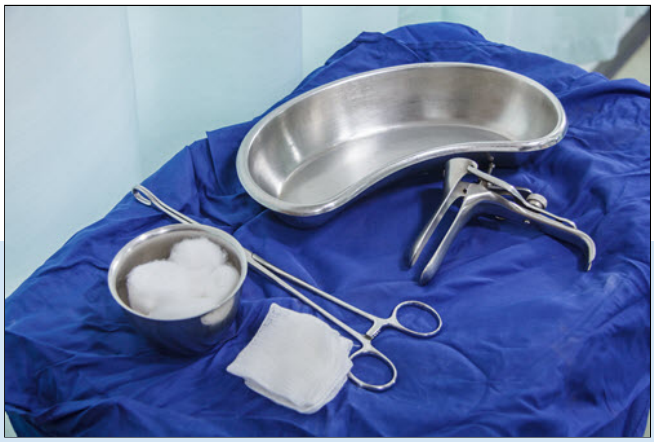
Antepartum hemorrhage AFTER 20 weeks gestation will now be discussed.

# Evaluation AFTER to 20 weeks gestation

- The small amount of blood and mucus vaginal discharge that occurs prior to labor by as much as 72 hours is known as 'bloody show.'
- Uterine bleeding occurring after 20 weeks of gestation that is not related to labor and delivery is known as antepartum bleeding.
- Four to five percent of pregnancies are complicated by antepartum bleeding.
- The major causes are:
- Placenta previa in 20 percent of pregnancies
- Abruptio placenta in 30 percent of pregnancies
- Rarely uterine rupture or vasa previa
- Remaining cases are associated with marginal separation of the placenta

# Evaluation AFTER to 20 weeks gestation

- A digital cervical exam is to be avoided in the second half of pregnancy until placenta previa has been excluded.
- Severe hemorrhage could occur when a digital exam is performed into the placenta.
- A hemodynamically unstable woman may have hypotension, tachycardia, orthostasis, or syncope. A baseline set of labs containing hemoglobin, hematocrit, and coagulation studies should be obtained.
- If heavy or persistent vaginal bleeding continues, the baseline set of blood tests will be valuable. In particular, these results will help to identify a concealed hemorrhage.

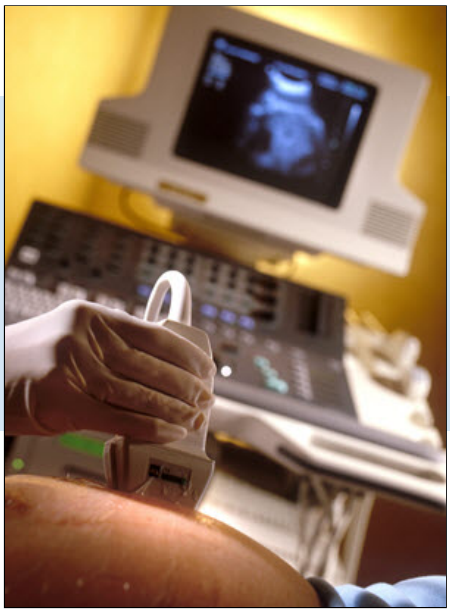


## Antepartum hemorrhage differential after 20 weeks gestation

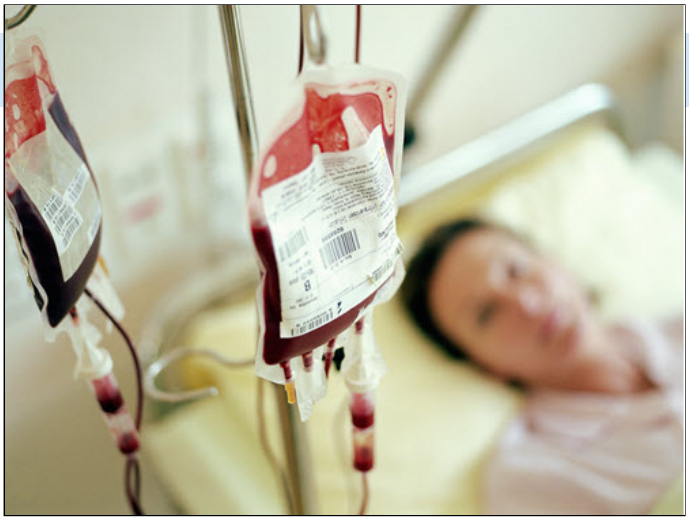
- Placenta Previa
- Abruptio Placenta
- Uterine Rupture and Vasa Previa
- Cervical or Vaginal Pathology
- Choriocarcinoma

*Click the terms in blue to see more information.*

- Adverse pregnancy outcome, chiefly preterm birth is associated with first, second, and third trimester bleeding.
- The degree and cause of bleeding is associated with the level of risk of adverse outcomes [1]. There is worse outcome with heavier bleeding and bleeding from non-previa sources [2,3].
- Preterm birth has a two-to-three-fold increased rate of occurrence when antepartum bleeding of unknown origin occurs in the second half of pregnancy [2,3].



There are numerous factors with the management of pregnant women with vaginal bleeding in the second and third trimesters including gestational age, the cause of bleeding, the severity and fetal status.



One aspect of managing maternal bleeding is determining when anti-D immune globulin (Rhogam) is needed.

Despite considerable proof of efficacy, there area still a large number of cases of Rh D alloimmunization [23].

- Women who carry the Rh D antigen are identified as Rh D positive and do not require Rhogam.
- Women who do not carry the antigen are identified as Rh D negative and will need anti-D immune globulin when exposed to fetal anti-D positive blood.
- Alloimmunization, what we want to prevent with Rhogam, refers to an immunologic reaction against foreign antigens distinct from antigens on an individual's cells; maternal formation of antibodies against fetal Rh D.
- Fetal-maternal hemorrhage is the term used to identify varying amounts of fetal cells in the maternal circulation from small interruptions at the fetal-maternal placental interface. Ordering the Kleihauer-Betke test from a maternal blood draw can determine the significance of this exposure when the mother is Rh D negative.
- The Kleihauer-Betke test may not be accurate when the maternal circulation has increased hemoglobin F in her circulation, which occurs when sickle-cell disease and thalassemias are present. Flow cytometry should be utilized to understand the exposure in these situations.
- When either study shows the fetal-maternal hemorrhage has occurred in a volume not covered by the standard 300microgram dose of anti-D immune globulin (greater than 30mL of fetal whole blood or 15mL of fetal red cells) additional vials of anti-D immune globulin can be administered at one time (up to eight full vials). These additional doses can be given intramuscular (IM) at separate sites every 12 hours until the desired dosage has been reached.
- The anti-D immune globulin should be given within 72 hours of the fetal-maternal exposure of blood.
- Women testing positive for weak D, formerly termed Du, are candidates for anti-D immune globulin and should be given this medication as indicated through the pregnancy to avoid alloimmunization.

## Management - Quick Overview

Notify staff and services that will or may be needed:

- Anesthesia
- Neonatology
- Blood bank
- Surgery
- Obstetrics
- Pelvic Surgery
- Maternal Fetal Medicine
- Gynecologic Oncology
- Interventional Radiology
- General Surgery

**Many of the interventions will be appropriate in acutely ill patients even if the etiology of hemorrhage is uncertain, and these can be initiated while the diagnostic evaluation is ongoing.**

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|



*Click each number in order to learn more.*

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# Congratulations!

**You have successfully completed this module.**

*Click on the above 'X' to take the post-test for this course.*
*If you do not attain a passing score after two attempts at the post-test the entire program must be repurchased.*

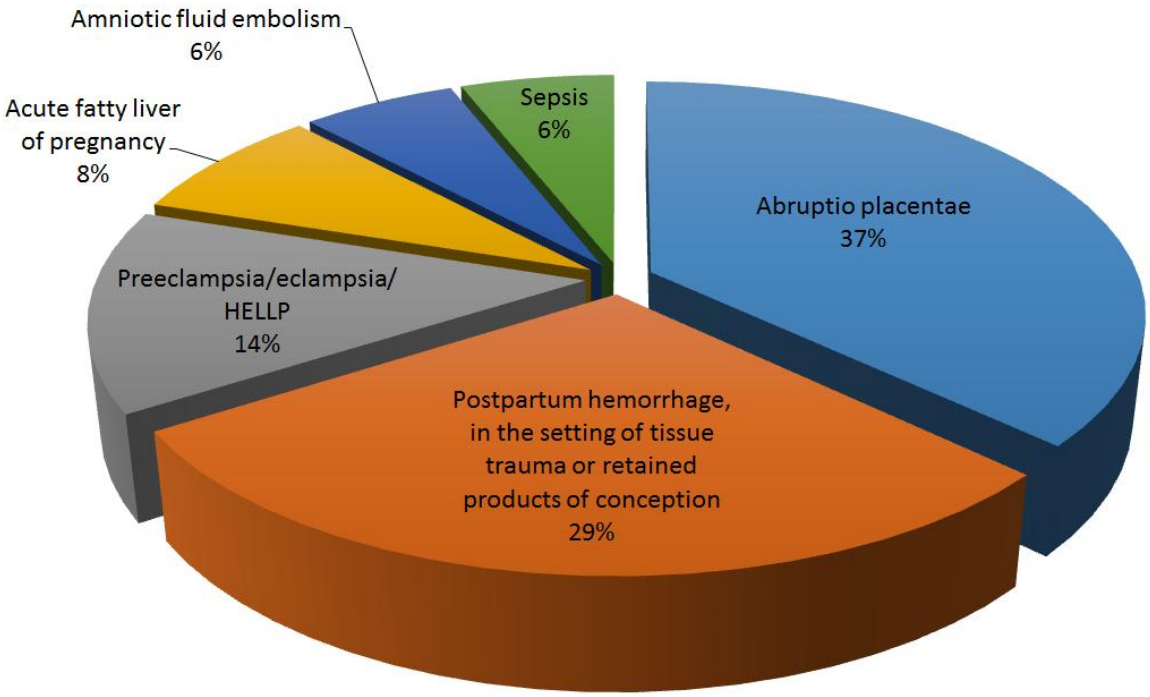
Amniotic fluid embolism
6%
Sepsis
6%
Acute fatty liver
of pregnancy
8%
Abruptio placentae
37%
Preeclampsia/eclampsia/
HELLP
14%
Postpartum hemorrhage,
in the setting of tissue
trauma or retained
products of conception
29%

**Table 1**

| Events | That | Initiate | DIC | |
|---|---|---|---|---|
| Septiciemia – gram Neg and Gram + | Crush injury or complicated surgery | Severe head injury | Abdominal aortic aneurysm | Peritoneovenous shunt |
| Cancer procoagulant (Trousseau's syndrome) | Acute Leukemia, especially promyelotic | Amphetamine overdoese | Giant Hemangioma (Kasaback-Merritt Syndrome) | Acute hemolytic transfusion reaction (ABO incompatibility) |
| Complications of pregnancy:<br>• Amiotic fluid embolism<br>• Abruption<br>• HELLP syndrome<br>• Eclapmsia and severe preeclampsia<br>• Septic abortion | Paroxysmal nocturnal hemoglobinuria | Snake and Viper venoms | Liver disease:<br>Fulminant hepatic failure<br>Reperfusion after liver transplant | Heat stroke |
| Burns | Purpura fulminans | Events that propagate and complicate DIC:<br>• Shock<br>• Complement pathway activation | | |

**Table 2**

| Test | Normal (reference) range | | |
|---|---|---|---|
| | First trimester | Second trimester | Third trimester |
| Prothrombin time (seconds) | 9.7 to 13.5 | 9.5 to 13.4 | 9.6 to 12.9 |
| Activated partial thromboplastin time (seconds) | 23.0 to 38.9 | 22.9 to 38.1 | 22.6 to 35.0 |
| Platelet count (x$10^9$/L) | 174 to 391 | 155 to 409 | 146 to 429 |
| Fibrinogen (mg/dL) | 244 to 510 | 291 to 538 | 301 to 696 |
| D-dimer (micrograms/mL) | 0.05 to 0.95 | 0.32 to 1.29 | 0.13 to 1.7 |

**Table 3**

| Product (mL) | Contents | Uses and effects |
|---|---|---|
| Whole blood (1 unit = 500 mL) | All components | Rarely required. Consider when massive bleeding requires transfusion of more than 5 to 7 units of packed red cells. |
| Red cells + additive solution (1 unit = 350 mL) | Red cells | One unit increases hematocrit by 3 percentage points and hemoglobin by 1 g/dL. |
| Frozen plasma (1 unit = 200 to 300 mL) | All clotting factors, but no platelets | Best used to correct deficiencies of multiple coagulation factors (eg, DIC, liver disease, warfarin overdosage). One unit FFP increases fibrinogen by 7 to 10 mg/dL. Usual dose is 10 to 15 mL/kg. |
| Cryoprecipitate (1 unit = 10 to 20 mL) | Fibrinogen, factors VIII, XIII, VWF | One unit of cryoprecipitate/10 kg body weight will raise plasma fibrinogen by about 50 mg/dL in the absence of heavy bleeding or consumption. The formula for raising plasma fibrinogen by 50 to 100 mg/dL is: number of units = 0.2 x body weight in kg. Cryoprecipitate is generally provided in pools containing 5 units and most patients receive two pools. |
| Whole blood-derived and apheresis-derived platelets (1 unit = 200 to 300 mL) | Platelets | Six units of whole blood-derived or one unit of apheresis-derived platelets will raise the platelet count by approximately 30,000/microL in an average sized adult. |

**Table 5**

| Product (mL) | Contents | Uses and effects |
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# Abruption

- Abruption of the placenta is usually characterized by the abrupt onset of mild to moderate vaginal bleeding, abdominal pain, back pain and accompanied by uterine contractions.
- However a placental abruption may be concealed, with no vaginal bleeding.
- The uterus has increased tone/rigidity and may be tender both during and between contractions.
- Patients with classic symptoms, abnormalities of fetal heart rate or fetal demise and/or DIC (disseminated intravascular coagulation) strongly support the clinical diagnosis and indicating extensive placental separation.

## Preeclampsia

Preeclampsia with severe features has hypertensioin associated with one or more signs or symptoms with increased maternal and fetal morbidity/mortality.

- The occurrence of a seizure upgrades the diagnosis to eclampsia
- Women with HELLP syndrome often have many of the clinical findings associated with preeclampsia, as well as the laboratory findings that establish the syndrome

## Preeclampsia with Severe Features

Symptoms of central nervous system dysfunction:

- Altered mental status:
- New onset cerebral or visual disturbance, such as:
- Photopsia, scotomata, cortical blindness, retinal vasospasm
- Severe headache (i.e. incapacitating, "the worst headache I've ever had") or headache that persists and progresses despite analgesic therapy
- Hepatic abnormality:
- Severe persistent right upper quadrant or epigastric pain unresponsive to medication and not accounted for by an alternative diagnosis or serum transaminase concentration ≥ twice normal, or both
- Severe blood pressure elevation:
- Systolic blood pressure ≥160 mmHg or diastolic blood pressure ≥110 mmHg on two occasions at least four hours apart while the patient is on bedrest (unless the patient is on antihypertensive therapy)
- Thrombocytopenia:
- <100,000 platelets/microL
- Renal abnormality:
- Progressive renal insufficiency (serum creatinine >1.1 mg/dL or doubling of serum creatinine concentration in the absence of other renal disease)
- Pulmonary edema

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# Amniotic Fluid Embolism

Amniotic fluid embolism (AFE) is characterized by the abrupt and fulminant onset of hypotension due to cardiogenic shock, hypoxemia and respiratory failure, and coma or seizures immediately postpartum or during labor.

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# Acute Fatty Liver of Pregnancy

- Acute fatty liver of pregnancy initially presents with nausea or vomiting (approximately 75 percent of patients), abdominal pain (50 percent epigastric region), anorexia, and jaundice.
- Approximately one-half of patients have signs of preeclampsia at presentation or at some time during the course of illness.

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# Retained Fetal Demise

Retained dead fetus is diagnosed readily by ultrasound imaging that confirms the absence of fetal cardiac activity and overlapping skull bones, gross distortion of fetal anatomy (maceration), and soft tissue edema.

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# Septic Abortion

Septic abortion is characterized by abdominal and/or pelvic pain, malodorous vaginal discharge, fever and chills, bleeding or spotting, and uterine or adnexal tenderness after a spontaneous or induced abortion.

## Hemodynamically stable mother with dead or nonviable fetus

- The goal is to minimize maternal morbidity and mortality risk when the fetus is dead or has a very poor prognosis (gestation is less than 23-24 weeks, lethal or life threatening congenital anomaly, preterminal FHR tracing).
- In many but not all cases, this means avoiding cesarean delivery because of the risk of uncontrollable hemorrhage from surgical incisions and lacerations.
- Delivery is initiated and the mother is supported with crystalloid (with out or with colloids) and blood products.
- The trigger for bleeding is generally removed upon delivery in many obstetrical cases, causing the myometrium to contract (involution of the uterus), thus removing both the major sources and site of hemorrhage.
- Dilation and extraction (D&E) is a good option in the second trimester for rapid uterine evacuation if the clinician is skilled in this procedure.
- Women able to labor should be induced if not already in labor or augmented if not progressing rapidly.
- When the cervix is not favorable, the use of either a mechanical method of ripening (balloon catheter or hygroscopic dilator) or a pharmacologic method of induction (misoprostol or oxytocin).

# Vaginal Delivery

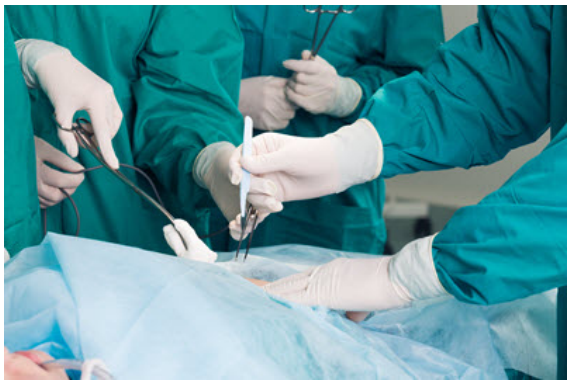
- The safest maternal option may not be vaginal delivery when hemodynamic instability from ongoing brisk uterine bleeding is occurring, nor if the mother would be endangered by vaginal delivery (for example, prior classical hysteretomy).
- In these cases, cesarean delivery is indicated to save the mother's life.
- Cesarean delivery is also indicated if prompt delivery has the potential to reduce fetal morbidity and mortality.

# Cesarean Delivery

- Not always possible, but desirable to correct and improve the clotting abnormality prior to cesarean delivery.
- If there were a delay in operative intervention this could lead to worsening of coagulopathy, further blood loss, and potential fetal death.
- However, immediate operative intervention in a woman with severe hypovolemia and DIC could prove fatal to the woman.
- When cesarean delivery is imminent, then RBC's, plasma (or FFP), platelets, and cryoprecipitate should be readily available in the operating room and administer if there is clinical or laboratory evidence of impaired coagulation. With cesarean birth, bleeding without clotting from the incision and needle sites is a clinical sign of coagulopathy.
- Without waiting for laboratory results, FFP and cryoprecipitate should be given immediately.

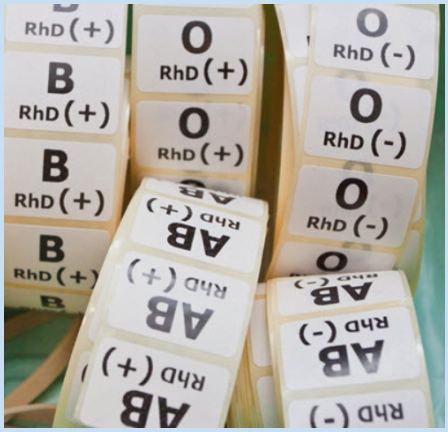
# Hysterectomy

- As a last resort in a woman desiring childbearing preservation, hysterectomy is performed, but should be initiated sooner than later when future pregnancy is not planned.
- Delaying hysterectomy increases blood loss and frequency of complications.
- Despite rescue measures some patients will enter a lethal downward spiral characterized by hypothermia, coagulopathy and metabolic acidosis.
- Criteria proposed for this "in extremis" state include pH <7.30, temperature <35 degrees Celsius, combined resuscitation and procedural time >90 minutes, non-mechanical bleeding, and transfusion requirement >10 units packed RBCs [29]
- To abort the cycle, the bleeding area can be tightly packed using a pelvic pressure pack or lap sponges [30].
- The abdominal wound, including the fascia, is left open and a pressure dressing is applied.
- Towel clips have been utilized to temporarily re-approximate the skin/subcutaneous tissue.



## Management - Transfusion

- In most instances, preparation of fully typed and cross-matched red blood cells (RBCs) requires at least 20 minutes.
- Clinicians can begin transfusion immediately using type O, Rh(D)-negative RBCs, if necessary, and then switch to type-specific or typed and cross-matched RBCs when available.
- Initially, type AB Fresh Frozen Plasma (FFP; either Rh(D) positive or negative) can be used when transfusion is necessary prior to obtaining type-specific FFP.



Bedside Responsibilities

Blood Bank Responsibilities

Nursing Responsibilities

Transfusion Targets

Laboratory Testing

Review of massive transfusion protocol events by transfusion services

Attending Physician, Surgeon, or Anesthesiologist Responsibilities

*Click each blue term above to learn more.*

**Massive Transfusion Policy**

- The massive transfusion protocol (MTP) is a multidisciplinary process whereby blood and blood components are obtained rapidly for an exsanguinating patient.
- The MTP is initiated as soon as possible reporting to the physician in charge of the transfusion service (TS MD) by the blood bank staff or patient care provider.
- The TS MD serves as a consultant in the evaluation and management of the patient's transfusion therapy during the massive transfusion episode.

**Example reasons for initiation:**

- Replacement of at least one blood volume (8 to 10 red blood cell units in a 70 kg adult) within 24 hours or at least one half blood volume within 2 hours
- Life-threatening trauma presenting to the emergency department
- Unexpected or anticipated surgical blood emergencies
- Severe obstetrical hemorrhage

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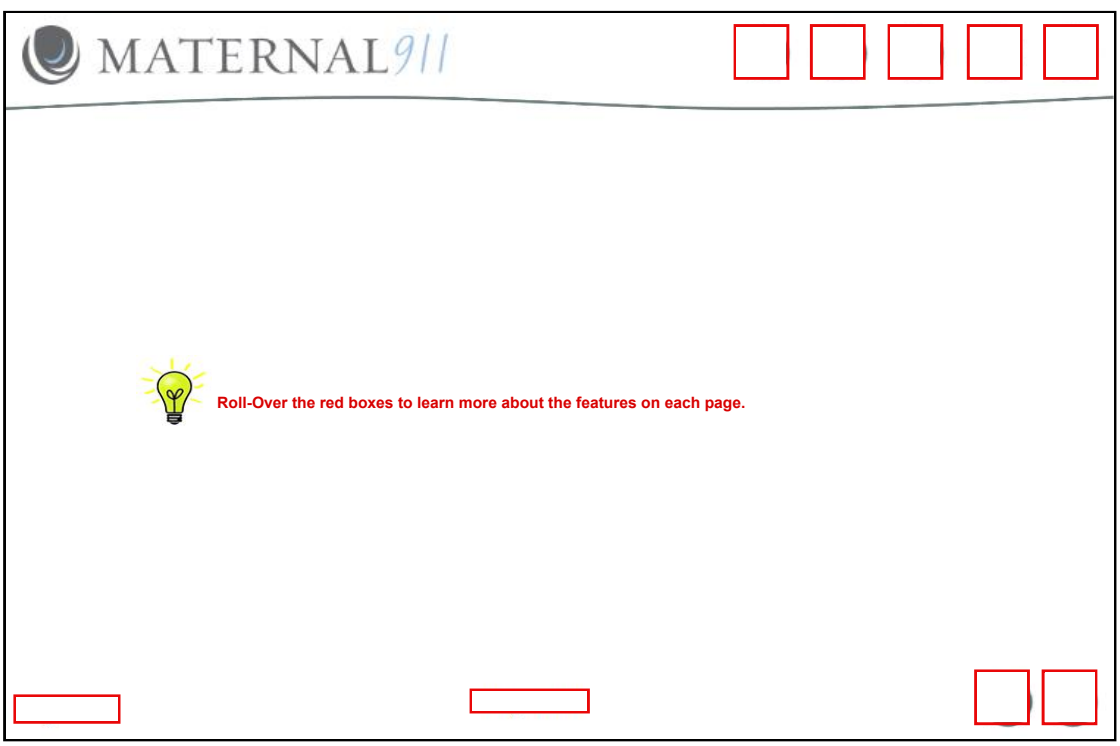

## References


1. Towers CV, Burkhart AE. Pregnancy outcome after a primary antenatal hemorrhage between 16 and 24 weeks' gestation. Am J Obstet Gynecol 2008; 198:684.e1.

2. Magann EF, Cummings JE, Niederhauser A, et al. Antepartum bleeding of unknown origin in the second half of pregnancy: a review. Obstet Gynecol Surv 2005; 60:741.

3. Bhandari S, Raja EA, Shetty A, Bhattacharya S. Maternal and perinatal consequences of antepartum haemorrhage of unknown origin. BJOG 2014; 121:44.

4. Cantle, PM, Cotton, BA. Prediction of Massive Transfusion in Trauma. Crit Care Clin 2017, 33-71.

5. Hardy JF, De Moerloose P, Samama M, Groupe d'intérêt en Hémostase Périopératoire. Massive transfusion and coagulopathy: pathophysiology and implications for clinical management. Can J Anaesth 2004; 51:293.

6. Smith HM, Farrow SJ, Ackerman JD, et al. Cardiac arrests associated with hyperkalemia during red blood cell transfusion: a case series. Anesth Analg 2008; 106:1062.

7. British Committee for Standards in Haematology, Stainsby D, MacLennan S, et al. Guidelines on the management of massive blood loss. Br J Haematol 2006; 135:634.

8. American College of Surgeons Committee on Trauma. Advanced Trauma Life Support (ATLS) Student Course Manual, 9th ed, American College of Surgeons, Chicago 2012.

9. Holcomb JB, Jenkins D, Rhee P, et al. Damage control resuscitation: directly addressing the early coagulopathy of trauma. J Trauma 2007; 62:307.

10.Mannucci PM, Federici AB, Sirchia G. Hemostasis testing during massive blood replacement. A study of 172 cases. Vox Sang 1982; 42:113.

11. Hess JR. Blood and coagulation support in trauma care. Hematology Am Soc Hematol Educ Program 2007; :187.

12. Meng ZH, Wolberg AS, Monroe DM 3rd, Hoffman M. The effect of temperature and pH on the activity of factor VIIa: implications for the efficacy of high-dose factor VIIa in hypothermic and acidotic patients. J Trauma 2003; 55:886.

13. Cosgriff N, Moore EE, Sauaia A, et al. Predicting life-threatening coagulopathy in the massively transfused trauma patient: hypothermia and acidoses revisited. J Trauma 1997; 42:857.

14. Stanworth SJ, Walsh TS, Prescott RJ, et al. A national study of plasma use in critical care: clinical indications, dose and effect on prothrombin time. Crit Care 2011; 15:R108.

15. Smith HM, Farrow SJ, Ackerman JD, et al. Cardiac arrests associated with hyperkalemia during red blood cell transfusion: a case series. Anesth Analg 2008; 106:1062.

16. Reed RL Jr, Ciavarella D, Heimbach DM, et al. Prophylactic platelet administration during massive transfusion. A prospective, randomized, double-blind clinical study. Ann Surg 1986; 203:48.

17. Bracey A. Guidelines for Massive Transfusion, American Association of Blood Banks, Bethesda, MD 2005.1111111

18. Technical Manual, 16th ed, American Association of Blood Banks, Bethesda, MD 2008.

19. http://s0www.utdlab.com/contents/image.do?imageKey=OBGYN%2F91236

20. http://www.uptodate.com/contents/massive-blood-transfusion?source=search_result&search=massive+transfusion&selectedTitle=1%7E56

21. Smith HM, Farrow SJ, Ackerman JD, et al. Cardiac arrests associated with hyperkalemia during red blood cell transfusion: a case series. Anesth Analg 2008; 106:1062

## Links

| Title | Link |
| --- | --- |