MATERNAL911®

2nd and 3rd Trimester Hemorrhage

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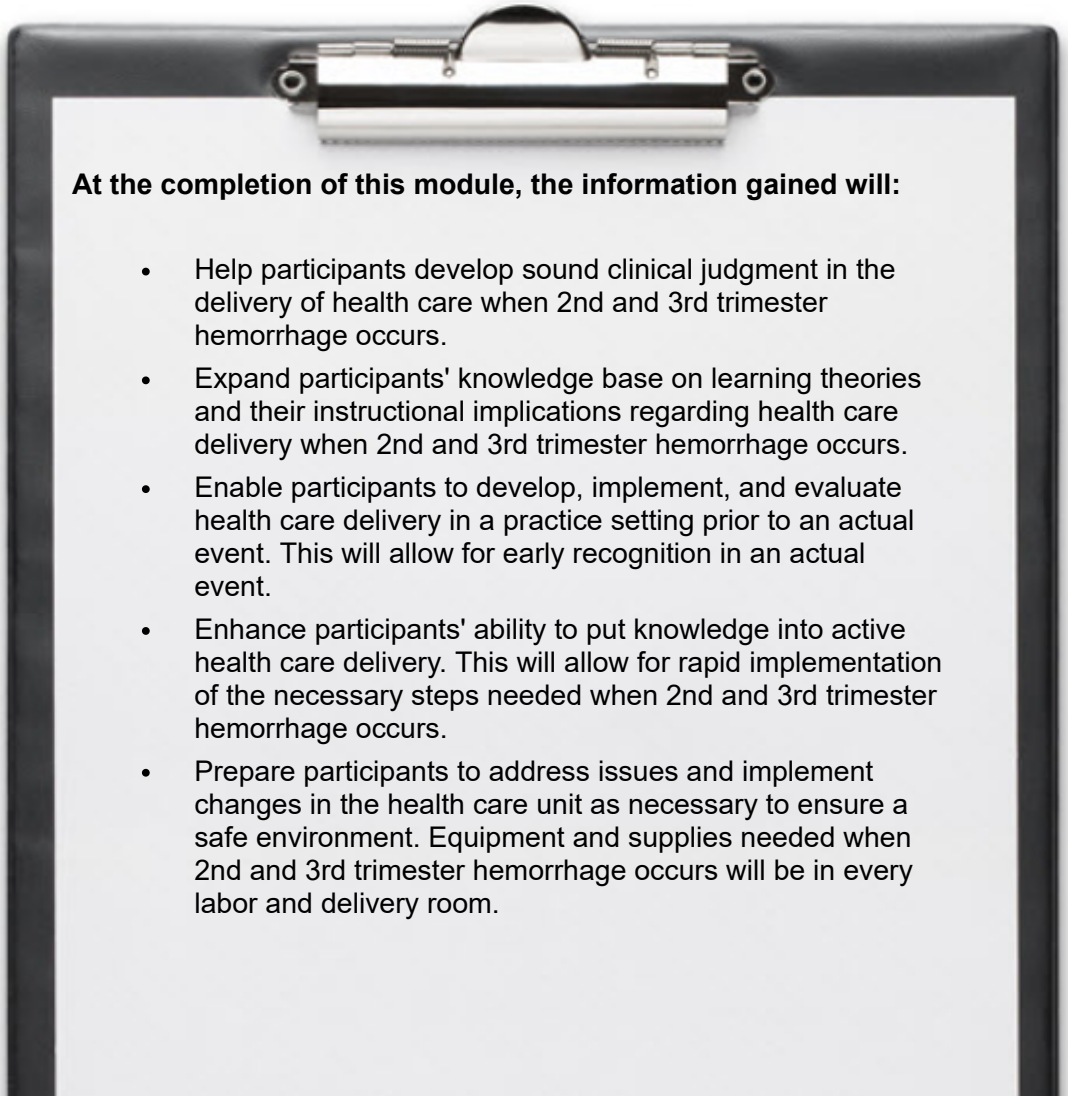
Course Description:

Second and third trimester hemorrhage is an event that is life threatening to both the mother and fetus. This course will help participants develop an understanding of the issues involved when hemorrhage occurs. The participants will gain knowledge in the signs and symptoms the woman may have when hemorrhage occurs. The knowledge gained will be valuable in communicating findings with other providers of the health care team, 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 participants develop sound clinical judgment in the delivery of health care when 2nd and 3rd trimester hemorrhage occurs.
- Expand participants' knowledge base on learning theories and their instructional implications regarding health care delivery when 2nd and 3rd trimester hemorrhage occurs.
- Enable participants to develop, implement, and evaluate health care delivery in a practice setting prior to an actual event. This will allow for early recognition in an actual event.
- Enhance participants' 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 participants 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.

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.

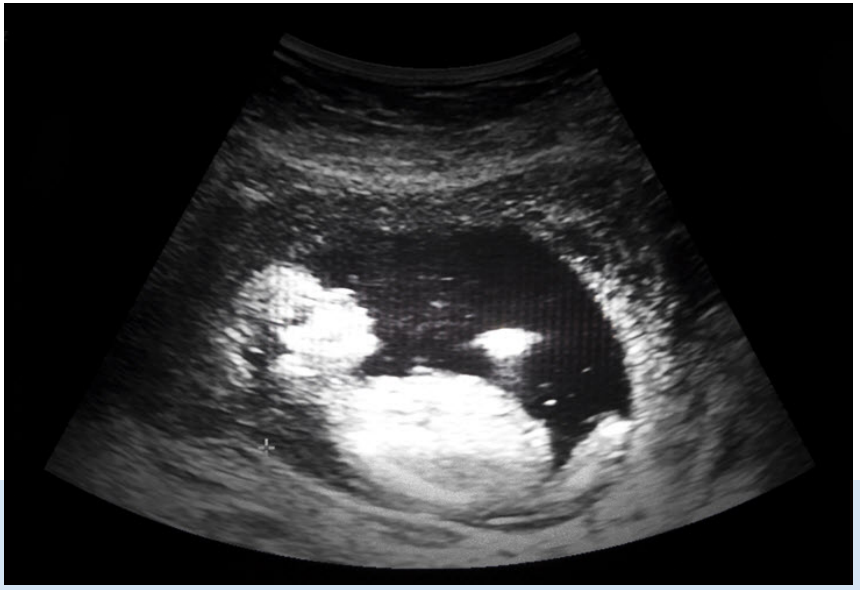
- Vaginal bleeding is common at all stages of pregnancy.
- Bleeding is generally maternal and not fetal.
- Bleeding may be caused by cervical or vaginal lesions or disruption of blood vessels in the decidua.
- The patient's gestational age, amount of bleeding, associated pain or absence of pain, and 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 if there are no 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, the 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 2nd 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.

Differential Diagnosis - Prior to 20 Weeks Gestation

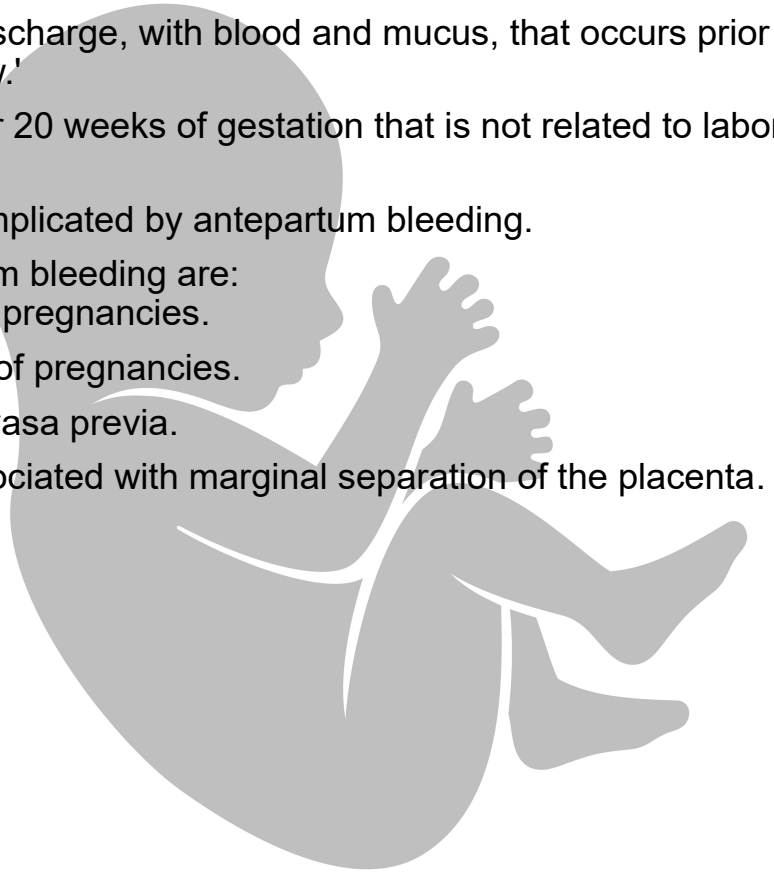
- Abruptio Placentae:
  - Bleeding and cramping may be present when there is placental= separation due to hemorrhage into the decidua.
  - Placental separation is not generally observed on ultrasound= examination, so this diagnosis is one of exclusion.
  - A subchorionic hematoma supports the diagnosis if an abruptio placentae.

- Ectopic Pregnancy:
  - Ectopic pregnancy is rare in the 2nd trimester.
  - If an ectopic pregnancy is diagnosed in the 2nd trimester, the location is generally abdominal, cervical, cesarean scar, cornual, or coexistent intrauterine and extrauterine pregnancies.

Antepartum hemorrhage AFTER 20 weeks gestation will now be discussed.

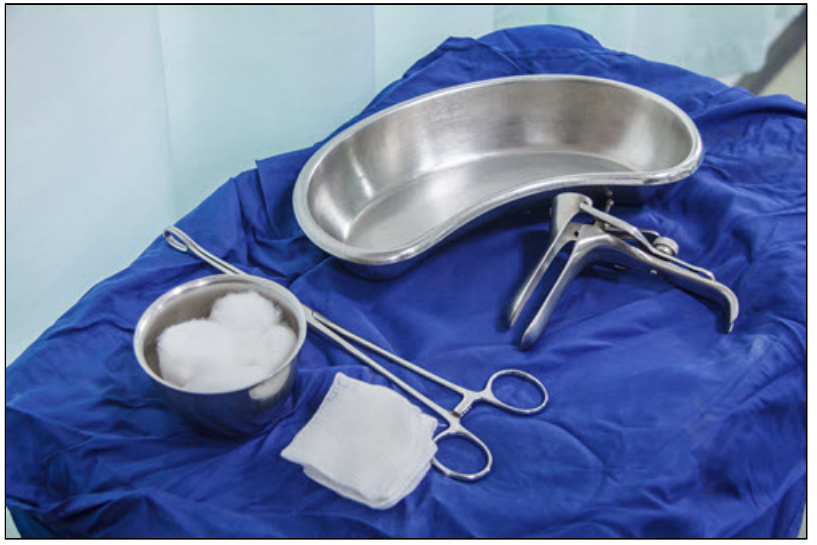
Evaluation AFTER 20 Weeks Gestation

- The small amount of vaginal discharge, with blood and mucus, 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.
- 4 to 5% of pregnancies are complicated by antepartum bleeding.
- The major causes of antepartum bleeding are:
  - Placenta previa in 20% of pregnancies.
  - Abruptio placenta in 30% of pregnancies.
  - Rarely uterine rupture or vasa previa.
  - Remaining cases are associated with marginal separation of the placenta.



Evaluation AFTER 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

- In the second half of pregnancy, placenta previa should be considered when the woman is experiencing vaginal bleeding.
- Abdominal pain and uterine contractions were generally thought to be associated with abruptio placenta and distinguishes abruption from placenta previa.
- Some women may experience uterine contractions when placenta previa is present; therefore, they may have painful vaginal bleeding.
- Placenta previa is determined by ultrasound examination.
- Again, do not perform a digital cervical exam in a pregnant woman who is bleeding in the second half of pregnancy until placenta previa has been excluded.

Click the terms in blue to see more information.

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.

- Premature separation of an implanted placenta prior to delivery of the infant is referred to as aburptio placenta.
- Common risk factors associated with abruption include:
  - Prior placental abruption
  - Trauma
  - Smoking
  - Cocaine use
  - Hypertension
  - Preterm premature rupture of membranes (PPROM)
- The typical presentation of abruptio placenta with or without nonreassuring fetal testing:
  - Vaginal bleeding (80%)
  - Uterine tenderness (70%)
  - Uterine contractions (35%) that can be with or without nonreassuring fetal testing
- Extravasation of blood into the myometrium, called a Couvelaire uterus, causes uterine tenderness with enlargement and a bluish-purple color because blood goes through the myometrium to the serosa.

Click here learn more about Abruptio Placenta.

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.

Blood can penetrate through the uterine serosa and into the peritoneal cavity in severe cases.

- There may be concealed bleeding within the uterus so the amount of vaginal bleeding does not indicate the severity of the hemorrhage.
- It is uncommon to detect abruption placenta on ultrasound.
- Placenta abruption is detected on only 2% of ultrasound exams.
- Ultrasound is commonly used to exclude placenta previa.
- Abruptio placenta can range from mild to life-threatening. This may be an acute or a chronic condition.
- When a pregnant woman is being evaluated for trauma such as a motor vehicle accident, fall, or domestic violence, an abruption should be considered.

Antepartum Hemorrhage
Differential After 20 Weeks Gestation

Placenta Previa

Abruptio Placenta

Uterine Rupture and Vasa Previa

Cervical or Vaginal Pathology

Choriocarcinoma

- Uterine rupture and vasa previa are rare causes of vaginal bleeding, and occur more often intrapartum than antepartum.
- Vasa previa refers to bleeding from the umbilical cord resulting in the loss of fetal rather than maternal blood.
- Both may lead to fetal death.
- Other etiologies for bleeding may include a non-tubal pregnancy or cervical, vaginal, or uterine pathology, which may include trophoblastic disease (a discussion beyond the module' scope).

Click the terms in blue to see more information.

Antepartum Hemorrhage
Differential After 20 Weeks Gestation

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

Possible causes include:

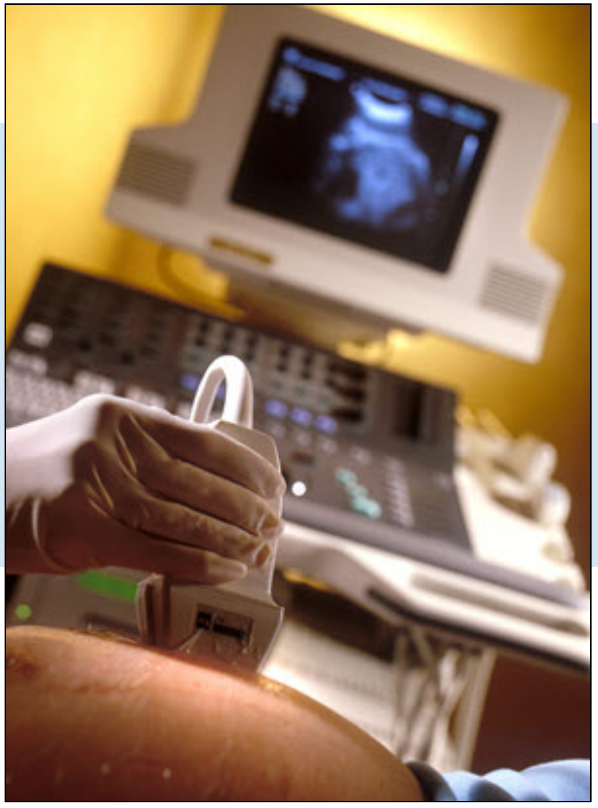
- Vaginitis
- Trauma
- Tumor
- Warts
- Polyps
- Fibroids

Antepartum Hemorrhage
Differential After 20 Weeks Gestation

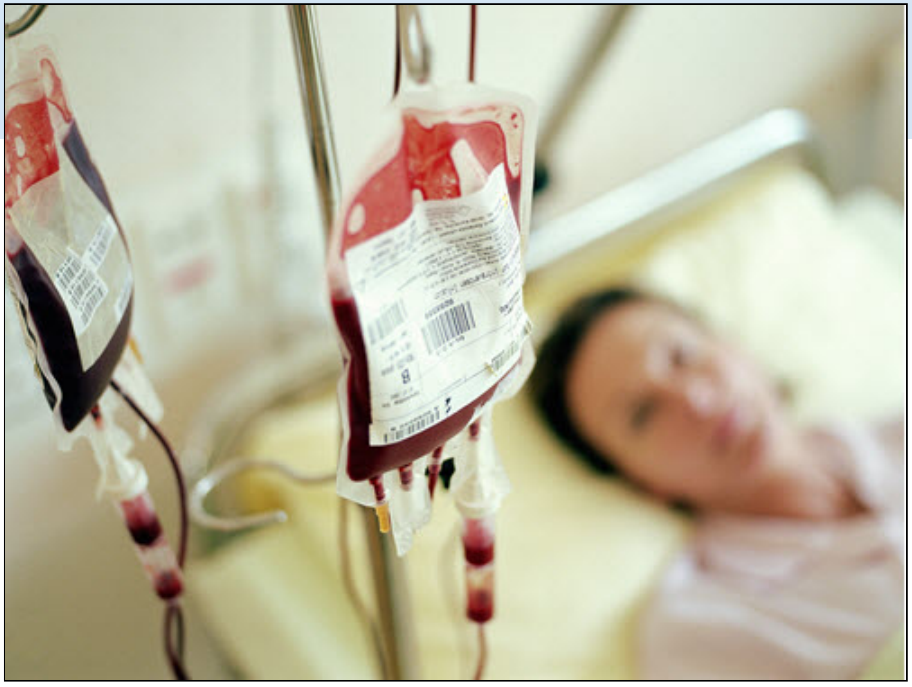
- **Placenta Previa**
- **Abruptio Placenta**
- **Uterine Rupture and Vasa Previa**
- **Cervical or Vaginal Pathology**
- **Choriocarcinoma**

- The most common symptom of choriocarcinoma is antepartum vaginal bleeding and may occur in any trimester. The bleeding may be from vaginal metastases or the intrauterine tumor.
- However, choriocarcinoma is rare and should only be considered after ruling out the more common causes of antepartum bleeding.

- Adverse pregnancy outcome, chiefly preterm birth, is associated with 1st, 2nd, and 3rd trimester bleeding.
- The degree and cause of bleeding is associated with the level of risk of adverse outcomes [1]. Outcomes worsen when bleeding is heavier and when bleeding is 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 to consider in the management of pregnant women with vaginal bleeding in the 2nd and 3rd 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 are 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.

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

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

- The Kleihauer-Betke test may not be accurate when maternal circulation shows an increase in hemoglobin F, 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 300mcg 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 8 full vials). These additional doses can be given intramuscularly (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

Click the grey arrows to see more information.

Management - Quick Overview

- Place at least two large bore (≥18 gauge) catheters.
- Peripheral venous access should be attempted before attempting other forms of vascular access if peripheral veins can be readily seen or palpated.
- Attempts at peripheral and central venous access in the head, neck, and chest should be limited during cardiopulmonary resuscitation (CPR) to avoid interruption of ventilation and chest compressions.
- During CPR or the treatment of severe shock, intraosseous cannulation and peripheral venous access should be pursued simultaneously [3,4].

Click the grey arrows to see more information.

Management - Quick Overview

- Protocols can help to facilitate the patient's care. Rapid establishment of venous access being a high priority [5].
  - In one study, for example, a protocol was designed to limit the time spent in futile attempts to achieve peripheral and central venous catheterization [6].
  - Significant improvement on venous access was found when a study revealed rapid sequential steps. In this study, rapid sequential attempts at percutaneous femoral vein catheterization, saphenous vein cutdown, and intraosseous cannulation were initiated if initial peripheral IV insertion failed after 90 seconds [6].
  - The study found resuscitations in compliance with the protocol achieved IV access more rapidly than did those deviating from the protocol when initiating percutaneous peripheral IV attempts failed [6].
  - Intraosseous cannulation had a high degree of success when other measures failed.

Click the grey arrows to see more information.

Management - Quick Overview

- Administer crystalloid with or without colloid, blood, and blood products, as needed.
- O-negative red blood cells, group AB fresh frozen plasma, and lyophilized fibrinogen can be given immediately and continued until the type and cross-match is complete, at which point the patient should be switched to type-specific fresh frozen plasma and crossmatch compatible red blood cells.
- The goal with transfusions is to keep:
  - Hemoglobin above 7g/dL
  - Fibrinogen above 300mg/dL
  - Platelets above 50,000/microL
  - PT & PTT <1.5 times control

Click the grey arrows to see more information.

Management - Quick Overview

- Maintain oxygen saturation above 95%
- Keep the patient warm
- Identify and begin treatment of the triggering event

Click the grey arrows to see more information.

Management - Quick Overview

- Order a laboratory panel to assess coagulation (PT, aPTT, fibrinogen); draw 5mL blood in a red top tube and observe clot formation over 8 to 10 minutes.
- Order a baseline laboratory panel: CBC, BUN, creatinine, and liver function tests.

Click the grey arrows to see more information.

Management - Quick Overview

- Assess fetal status (gestational age, FHR).
- Assess maternal condition (blood loss, cervical status, hemodynamic stability, and uterine contractions).
- Appropriate personnel, equipment, and supplies (e.g., pelvic pack) should be available if hysterectomy is being considered.

Click the grey arrows to see more information.

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.

Notify the Anesthesia Staff

- Notify the anesthesia staff for assistance with patient management and to provide anesthetic support for delivery if the patient is not already in the operating room.
- Placement of epidural and spinal anesthesia techniques is generally contraindicated in patients with a severe bleeding diathesis because of the risk of spinal epidural hematoma.

Click each number in order to learn more.

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.

Notify the Transfusion Service

- The transfusion service or blood bank should be notified of the pregnant patient regarding the potential need for blood products, including the need for a massive transfusion.
- Pretransfusion testing (crossmatching) can be initiated; if necessary, emergency-release blood products can be made available.

Click each number in order to learn more.

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.

Establish IV Access and Begin Fluid Resuscitation

- Establish IV access peripherally with at least two IV catheters (≥18 gauge) and infuse crystalloid (with or without colloid) and blood products, when available, to support blood pressure (systolic ≥90mmHg or mean arterial pressure ≥65mmHg) and maintain urine output (≥0.5mL/kg/hour).
- The best approach to fluid resuscitation remains controversial.
- Initial fluid resuscitation for hemorrhagic shock with infusion of 2 to 3 liters of Lactated Ringers (LR) is reasonable when blood and blood products are not available.

Click each number in order to learn more.

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.

Recognize and Treat What Caused the Event

Click the terms and icons to see more information.

- The principle of therapy is to identify the underlying disorder leading to hemorrhage and initiate appropriate treatment.
- Obstetric causes of hemorrhage are generally readily identified by history, physical exam, and ultrasound findings.
- Delivery is a key component in management of all obstetric etiologies of hemorrhage, because termination of pregnancy leads to resolution of the obstetric disorder that initiated hemorrhage.

Abruption

Preeclampsia

Amniotic Fluid Embolism

Acute Fatty Liver of Pregnancy

Retained Fetal Demise

Septic Abortion

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Abruption

- Mild to moderate vaginal bleeding, abdominal pain, back pain, and uterine contractions are characteristics of placenta abruption.
- No vaginal bleeding may be present in concealed placental abruption.
- The woman may complain of uterine tenderness during and between contractions. The uterus will have increased tone and rigidity.
- Typical symptom; abnormalities of fetal heart rate (FHR) or fetal demise, and/or DIC support the clinical diagnosis of abruptio placentae.

Preeclampsia

Preeclampsia with severe features includes 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 hemolysis, elevated liver, and low platelets (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 a 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 ≥160mmHg or diastolic blood pressure ≥110mmHg 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 >1.1mg/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 exceedingly sudden onset of hypotension due to cardiogenic shock, hypoxemia, respiratory failure, and coma or seizures during labor or immediately postpartum.

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Acute Fatty Liver of Pregnancy

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

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Retained Fetal Demise

Retained fetal demise is diagnosed by ultrasound imaging that confirms the absence of the fetal heart rate, overlapping skull bones, gross distortion of fetal anatomy due to maceration, and soft tissue edema.

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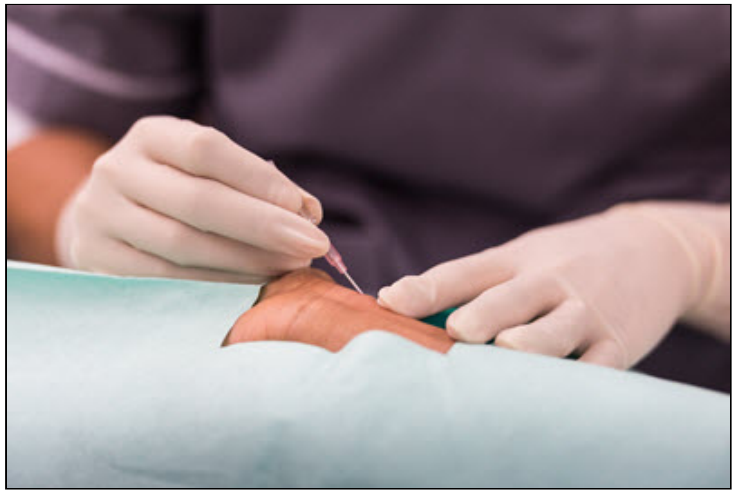
Septic Abortion

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.

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.



Insert an Arterial Line

An arterial line may be appropriate in the patient who needs continuous blood pressure monitoring, but the relative benefits versus risks depend on the severity of the hemorrhage.

Click each number in order to learn more.

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Blood Products

Obstetrical patients have or are at a high risk for serious bleeding and thus have a high association to require an invasive procedure, often requiring transfusions.

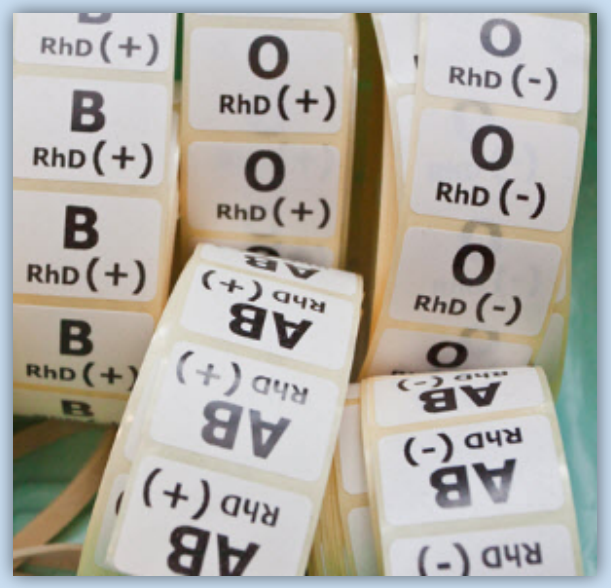
Transfusion

Massive Transfusion

Click the blue boxes to learn more about transfusions.

Management - Transfusion

- Fully typed and crossmatched red blood cells (RBCs) requires at least 20 minutes.
- Transfusion may begin immediately using type 0, Rh(D)-negative RBCs. When fully typed and crossmatched RBCs are available switch to this type specific.
- When transfusion is necessary prior to obtaining type-specific fresh frozen plasma (FFP), type AB FFP, either Rh(D) positive or negative can be safely used.



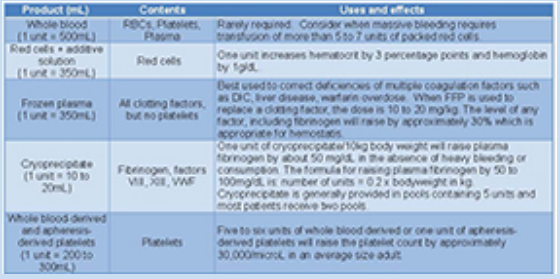
Management - Transfusion

- When making an initial order for transfusion products, the following should be ordered:
  - 6 units of FFP
  - 1 or 2 cryoprecipitate pools
    - A pool contains 5 individual units
- 1 dose of platelets, either:
  - A pool of 4 to 6 whole blood-derived platelet concentrates OR a single apheresis platelet unit.
- Many massive transfusion protocols recommend transfusion of RBCs, FFP, and platelets in a ratio of 1:1:1.

Management - Transfusion

- Correcting the low fibrinogen levels, which commonly occur in obstetrical hemorrhage, is important.
- FFP is generally given to correct hypovolemia and normalize coagulation in cases of obstetric hemorrhage.
- Cryoprecipitate is indicated when large amounts of fibrinogen must be administered in a low-volume product.
- A source of concentrated fibrinogen is cryoprecipitate, but takes time to be prepared for transfusion and brings risks of transmissible infections since it is a product that has pooled donors.
- Clinicians need to order cryoprecipitate with enough advanced planning to allow for this time.
- A fibrinogen concentration below 100 mg/dL is generally treated with 10 units of cryoprecipitate (table 3).

Click on Table 3 to view a larger version.



Product (mL)	Contents	Uses and effects
Whole blood (1 unit = 500mL)	RBCs, Platelets, Plasma	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 = 350mL)	Red cells	One unit increases hematocrit by 3 percentage points and hemoglobin by 1g/dL.
Frozen plasma (1 unit = 350mL)	All clotting factors, but no platelets	Best used to correct deficiencies of multiple coagulation factors such as DIC, liver disease, warfarin overdose. When FFP is used to replace a clotting factor, the dose is 10 to 20 mg/kg. The level of any factor, including fibrinogen will raise by approximately 30% which is appropriate for hemostasis.
Cryoprecipitate (1 unit = 10 to 20mL)	Fibrinogen, factors VIII, XIII, VWF	One unit of cryoprecipitate/10kg 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 100mg/dL is: number of units = 0.2 x bodyweight 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 300mL)	Platelets	Five to 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 size adult.

Table 3

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Cryoprecipitate (1 unit = 10 to 20mL)	Fibrinogen, factors VIII, XIII, VWF	One unit of cryoprecipitate/10kg 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 100mg/dL is: number of units = 0.2 x bodyweight 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 300mL)	Platelets	Five to 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 size adult.

Management - Transfusion

- Lyphilized fibrinogen (RiaSTAP), a human fibrinogen concentrate, is very expensive but can be reconstituted immediately for use to correct low fibrinogen levels.
  - The use of purified, virally inactivated fibrinogen concentrate had a similar outcome as cryoprecipitate in resolving hypofibrinogenemia in an observational study of 77 cases of major obstetrical hemorrhage [22].
- The blood bank should be notified of the potential need for massive transfusion and a massive transfusion protocol initiated, if indicated and available.
- It is essential to have rapid restoration of blood components in massive hemorrhage to ensure adequate tissue perfusion, prevention of acidosis, coaguloapthy and hypothermia, which is often lethal.
- Laboratory studies every thirty minutes will help to guide blood product replacement. Then, as the clinical situation improves, the interval may be extended.
- Some centers have found thromboelastography (TEG) or rotational thromboelastometry (ROTEM), useful in the setting of massive hemorrhage as it provides a "rapid global assessment" of hemostatic function [23-25].

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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 70kg 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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- The massive transfusion protocol (MTP) is initiated by the patient's staff physician or the staff anesthesiologist by calling the blood bank (this phone call may be delegated to another individual).
- Clearly state to the blood bank: "Initiate the massive transfusion protocol." Indicate whether it is an adult MTP or pediatric MTP (for patient's less than 35kg).
- Give the patient's name and medical record number.
- Provide the patient's current location and a phone number that can be used to reach the patient's care team.
- Determine if patient requires emergency release of two uncrossmatched and untagged O Neg RBCs for immediate transfusion.

Note: Average time for first MTP set is 15 to 20 minutes

- Send a properly labeled specimen (3mL purple tube) to the blood bank for a type and screen if not done in last 3 days. The specimen label must contain the patient's name, medical record number, date, and the initials of the collector written on the tube.
- Record initiation of protocol in the patient's chart.

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Blood Bank Responsibilities

- Release 2 emergency O Neg RBCs if requested.
- Prepare 4 RBCs, 4 plasma, and 1 dose of platelets for adult MTP or 2 RBCs, 2 plasma, and ½ platelet apheresis for pediatric MTP.

Note: ***Group "O" uncrossmatched RBCs will be issued, if necessary, until type specific and later crossmatched becomes available.***

- Provide a cooler with ice for each set of RBC and plasma components.
- Notify the patient's care team when a set of components is ready for pickup.
- Notify physician on-call.
- Stay 1 MTP set ahead (prepare each set immediately following pickup of previous set).
- Continue the process until notified to discontinue the protocol.

Click each blue term above to learn more.

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- Assign personnel to obtain the set of components from the blood bank.
- Blood bank will call when each set is ready for pickup.
- Send a completed release form with the personnel picking up the components.
- Order labs as directed by the team.
- Communicate the lab results to the team and to the blood bank.

- Bedside Responsibilities
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Blood products are transfused to achieve the following minimum levels for delivery:

- Hemoglobin ≥7g/dL and ≥10 g/dL if she has not delivered, since women lose blood at the time of delivery.
- Platelet count ≥50,000/microL
- Fibrinogen >200 mg/dL
- PT and aPTT <1.5 times control

Click here to learn more.

Bedside Responsibilities
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Hemoglobin Management

- To determine the optimal hemoglobin concentration for pregnant women about to deliver, many factors need to be evaluated: expected blood loss during delivery, baseline hemoglobin, rate of blood loss and medical comorbidities.
- The overall risk of mortality increases as the hemoglobin concentration decreases; some experts have suggested a minimum hemoglobin of 7g/dL for pregnant patients receiving massive transfusion with an overall treatment target of 8 to 10g/dL in women with severe postpartum hemorrhage [29,30].
- Additional evidence to support transfusion targets in other settings is beyond the scope of this program.
- Maintaining the hemoglobin above 10g/dL is a goal in massive transfusion due to pregnant women with DIC having ongoing blood loss, which further increases at the time of delivery and because equilibration generally results in reduced hemoglobin.
- A lower hemoglobin level is acceptable after the patient has delivered, is no longer actively bleeding, or is hemodynamically stable.
- A fibrinogen level ≥100 mg/dL is considered the minimum level necessary for adequate coagulation.
- An observational study demonstrated that 100% of postpartum women who developed severe hemorrhage had fibrinogen levels <200mg/dL, while 80% of those with fibrinogen >400mg/dL did not develop severe hemorrhage [27].
- Similar predictive data for platelet concentration is not available.

Click each blue term above to learn more.

Click here to view recommended uses of blood replacement products.

Table 3

Product (mL)	Contents	Uses and effects
Whole blood (1 unit = 500mL)	RBCs, Platelets, Plasma	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 = 350mL)	Red cells	One unit increases hematocrit by 3 percentage points and hemoglobin by 1g/dL.
Frozen plasma (1 unit = 350mL)	All clotting factors, but no platelets	Best used to correct deficiencies of multiple coagulation factors such as DIC, liver disease, warfarin overdose. When FFP is used to replace a clotting factor, the dose is 10 to 20 mg/kg. The level of any factor, including fibrinogen will raise by approximately 30% which is appropriate for hemostatis.
Cryoprecipitate (1 unit = 10 to 20mL)	Fibrinogen, factors VIII, XIII, VWF	One unit of cryoprecipitate/10kg 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 100mg/dL is: number of units = 0.2 x bodyweight 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 300mL)	Platelets	Five to 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 size adult.

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Click each blue term above to learn more.

- Laboratory studies are drawn initially every 30 minutes to guide blood product replacement.
- As the woman stabilizes, the laboratory testing interval can be extended.
- Some centers have found thromboelastography (TEG) useful in the setting of massive hemorrhage as it provides a "rapid global assessment" of hemostatic function [23-25].

- Bedside Responsibilities
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- **Review of Massive Transfusion Protocol Events by Transfusion Services**
- Attending Physician, Surgeon, or Anesthesiologist Responsibilities

- Each event is summarized by blood bank staff.
- Review is performed by blood bank supervisor and transfusion service physicians.
- The events are reported to the transfusion committee.

Click each blue term above to learn more.

- Bedside Responsibilities
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Click each blue term above to learn more.

Click here to learn more.

- Obtain baseline CBC and coagulation studies.
- Determine if rFVIIa is required (see section below for guidelines).
- Monitor CBC, ABG, potassium, ionized calcium, and coag tests frequently.
- If a coagulopathy is suspected measure the fibrinogen test and other coagulations studies.
- Determine when the protocol should be discontinued.
- Call the blood bank (this phone call may be delegated to another individual).
- Document discontinuation in the patient's chart.

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Use of rFVIIa (Novaseven) in surgery and trauma (not indicated in pregnancy but may be utilized postpartum):

- Indication of the use of rFVIIa:
  - Active bleeding following administration of 6 to 8 units of red blood cells,= 6 to 8 units of plasma, and one dose of platelets.
- Administer 10 units of cryoprecipitate if the fibrinogen is <100mg/dL
- Contraindications for the use of rFVIIa:
  - pH <7.00
  - Immediately following cardiac arrest
  - Patient considered "unsalvageable" by staff surgeon
  - Pregnancy
  - Recent thrombotic event, MI, or stroke
- Dosing of rFVIIa:
  - If the patient has been on warfarin and arrives with an elevated INR and rapid bleeding, consider using one small vial of rFVII or 1.2mg. This is usually a 15 micrograms/kg dose for adults.
  - If the patient is not on warfarin, consider using 45mcg/kg as a half dose and repeat this dose in 30 to 60 minutes.
  - Always round down to the nearest full vial for doses of rFVIIa.

Click each blue term above to learn more.

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.

Maintain Oxygenation

Keep arterial oxygen saturation above 95%.

Avoid Hypothermia

- The patient should be kept warm with a forced-air warming system (e.g., Bair Hugger), which is the most effective method to maintain normothermia.
- Other interventions include the use of warmed blankets and fluid warmers, which should be used as needed.
- If large volumes of fluid and blood products are given, the infused fluids/blood products should be warmed so they are close to body temperature to prevent a significant drop in maternal core temperature.

Click each number in order to learn more.

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Assess Blood Loss

- Concealed hemorrhages may occur in cases of severe abruption with the magnitude of blood loss being estimated and monitored using a combination of parameters: hourly assessment of changes in fundal height, clot volume on ultrasound, urine output and serial hemoglobin/hematocrit assessment
- Quantifying blood loss [27]
- Indirect assessment of blood loss can be accomplished with vital signs, knowing pregnant women can display changes in vitals later than their nonpregnant counterpart.
- Hemodynamic instability in non-anesthesthesized pregnant women may be suspected when:
  - Systolic blood pressure <100mmHg
  - Pulse >100 bpm
  - Urine output <30 mL per hour
- Other signs and symptoms of hemodynamic instability may be present, such as altered level of consciousness, shortness of breath, cold clammy skin, and pallor.

Click each number in order to learn more.

Quantifying Blood Loss

- Visual estimation of blood loss can result in both over and underestimations.
- Attempts to quantify the blood loss can occur with weighing the blood soaked items, subtracting the dry weight of the item and understanding that 1gm of weight equals 1ml of blood loss [27].
    - Validation with additional research is needed.
    - Artificial intelligence-based algorithms that use colorimetric analysis of pictures to quantify blood loss in real time do appear promising.
- Ongoing blood loss assessment should continue as long as active bleeding is present or if the patient is unstable [27].
- Quantifying the blood loss is an important part of evidence-based hemorrhage bundles [27].
    - Additional research is needed.
    - The clinical utility specific to the quantification approach remains unproven.
- Fluid and blood clots from the drapes can be measured by volume and added to the weighed items for an accumulative quantification of blood loss.
    - Calibrated drapes had an error rate less than 15% [28].

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.

Notify the Neonatology Service

- To prepare for birth of a compromised infant and/or prematurity, the neonatology service department should be notified.
- Neonatology services may counsel the parents about newborn issues prior to the actual event.

Fetal Assessment

- Management of the pregnant woman is impacted by fetal viability and gestational age.
- The focus is on the mother when there is an intrauterine fetal demise or the fetus is confirmed to be previable.
- By determining the limits of viability, desired futile interventions that are painful and costly may be avoided in the fetus or neonate that does not have a reasonable favorable outcome.
- Viability is the stage of maturity that would likely result in a chance of survival without severe deficits.

Click here to learn more about fetal assessment.

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.

Fetal Assessment Continued

- Determining viability is desired to prevent interventions that are painful and costly in the fetus or neonate that does not have a favorable outcome.
- The age of viability is a challenge, especially those born at 23 to 24 weeks gestation. The decision lies upon a reasonable chance of survival without severe deficits.
- Determining the morbidity from prematurity, intensity of care and likelihood at various gestational ages is beyond the scope of this program.
- With a live fetus at a viable gestational age, a FHR typically shows a Category III tracing in pregnancies complicated by major bleeding, often resulting in poor placental perfusion and suboptimal fetal oxygenation.
- Weighing the outcomes between immediate delivery versus delaying delivery to optimize fetal outcome should be considered when maternal hemorrhage occurs.
- In these cases, the maternal and fetal risks and benefits of immediate delivery, for treatment of hemorrhage versus delaying delivery to optimize fetal outcomes, need to be weighed.
- Involving the neonatology and anesthesia services can help when discussing these issues with the patient and her family.

Click number 10 to continue learning about interventions.

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.

Management of Delivery

A key component to management of delivery, termination of pregnancy, usually leads to resolution of the obstetrical disorder that initiated the hemorrhage.

Non-Viable Fetus | **Vaginal Delivery** | **Cesarean Delivery** | **Hysterectomy**

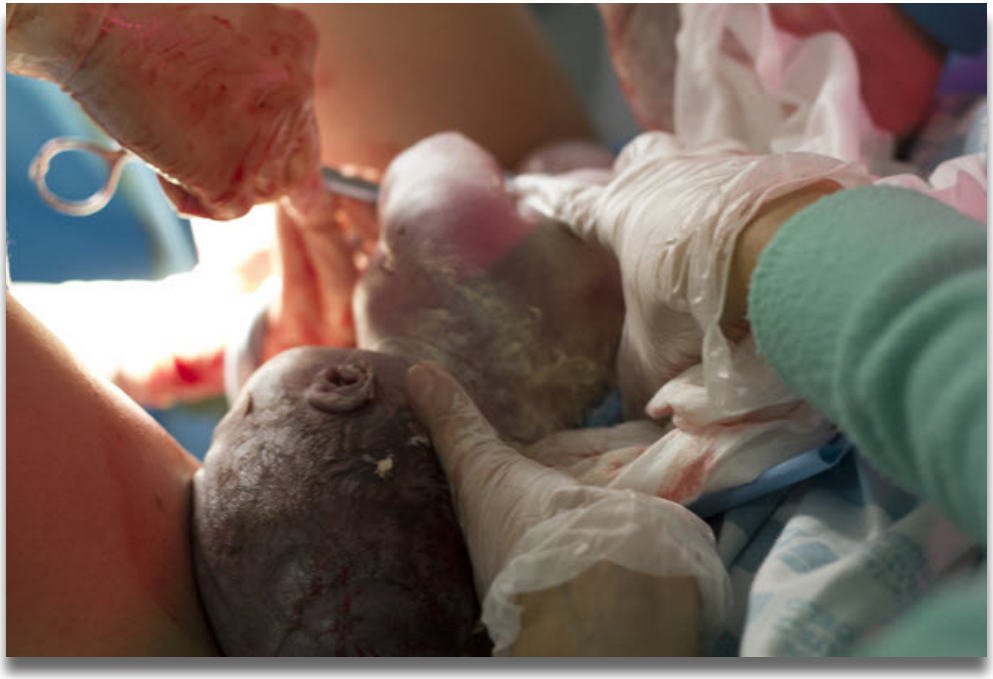
Click the blue boxes to learn more about delivery management.

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 <23-24 weeks, lethal or life threatening congenital anomaly, preterminal FHR tracing).
- In many but not all cases, this means avoiding cesarean delivery to reduce the risk of uncontrollable hemorrhage from surgical incisions and lacerations.
- Delivery is initiated and the mother is supported with crystalloid (without 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 2nd 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) is recommeded.

Vaginal Delivery

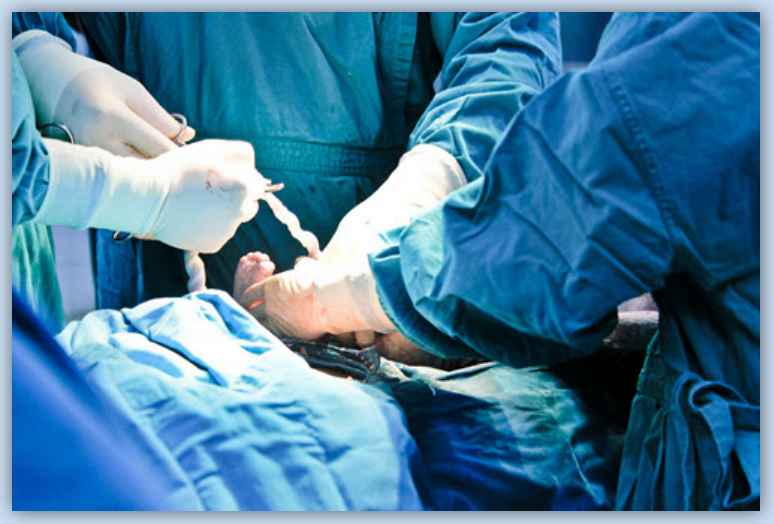
- The safest maternal option may not be vaginal delivery when hemodynamic instability from ongoing brisk uterine bleeding is occurring, nor if the mother would be endangered by vaginal delivery (for example, prior classical hysteretomy).
- In these cases, cesarean delivery is indicated to save the mother's 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, FFP, platelets, and cryoprecipitate should be readily available in the operating room and administered 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.
- When bleeding is severe, there is no need to wait for laboratory studies, the FFP and cryoprecipitate should be given immediately.

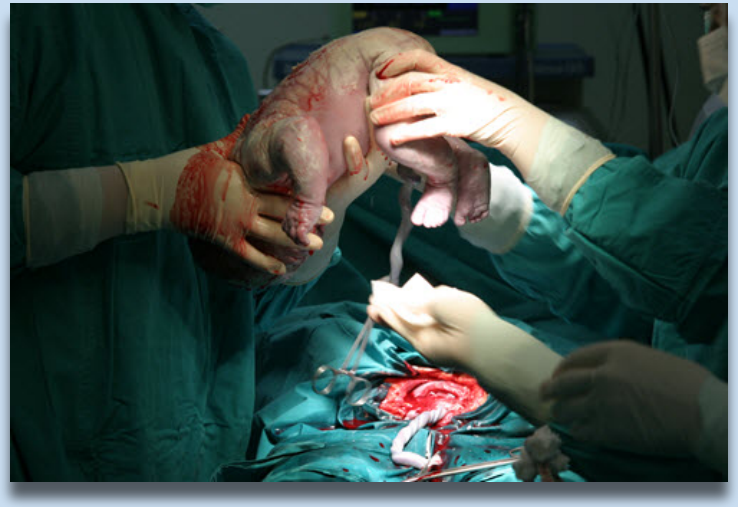
Cesarean Delivery - Con't



- Surgeons with experience in puerperal hysterectomy, pelvic surgery, and management of pelvic hemorrhage should be present.
- A GYN oncology surgeon, maternal fetal medicine specialist, obstetrician or general surgeon should be considered.
- Involvement of anesthesia, neonatology, and transfusion medicine service can be helpful for maternal and fetal outcome.
- Notifying the neonatal staff so they can prepare for resuscitation of a potentially compromised newborn will be helpful.
- When an interventional radiologist is available, notify them of their potential need.

Cesarean Delivery - Con't

- The surgical approach does not have data of randomized trials or controlled studies to recommend a certain surgical approach.
- The surgical approach decision is based on individual patient's characteristics and the clinical experience of the surgeon.
- Knowing the vertical infraumbilical incision is fast, provides excellent exposure and is less likely to be complicated by a rectus sheath hematoma, making this approach a good choice.
- Once the fetus is delivered, manual extraction of the placenta is important to perform to hasten involution of the uterus. It would also be diligent to have uterotonic drugs (such as oxytocin or methylergonovine) given and the hysterotomy incision closed promptly. All of these efforts help to curtail bleeding.



Cesarean Delivery - Con't

- Important points to communicate between the obstetrician, anesthesia and surgical team members may include the volume of blood loss, rate of blood loss, quality of clot formation and response to techniques used to control hemorrhage.
- When uterine bleeding remains brisk and maternal hemodynamic status deteriorates despite initial surgical intervention and blood component transfusion, consideration of a penrose drain or urinary catheter as a uterine tourniquet may be useful.
  - When the drain or catheter is placed, the goal is to place it as low as possible around the lower uterine segment without involving the urinary bladder. Then, pull the two ends in the opposite direction as tightly as possible around the corpus to mechanically obstruct the vascular supply.
  - The tourniquet can be held in place with a clamp.
  - This procedure markedly reduces blood loss and allows time for the anesthesia team members to catch up with transfusion requirements.
  - The tourniquet can be removed once the patient is hemodynamically stable. The surgery can then be completed and the abdomen closed in standard fashion.

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 moribund 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 stop 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.

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.

Post Delivery

- It is reasonable to transfer the patient to the intensive care unit (ICU) for continued monitoring, replacement of appropriate blood products, broad spectrum antibiotics and correcting physiologic derangements [29].
- When the patient continues to need 2 or more units of packed RBC's per hour for 3 hours, it is a sign she has ongoing bleeding and needs surgical intervention or arterial embolization by an interventional radiologist.
- Otherwise, when the patient is stable, she is returned to the operating room to undergo definitive surgical care.
- This approach halts the downward spiral and lessens the risk of abdominal compartment syndrome.

Click each number in order to learn more.

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.

Hemostatic and Anticoagulant Therapies

- There is a lack of sufficient data on safety and efficacy in hemorrhaging pregnant women to make recommendations on hemostatic and antifibrinolytic drugs.
- There are no randomized clinical trials on the safety and efficacy of most hemostatic and antithrombogenic drugs or products in the treatment of the hemorrhage in women during pregnancy.
- These include heparin, danaparoid sodium, synthetic protease inhibitor, antithrombin, human recombinant activated protein C, recombinant human soluble thrombomodulin, recombinant tissue factor pathway inhibitor and recombinant activated factor VII (rFVIIa) [31].
- Pro-hemostatic treatment with tranexamic acid has been used for management of postpartum hemorrhage [33].

Click to learn more about tranexamic acid

Click each number in order to learn more.

Tranexamic Acid (TXA)

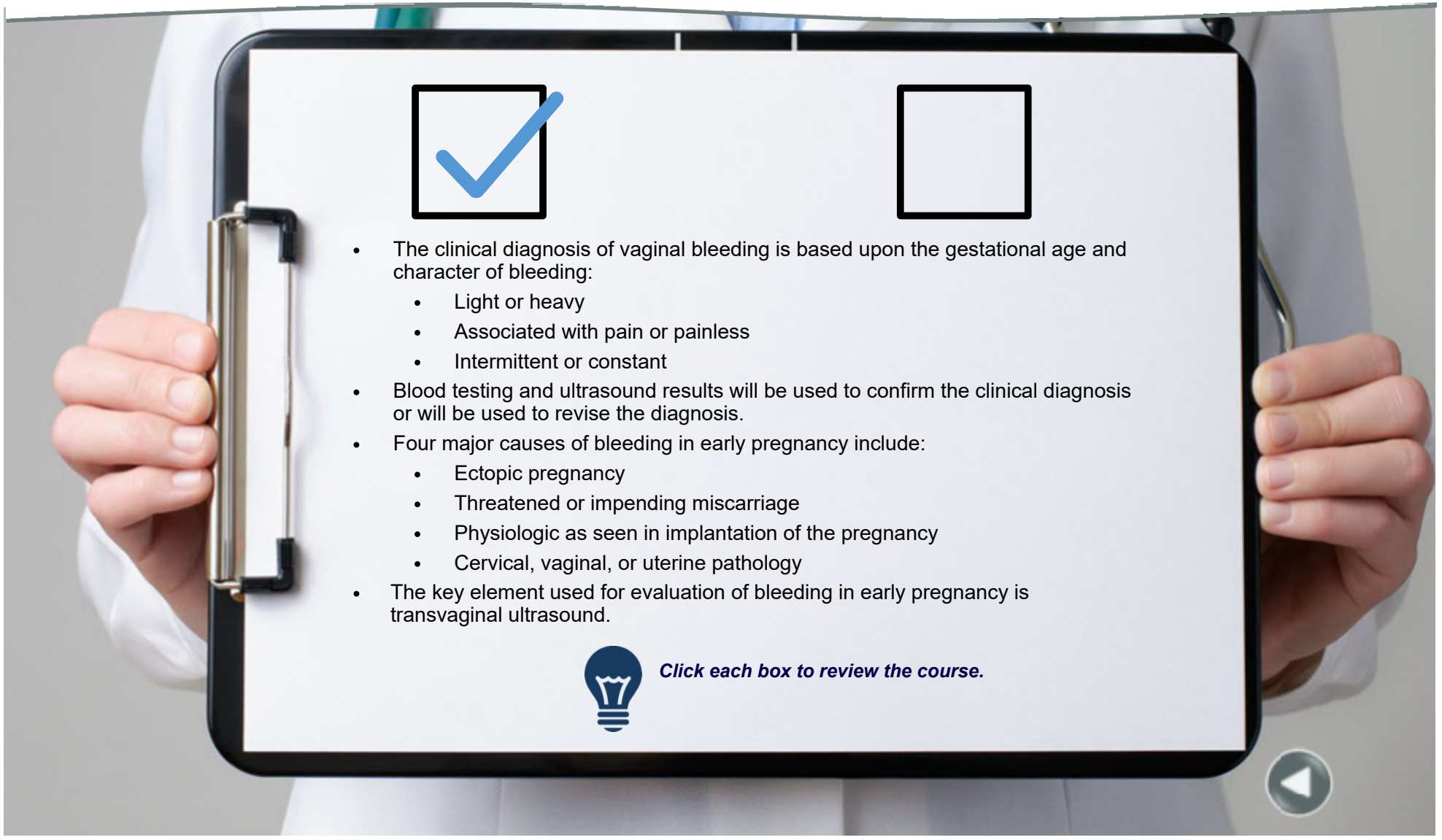
- Intravenous tranexamic acid (TXA) is recommended by the World Health Organization (WHO) to be used early, even within 3 hours, following vaginal birth or cesarean delivery in addition to standard care for women diagnosed with postpartum hemorrhage (PPH).
- TXA is a competitive inhibitor of plasminogen activation and can reduce bleeding by inhibiting the breakdown of fibrinogen and fibrin clots.
- By giving within 3 hours of birth, maternal death from hemorrhage may be prevented, regardless of the cause. There were no noted adverse maternal effects from the medication.

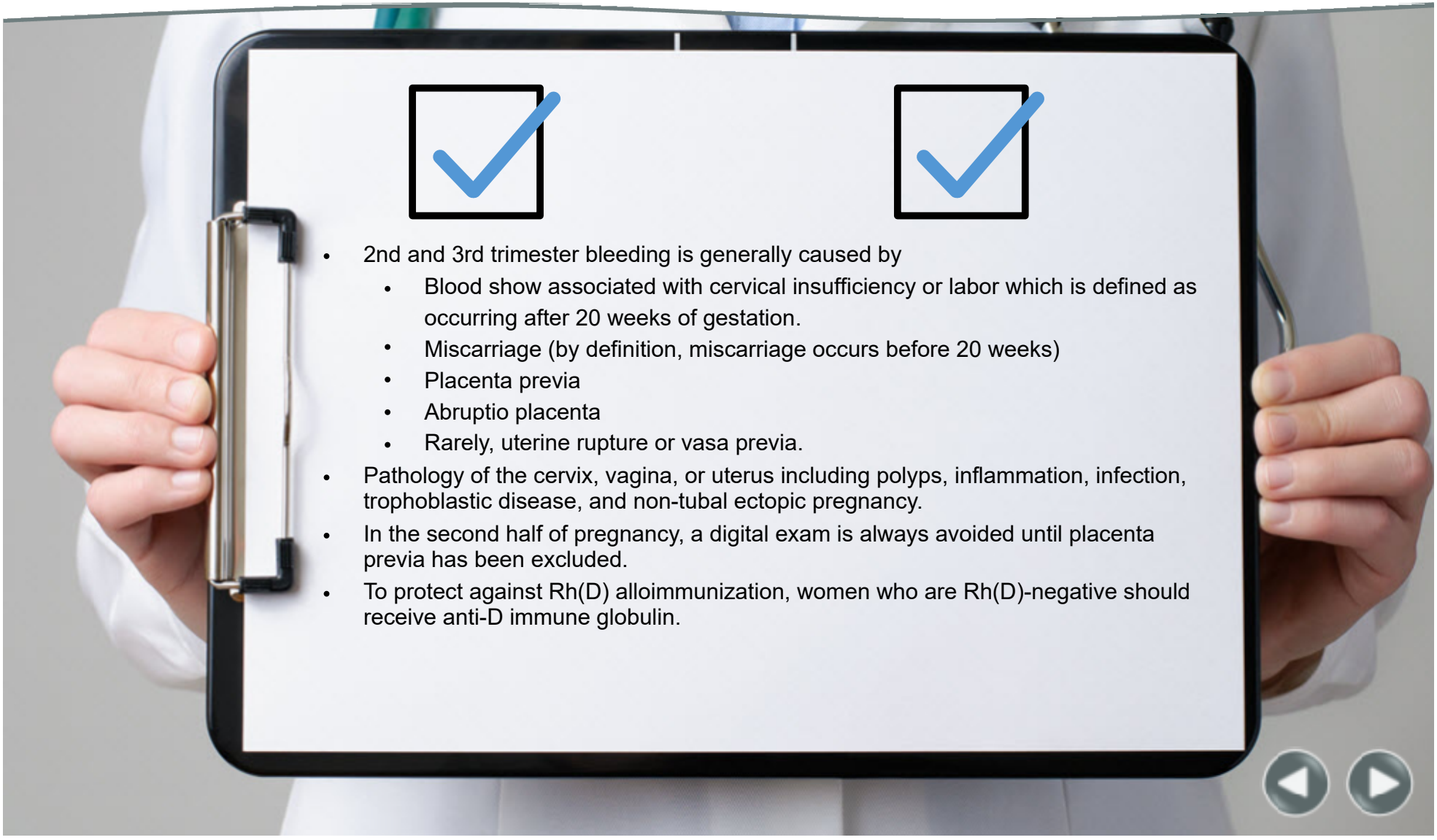
Tranexamic Acid (TXA)

- TXA for PPH should not be utilized more than 3 hours after birth.
  - The benefits of TXA appear to decrease by 10% for every 15-minute delay, with no benefit seen after 3 hours from birth.
- TXA should be initiated as soon as possible after the onset of bleeding and within 3 hours of birth and should be considered part of the standard PPH treatment package (i.e., uterotonics, non surgical and surgical interventions).
- Regardless of whether the postpartum hemorrhage is from the genital tract trauma or other causes, TXA should be used in all cases.
- TXA administration involves a fixed dose of 1 gram in 10mL (100mg/mL) IV at 1mL per minute (administered over 10 minutes)
  - A second dose of 1g IV if bleeding continues after 30 minutes or if bleeding restarts within 24 hours of completing the first dose.
  - A bolus of TXA should be avoided due to a potential risk of transient lowering of blood pressure.
  - A decreased dose should be given when she has renal insufficiency.
  - TXA should not be given with solutions containing blood products, penicillin or mannitol.
- The half-life of TXA is 2 hours and antifribinolytic effect lasts for 7-8 hours.

Contraindications to TXA

- Avoid in women with clear contraindications:
  - Known thromboembolic event in pregnancy
  - History of coagulopathy
  - Active intravascular clotting
  - Known hypersensitivity to TXA
  - In patients with subarachnoid hemorrhage or DIC


MATERNAL911®
The clinical diagnosis of vaginal bleeding is based upon the gestational age and character of bleeding:
Light or heavy
Associated with pain or painless
Intermittent or constant
Blood testing and ultrasound results will be used to confirm the clinical diagnosis or will be used to revise the diagnosis.
Four major causes of bleeding in early pregnancy include:
Ectopic pregnancy
Threatened or impending miscarriage
Physiologic as seen in implantation of the pregnancy
Cervical, vaginal, or uterine pathology
The key element used for evaluation of bleeding in early pregnancy is transvaginal ultrasound.
Click each box to review the course.



- 2nd and 3rd trimester bleeding is generally caused by
  - Blood show associated with cervical insufficiency or labor which is defined as occurring after 20 weeks of gestation.
  - Miscarriage (by definition, miscarriage occurs before 20 weeks)
  - Placenta previa
  - Abruptio placenta
  - Rarely, uterine rupture or vasa previa.
- Pathology of the cervix, vagina, or uterus including polyps, inflammation, infection, trophoblastic disease, and non-tubal ectopic pregnancy.
- In the second half of pregnancy, a digital exam is always avoided until placenta previa has been excluded.
- To protect against Rh(D) alloimmunization, women who are Rh(D)-negative should receive anti-D immune globulin.

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.

1. AWHONN Practice Brief. Quantification of Blood Loss: AWHONN Practice Brief Number 1. JOGNN, 44, 158-160; 2015. DOI: 10.1111/1552-6909.1219.

2. Toledo, P., McCarthy, R., Hewlett, B., Fitzgerald, P., & Wong, C. (2007). The accuracy of blood loss estimation after simulated vaginal delivery. Anesthesia & Analgesia, 105, 1736-1740.

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.

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.

22. Bruining HA, Boelhouwer RU, Ong GK. Unexpected hypopotassemia after multiple blood transfusions during an operation. Neth J Surg 1986; 38:48.

23. Prevention of Rh D Alloimmunization. ACOG Practice Bulletin. Number 181, August 2017

24. Howland WS, Schweizer O, Carlon GC, Goldiner PL. The cardiovascular effects of low levels of ionized calcium during massive transfusion. Surg Gynecol Obstet 1977; 145:581.

25. 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.

26. WOMAN Trial Collaborators. 2017. Effect of early tranexamic acid administration on mortality, hysterectomy, and other morbidities in women with post-partum haemorrhage (WOMAN): an international, randomised, double-blind, placebo-controlled trial. Lancet. 389(10084):2105-2116. doi: 10.1016/S0140-6736(17)30638-4.

27. AWHONN Practice Brief. Quantification of Blood Loss: AWHONN Practice Brief Number 1. JOGNN, 44, 158-160; 2015. DOI: 10.1111/1552-6909.1219

28. Toledo, P., McCarthy, R., Hewlett, B., Fitzgerald, P., & Wong, C. (2007). The accuracy of blood loss estimation after simulated vaginal delivery. Anesthesia & Analgesia, 105, 1736-1740.

29. Sagraves SG, Toschlog EA, Rotondo MF. Damage control surgery-- the intensivist's role. J Intensive Care Med 2006; 21:5.

30. Dildy GA, Scott JR, Saffer CS, Belfort MA. An effective pressure pack for severe pelvic hemorrhage. Obstet Gynecol 2006; 108:1222.