Chapter 12
Obstetrics in the Emergency Room

Rachel A. Pilliod

Normal Labor

Definitions

Pregnancy Dating Pregnancy can be divided into three trimesters, with the first trimester classically defined as 2–13 6/7 weeks gestational age (GA), the second trimester as 14–27 6/7 weeks GA, and the third trimester as after 28 weeks GA. Between 37 and 42 weeks, a pregnancy is considered to be at term, while before 37 weeks, a pregnancy is considered preterm, with higher risks of neonatal morbidity including respiratory distress and jaundice [1].

Pregnancies are dated by the first day of the last menstrual period (LMP), with the estimated due date (EDD) 40 weeks after the LMP. Many electronic applications can be used to calculate the current gestational age and EDD based on the LMP [2]. If a pregnant patient with unsure dating presents for emergency care, a rough estimate of GA is the fundal height.

R.A. Pilliod, MD (✉)
Department of Obstetrics, Gynecology and Reproductive Biology, Brigham and Women's Hospital, Boston, MA, USA

Department of Obstetrics and Gynecology, Massachusetts General Hospital, Boston, MA, USA
e-mail: rpilliod@gmail.com

P.C. Brady, *Handbook of Consult and Inpatient Gynecology*,
DOI 10.1007/978-3-319-27724-0_12

Measured in centimeters from the pubic bone to the most cephalad aspect of the uterus (called the fundus), the fundal height in centimeters is roughly equivalent to the GA in weeks. When ultrasound is available, first trimester dating can be obtained by measuring a fetal crown-rump length (CRL). In fetuses thought to be 14 weeks GA or more, the biparietal diameter (BPD) is used for dating the pregnancy. The head circumference, abdominal circumference, and femur length can also be used in various regression formulas to estimate gestational age [2]. If this estimate differs by more than 2 weeks from the LMP or the LMP is unknown, ultrasound measurements may be used to make management decisions; however, the possibility of fetal growth restriction should be considered (as may be the case in a patient presenting with hypertension) [2].

Viability The survival of a fetus outside the uterus. The estimated survival rate of extremely preterm infants is 9% at 22 weeks, 33 % at 23 weeks, 65 % at 24 weeks and 81 % at 25 weeks, though surviving fetuses may suffer significant morbidity including necrotizing enterocolitis, sepsis, retinopathy, bronchopulmonary dysplasia and intracranial hemorrhage, and long-term neurodevelopmental impairment [3]. The gestational age threshold for resuscitation may vary by institution, but is generally 23–24 weeks.

Gravidity (G) The number of times a woman has been pregnant.

Parity (P) The number of deliveries a woman has had at or beyond 20 weeks GA. Parity is frequently further described in a series of numbers representing term deliveries, preterm deliveries, abortions, and living children, in that order; abortion accounts for all pregnancies that did not extend beyond 20 weeks, including therapeutic and spontaneous abortions. For instance, a woman who has had three pregnancies total—an early spontaneous abortion, a term delivery of a healthy baby, and a set of living twins delivered prematurely (counted as a single pregnancy but with two living children)—is represented as G3P1113. The prefixes nulli- and multi- are also used to describe parity, referring to women with zero or at least one delivery, respectively.

Labor Cervical dilation secondary to forceful contractions, diagnosed by physical exam. The first stage of labor entails cervical dilation to 10 centimeters (cm), at which point a patient is "fully dilated." Labor progresses more quickly in multiparous women as compared to nulliparous women; early labor (up to 5–6 cm of dilation) can last for several hours, while dilation at a rate of 1 cm per hour is generally expected once a patient reaches 5–6 cm of dilation [4] The second stage of labor refers to maternal pushing and delivery of the infant; in women without an epidural, the median time to delivery in nulliparous women is 0.6 h, with 2.8 h representing the 95th percentile; the median time to delivery in multiparous women is 0.2 h (95th percentile: 1.3 h) [4]. Use of an epidural extends these times.

Rupture of Membranes Rupture of the amniotic membrane around the fetus. Rupture of membranes is suggested by a history of leakage of fluid from the vagina, usually abrupt in onset and ongoing. The color of the fluid can further inform the clinical scenario. For example, dark red fluid may be secondary to a placental abruption (separation of placenta, a potentially highly morbid complication), while green fluid is a sign of fetal meconium (stool) passage, most commonly seen in late term pregnancies and an indicator of fetal distress.

Braxton-Hicks Contractions Mildly painful contractions that do not cause cervical change, often triggered by dehydration or other systemic infections.

Differential Diagnosis

Abdominal Pain in a Viable Pregnancy

- Labor
- Braxton-Hicks contractions
- Placental abruption
- Uterine rupture (particularly in women with prior uterine surgery)
- Chorioamnionitis (intrauterine infection)

(continued)

(continued)

Preeclampsia or hemolysis, elevated liver enzymes, and low platelet (HELLP) syndrome
Any causes of abdominopelvic pain, including ovarian torsion, urinary tract infection, pyelonephritis, nephrolithiasis, gastroenteritis, bowel obstruction, appendicitis, cholelithiasis, ovarian vein thrombosis, musculoskeletal pain and opiate withdrawal.

Leaking Fluid in a Viable Pregnancy

Rupture of membranes
Physiologic discharge
Passage of mucous plug
Vaginitis
Involuntary leakage of urine

When You Get the Call Ask for a complete set of vital signs and whether a physical exam and confirmation of fetal cardiac activity have been performed. Ask for the patient's parity and gestational age, if known. In an institution with pediatricians or neonatologists and obstetricians, be sure to alert these teams to the possibility of a laboring patient in the emergency room.

When You Arrive Assess whether the patient is having vaginal bleeding, and clinically assess the patient's degree of discomfort. View the full flow sheet of vital signs, assessing for fever or hemodynamic instability. Particularly if the patient has either bleeding or moderate to severe discomfort, ensure that the patient has intravenous (IV) access. Ask for an ultrasound or Doppler at the bedside, if available, to assess the fetal heart rate.

History

In stable patients, obtain an obstetric history and inquire about any complications with the current pregnancy. Also obtain a full past medical history, surgical history including

prior cesarean deliveries or other uterine or abdominal surgeries, medications, allergies, and social history including any active drug or alcohol use or intimate partner violence.

Perform an obstetric review of systems, asking the patient about vaginal bleeding, leakage of fluid, and fetal movement. Ask about the frequency and duration of her contractions. Review of systems should also inquire about any evidence of dehydration or infectious symptoms including gastrointestinal or genitourinary issues and complaints of persistent uterine tenderness between contractions.

Physical Examination

Assess for an appropriate fetal heart rate, which should be between 110 and 160 beats per minute [5]. A targeted maternal exam includes palpating the size of the uterus and assessing for any abdominal tenderness between contractions, which may suggest additional causes of pain including infection, uterine rupture or placental abruption. Also assess fetal lie (transverse or longitudinal in the uterus) and presentation (breech or cephalic); use of ultrasound to confirm this assessment is advisable.

The vaginal exam includes a speculum exam if the patient's history raises concern for rupture of membranes. Three tests are used to assess for **rupture of membranes**: (1) "the pool test" or visual inspection for a large pool of fluid in the vagina; (2) the pH of the vaginal fluid, as a pH of 6.5 or greater suggests the presence of amniotic fluid, though blood and semen can also affect pH; and (3) microscopic assessment of a thin film of fluid dried on a slide for the presence of "ferns," which is a characteristic crystal pattern (Fig. 12.1) [6, 7]. Patients with ruptured membranes will have a combination of a pool of fluid in the vagina of high pH and positive ferning.

Patients without a pool of fluid in the vagina, or a small pool, can be asked to cough, as Valsalva may expel fluid from the uterus. Physical examinations resulting in borderline findings can be repeated after having the patient rest supine, to

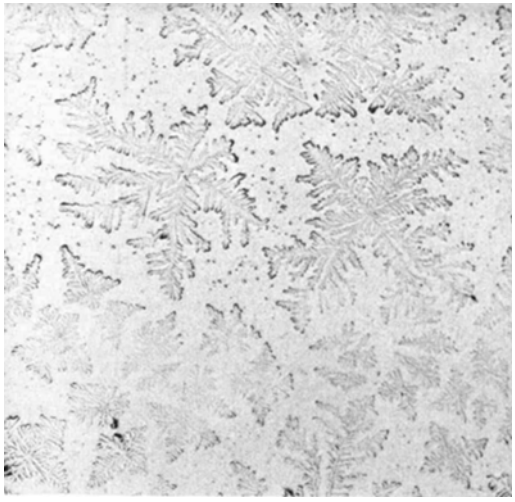

FIG. 12.1 Amniotic fluid ferning (Reprinted from Brookes C, Shand K, Jones WR, *A reevaluation of the ferning test to detect ruptured membranes*. Australian and New Zealand Journal of Obstetrics and Gynaecology, 2008, with permission from John Wiley & Sons, Inc., and the Royal Australian and New Zealand College of Obstetricians and Gynaecologists)

allow fluid to collect in the vagina. Confirmation of ruptured membranes may be helpful in supporting the diagnosis of active labor.

If a speculum exam is deferred, or if the cervix is not easily visible, a digital exam of the cervix is necessary to determine if the patient is in labor. Due to risk of introducing infection, digital exams should not be performed in patients with rupture of membranes prior to 34 weeks of gestational age, unless the patient appears to be in active, painful labor. Prior to an exam, confirm (either by ultrasound or from records) that the placenta is not overlying the cervical os or adjacent to the os (**placenta previa** and marginal previa, respectively). A digital exam of a patient with placenta previa can lead to massive hemorrhage and necessitate emergent delivery.

The elements of the exam are dilation, effacement, consistency, position, and station. Dilation of the internal cervical os is measured between 0 and 10 cm. Dilation to 10 cm is required for a term vaginal delivery (though a very small, preterm fetus could deliver through a less dilated cervix, which may also not be fully effaced). Effacement quantifies the thinning of the cervix; the cervix must be 100 % effaced in order for a vaginal delivery to occur. Consistency of the cervix is reported as firm, medium, and soft, and the position of the cervix is reported as posterior (closer to the sacrum, in early labor) to anterior (closer to the pubic bone, in progressive labor). Fetal station refers to the position of the fetal head—specifically the biparietal diameter—relative to the maternal ischial spines ("zero station"), which can be palpated vaginally. Fetal station is often reported from 5 cm above the ischial spines (negative 5) to 5 cm below the ischial spines (positive 5); the fetal head is typically visible at the perineum beyond "plus 3 station."

Diagnosis

The diagnosis of labor is made during the physical examination. The first stage of labor begins with cervical dilation and is complete with full dilation of 10 cm and 100 % effacement. On digital exam, the examiner feels only fetal head and no adjacent cervical tissue.

Management

The Emergency Medical Treatment and Active Labor Act requires hospitals accepting Medicare to provide care for emergency medical conditions (including contractions in pregnancy). A facility without sufficient obstetrical and neonatal services may transfer a pregnant woman only if she and the fetus are stable, transfer does not pose a risk to the patient or fetus, and delivery is not expected prior to completion of the transfer. Otherwise, care must continue at the initial facility.

If a transferring physician documents that benefits of transfer outweigh the risks to the patient and fetus, an unstable patient (i.e., in active labor) may be transferred [8]. In a hospital with obstetric services, the obstetrician or midwife may need to come to the emergency room to provide assessment and care of acutely unstable patients or those very near delivery [9].

Antibiotics should be administered to patients in whom rupture of membranes or active labor is confirmed, if they meet any of the following criteria: positive test for group B strep (GBS) by rectovaginal or urine culture during the current pregnancy, unknown GBS status at less than 37 weeks of GA, membranes ruptured for greater than 18 h, temperature greater than 100.4 °F, prior infant with invasive GBS infection [10]. Treatment regimens are shown in Table 12.1.

If labor is progressing faster than transfer can safely be arranged, and if the patient is determined to be fully dilated, management of the second stage of labor is recommended. At this point, the patient may begin to push. Effective pushing can be accomplished in a variety of ways, but frequently patients are encouraged to push with sustained effort for 8–10 s, repeated three times per contraction. As the fetal head approaches the perineum, the provider should prepare by wearing eye protection, mask, gown, and sterile gloves and should have available two Kelly clamps, sterile scissors, and a suction bulb. Additional providers should be available to assist with the newborn.

Table 12.1 Antibiotics for group B streptococcus prophylaxis

No penicillin allergy	Penicillin G (five million units IV, followed by 2.5–3 million units every 4 h) Ampicillin (2 g IV followed by 1 g IV every 4 h)
Mild allergy to penicillin	Cefazolin 2 g IV once, followed by 1 g IV every 8 h
Anaphylaxis to penicillin or cephalosporins	Consult GBS culture data or vancomycin (1 g IV every 12 h) or clindamycin (900 mg IV every 8 h)

Verani et al. [10]

The delivery of the head in a controlled fashion minimizes maternal perineal trauma. To facilitate this, apply one hand to the perineum to reinforce this tissue and minimize perineal lacerations, and one hand to the anterior aspect of the presenting fetal head to control delivery momentum. As the head delivers, apply gentle downward pressure to counteract extension of the fetal head and to prevent periurethral lacerations. Once the head is delivered, assess for the presence of the umbilical cord around the infant's neck, which should be released by gently slipping it over the fetal head.

The shoulders must be delivered next (Fig. 12.2). With flat hands applied to the anterior and posterior sides of the infant head, apply gentle downward pressure with a contraction and maternal pushing effort to deliver the anterior shoulder. Once the anterior shoulder is past the perineum, apply gentle upward effort to facilitate the delivery of the posterior shoulder. The infant can be delivered up to the maternal abdomen, or securely

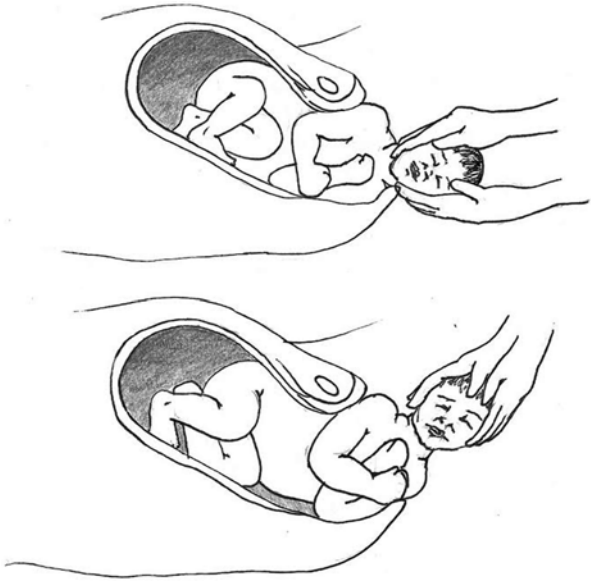

FIG. 12.2 Vaginal delivery. The anterior shoulder is delivered, followed by the posterior shoulder

held, with care taken not to put tension on the umbilical cord. Apply two Kelly clamps a few centimeters apart on the cord and cut the intervening section of the cord, in order to separate the infant from the mother. The infant should be dried with a warm towel and stimulated. Infant resuscitation is beyond the scope of the chapter, but a basic guideline is published by the World Health Organization for further reference [11].

The third stage of labor, following the delivery of the infant, involves the delivery of the placenta. The placenta commonly delivers within 30 min, though active management of the third stage of labor is associated with less blood loss [12, 13]. Massage the uterine fundus to ensure adequate contraction. Apply gentle pressure on the cord segment protruding from the vagina, while providing suprapubic pressure (above the pubic bone) to prevent uterine inversion [14]. Often, a small, abrupt increase in vaginal bleeding is noted when the placenta detaches from the uterine wall. Deliver the placenta in a controlled fashion, ensuring that trailing membranes are not separated from the placenta and retained in the uterus or vagina. With further fundal massage, the uterus should contract and be palpably firm on abdominal exam; vaginal bleeding is usually light.

Oxytocin is commonly administered to facilitate uterine involution and decrease the risk of hemorrhage. Whether to administer oxytocin before or after delivery of the placenta is unclear. Either way, oxytocin can be administered as ten units IM in patients without IV access, or 10–40 units IV in 500–1000 milliliters (mL) of a crystalloid solution, often administered over an hour [15].

Primary Obstetrical Hemorrhage

Definitions

Postpartum Hemorrhage Greater than 500 mL of blood loss following vaginal delivery, estimated to occur following 4–6 % of deliveries [16]. Postpartum hemorrhage is attributed primarily to uterine atony in 80 % of cases [16]. Risk factors for hemorrhage include prolonged or rapid labor, history of

prior postpartum hemorrhage, preeclampsia, overdistended uterus (multiple gestation, macrosomia, or polyhydramnios), chorioamnionitis, and Asian or Hispanic ethnicity [17, 18] After atony, lacerations and trauma account for the majority of cases with a minority attributed to coagulopathy.

Atony Failure of the uterus to contract appropriately, usually leading to hemorrhage. Affecting 1 in 20 deliveries, atony is a considerable cause of morbidity and mortality [19]. Risk factors for atony include uterine distension (multiple gestation, macrosomia, or polyhydramnios), high parity, induced or augmented labor, and prior postpartum hemorrhage [20]. Atony can be focal or diffuse and is diagnosed by an enlarged, boggy uterus.

Abnormal Placentation An abnormally adherent placenta, invading through the endometrium. Placenta accreta is defined as invasion through the endometrium; placenta increta describes invasion into the myometrium, while placenta percreta is defined as invasion through the myometrium to the uterine serosa or beyond. Abnormally adherent placentas are associated with prior uterine surgeries, including uterine curettage, myomectomy, and cesarean section [21]. The rate of placenta accreta increases with each successive cesarean section, up to 6.7 % in patients with five prior cesarean sections [22]. The further presence of a placenta previa (in which the placenta covers the cervical os), in women with prior cesarean sections, dramatically increases the risk of placenta accreta such that 39 % of women with a placenta previa and two prior cesarean sections are diagnosed with placenta accreta [23].

Uterine Rupture Transmural disruption of the uterus, most commonly associated with prior uterine surgeries or cesarean section. Uterine rupture is estimated to occur in 0.7 % of deliveries, the vast majority occurring in patients with a prior cesarean delivery [24].

Disseminated Intravascular Coagulation (DIC): Systematic activation of coagulation pathways causing diffuse fibrin deposition, leading to consumption of coagulation factors and platelets, and resulting in bleeding [25]. Conditions leading to

DIC include sepsis, malignancy, trauma, amniotic fluid embolism, placental abruption, retained intrauterine fetal demise, liver failure, and ABO incompatibility.

Differential Diagnosis

Atony
Abnormal placentation
Retained products of conception
Uterine inversion
Uterine rupture
Cervical laceration
Vaginal laceration
Infection
Hematologic abnormalities [26]

- Bleeding diathesis, such as von Willebrand disease
- Disseminated intravascular coagulation (DIC)
- Thrombocytopenia—caused by such etiologies as preeclampsia, HELLP, gestational thrombocytopenia, idiopathic thrombocytopenic purpura (ITP), and thrombotic thrombocytopenic purpura
- Anticoagulant medication

When You Get the Call Request IV access, a complete blood count, blood type and antibody screen, and coagulation labs (prothrombin time (PT) and activated partial thromboplastin time (aPTT), fibrinogen). Consider requesting blood products to be crossmatched or asking for emergency release O-negative blood to be delivered to the beside, particularly if the estimated blood loss is over 500 cc.

When You Arrive Ensure that the patient is hemodynamically stable. In patients with significant and ongoing hemorrhage on brief assessment, resuscitation should begin in parallel with diagnosis (see section "Management").

History

Review the patient's age and parity, and ask the delivering providers or first responders to provide details of the delivery, including intrapartum blood loss, any complications (including fever or shoulder dystocia), and ease of delivery of the placenta. Suspect adherent or retained placenta if removal of the placenta was difficult or if the placenta was not delivered within 30 min of delivery. A history of abdominal pain or vaginal bleeding preceding or during labor may raise suspicion for an abruption, which can lead to DIC (see section "Diagnosis" below).

Review the patient's obstetric history, and elicit any significant past medical history, including known bleeding diatheses, or prior episodes of excess bleeding with menses, surgery, or deliveries. Review whether the patient has a history of hypertension or asthma, as some uterotonic agents are contraindicated in these conditions.

Physical Examination

Patients with significant hemorrhage, particularly those with any vital sign changes including tachycardia, should be taken to the operating room for an exam under anesthesia. The lighting and instruments of an operating room are optimal for this examination and often necessary for adequate repair of deep or complex vaginal or cervical lacerations or to perform a dilation and curettage if needed.

In stable patients, request a stretcher or bed with stirrups to facilitate a thorough vaginal exam and repair of any lacerations. An abdominal and bimanual exam should be performed to assess fundal tone and evaluate for any clots or retained placenta. A bedside ultrasound can also be useful when performed by a skilled provider to assess for evidence of retained products of conception (Fig. 12.3). If the uterine fundus is difficult to palpate, ensure the patient's bladder is empty. A full or distended bladder can hinder uterine

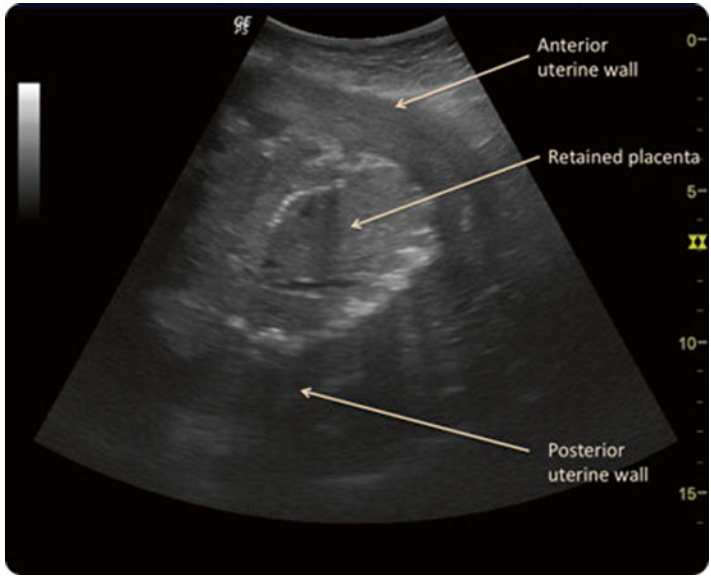

Fig. 12.3 Retained placenta. Ultrasound image of retained placenta in situ (Reprinted from Rosenstein and Vargas [27] with permission from Elsevier)

contraction as well as make the exam more difficult. In a hemorrhaging or unstable patient, a urinary catheter is indicated for monitoring of output.

Diagnosis

The amount of hemorrhage should be estimated; stages of hemorrhagic shock are shown in Table 12.2 [28]. In every patient with bleeding more than 500 mL postpartum and ongoing, a complete blood count, blood type and antibody screen, and coagulation labs (prothrombin time (PT) and activated partial thromboplastin time (aPTT), fibrinogen) should be collected.

The underlying cause of uterine hemorrhage may be suggested by the patient's medical history—including known

Table 12.2 Stages of hemorrhagic shock

Class I: blood volume lost <15 %	**Class II: blood volume lost 15–30 %**
Heart rate <100 beats per minute	Heart rate >100 beats per minute
Blood pressure normal	Blood pressure normal
Respiratory rate 14–20 breaths per minute	Respiratory rate 20–30 breaths per minute
Urine output >30 mL per hour	Urine output 20–30 mL per hour
Mental status normal	Mental status mildly anxious
Class III: Blood volume lost 30–40 %	**Class IV: Blood volume lost >40 %**
Heart rate >120 beats per minute	Heart rate >140 beats per minute
Blood pressure decreased	Blood pressure decreased
Respiratory rate 30–40 breaths per minute	Respiratory rate >35 breaths per minute
Urine output 5–15 mL per hour	Urine output negligible
Mental status anxious/confused	Mental status confused/lethargic
Often marks the onset of decompensated hypovolemic shock	

Committee on Trauma [28]

thrombocytopenia or clotting disorders—and is often confirmed by physical examination. **Uterine inversion** is suggested by depressed fundal height and part of the inverted uterus prolapsing into the vagina. An **abnormally adherent placenta** should be suspected in patients with a history of uterine surgery or prior placenta accreta or following difficult or piecemeal delivery of the placenta. **Atony** is suggested by an enlarged, boggy uterus. **Uterine rupture** should be suspected in patients with fetal bradycardia, abdominal pain independent of contractions, and vaginal bleeding, though hemorrhage may be concealed within the abdomen. Patients with uterine rupture may develop hypovolemic shock; bedside ultrasound may reveal complex free fluid in the abdomen resulting from intra-abdominal hemorrhage [29]. **Lacerations** are usually visualized by vaginal exam, which

should include a thorough assessment of the cervix, vaginal sulci, and periurethral area. A cervical laceration should be suspected if no vaginal laceration is identified and the uterus has appropriate tone, without suggestion of retained products of conception by ultrasound. There is usually insufficient time for a formal ultrasound, but bedside ultrasound can be helpful in diagnosing **retained products of conception** when performed by an experienced clinician (Fig. 12.3) [27].

Management

When postpartum hemorrhage is diagnosed, the available anesthesia and obstetrics staff should be notified.

In hemodynamically unstable patients, resuscitation should begin alongside the assessment. Most obstetric hemorrhage protocols utilize a 1:1 ratio in transfusing units of red blood cells to fresh frozen plasma, as obstetric hemorrhage can rapidly consume coagulation factors. Attention should also be paid to fibrinogen replacement (in the form of fibrinogen powder concentrate or cryoprecipitate), and a unit of apheresis platelets (usually composed of six units of random donor platelets) should be administered after every six units of packed red blood cells [30, 31]. Refer to Chap. 13, Preparing for Urgent and Emergent Surgery, for further resuscitation guidelines. For non-massive, goal-oriented resuscitation, goals include (1) hemoglobin greater than 7 g per deciliter (dL); (2) platelets above 50,000 per microliter (μL), particularly if surgery is planned; (3) an international normalized ratio (INR) less than 1.5; and (4) fibrinogen above 100 mg/dL [32, 33]. A patient's goal heart rate should generally be less than 100 beats per minute, with urine output at least 0.5 mL per kilogram per hour.

If the etiology of hemorrhage is diagnosed, management should focus on addressing that issue specifically. **Uterine inversion**, an uncommon cause of postpartum hemorrhage, can be diagnosed by physical exam immediately following delivery. Replace the uterus manually, as quickly as possible. Uterotonic medications should be stopped. Uterine relaxation

may be required, which can be achieved with 50 μg of intravenous nitroglycerin, repeated up to three times as needed [34]. Once the uterus is reverted, uterotonic agents should be given to prevent recurrence and to improve tone. If this is unsuccessful, surgical management may be required [35].

If **retained products of conception** or **abnormal placentation** (such as placenta accreta) is suspected, obstetricians may need to perform manual removal of the placenta or dilation and curettage, as needed. If a **cervical laceration** or deep sulcal vaginal tear is suspected, vaginal packing can be placed until the obstetrics team arrives; examination and repair in an operating room provides optimal visualization. If **uterine rupture** is suspected, the patient will require laparotomy for repair.

Intravenous access, emptying the bladder, fundal massage, and administration of uterotonics are first steps in the management of obstetrical hemorrhage (Table 12.3) [36–39]. If hemorrhage continues, particularly if the estimated blood loss reaches one liter, additional support should be requested (including other obstetricians, anesthesiologists, and potentially interventional radiologists or general surgeons). Repeat labs should be sent emergently, including blood count and coagulation studies (PT/INR, PTT, fibrinogen); transfusions are often initiated by this point.

Uterine tamponade can be established with a Foley catheter or Bakri® balloon (Cook Medical, Bloomington, IN), inflated with normal saline; a 30 mL Foley catheter can be inflated with 60 mL of normal saline, and a Bakri balloon can hold up to 500 mL [40, 41]. If these are not available, laparotomy sponges can be used.

If bleeding persists, more significant intervention should be considered, including uterine artery ligation, B-lynch sutures, or hysterectomy, all of which require open abdominal surgery. Interventional radiology may also perform uterine artery embolization, which can be helpful in the diagnosis and management of genital tract lacerations, vascular injuries or anomalies, refractory atony, and abnormal placentation (Fig. 12.4) [42, 43]. Transferring patients to interventional radiology, however, often requires time; for this reason,

Table 12.3 Uterotonic medications

Medication	Comment
Misoprostol 800–1000 μg PO, SL, PV or PR	Peak serum concentration of misoprostol is lower following rectal administration
Oxytocin 10 units IM or 10–40 units IV in 1 L of normal saline or lactated Ringer's	
Methylergonovine maleate (Methergine®, Novartis, East Hanover, New Jersey) 0.2 mg IM every 2–4 h, or PO every 6–8 h	Contraindicated in patients with hypertension
Carboprost tromethamine (Hemabate®, Pfizer, New York, NY) 0.25 mg IM every 15–90 min, maximum 8 doses	Contraindicated in patients with asthma or suspected amniotic fluid embolism

From: O'Connell et al. [37]; American College of Obstetricians and Gynecologists [17]
PO oral, *SL* sublingual, *PV* vaginally, *PR* rectally, *IM* intramuscular

interventional radiology should be contacted earlier in the process of managing postpartum hemorrhage.

After the immediate postpartum period, women with an initial or primary hemorrhage are at risk of secondary hemorrhage. Secondary hemorrhage can occur between 24 h and 6 weeks following delivery. Overall, secondary postpartum hemorrhage affects 0.5–2 % of deliveries; of these women, two-thirds will have experienced a primary hemorrhage [44]. In addition to the assessment indicated for primary hemorrhage, secondary hemorrhage should initiate coagulation studies to assess for von Willebrand disease and ultrasound imaging to assess for retained products of conception and vascular malformations of the uterus, including arteriovenous malformations and uterine artery aneurysms.

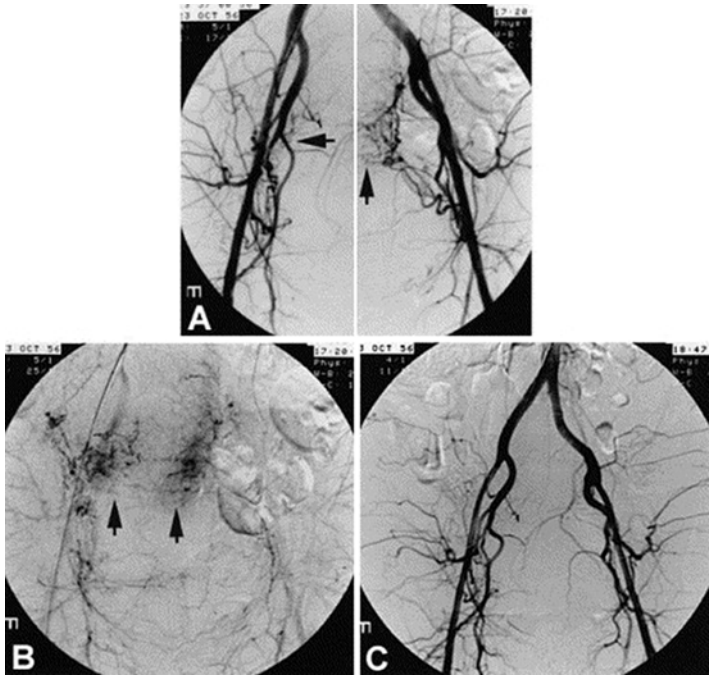

FIG. 12.4 Uterine artery embolization. Early (**a**) and delayed (**b**) digital subtraction angiogram of pelvis. Pelvic hypervascularity is clearly seen, with contrast blush at placental insertion sites (*arrowheads*). Contrast extravasation was present on right, at placental insertion site. (**c**), Angiogram obtained after embolic procedure shows complete embolization of the uterine arteries (Reprinted from the Hansch et al. [42] with permission from Elsevier)

Hypertensive Emergencies

Definitions

Hypertensive Disorders of Pregnancy Affecting up to 10 % of pregnancies, associated with significant maternal and fetal morbidity and mortality [45]. Risk factors for hypertensive disease in pregnancy include nulliparity, extremes of maternal age,

preeclampsia in prior pregnancy, obesity, pregestational diabetes, thrombophilias, chronic hypertension, renal disease, and multiple gestations [46]. Hypertension in pregnancy exists on a spectrum of clinical disease, from chronic hypertension (hypertension predating pregnancy) and gestational hypertension (new-onset hypertension without associated hematologic, hepatic, renal, or neurologic dysfunction) to preeclampsia and eclampsia (preeclampsia with seizure). Preeclampsia is defined as a syndrome of hypertension with proteinuria or with end-organ dysfunction [45]. Please see section "Diagnosis" for the diagnostic criteria of preeclampsia. Hemolysis, elevated liver enzymes, and low platelet (HELLP) syndrome is a related condition.

Delivery is usually curative for these diseases, and improvement of laboratory values occurs in the following days; hypertension usually improves within 48 h of delivery, but may rise again after 3–6 days or present for the first time after delivery. The incidence of postpartum preeclampsia is unknown, particularly as many hypertensive women are asymptomatic [47]. Preeclampsia could bring a woman to the emergency room as many as 6 weeks postpartum and should therefore not be overlooked, particularly if the presentation includes headache and associated hypertension.

Differential Diagnosis

Hypertension

- Chronic hypertension
- Gestational hypertension
- Preeclampsia
- HELLP syndrome
- Acute fatty liver of pregnancy (AFLP)
- Systemic lupus erythematosus
- Thrombotic microangiopathies (including thrombotic thrombocytopenic purpura and hemolytic uremic syndrome)

(continued)

(continued)

Renal artery stenosis
Pheochromocytoma
Drug effect: illicit drugs such as cocaine and amphetamines and withdrawal from antihypertensive medication or alcohol

Postpartum Seizure

Eclampsia
Underlying seizure disorder
Withdrawal from alcohol or benzodiazepines
Central nervous system lesions, including bleeding arteriovenous malformations or ruptured aneurysms

When You Get the Call Ask for a full set of vital signs. Pregnant patients with hypertension, particularly those at least 20 weeks of gestational age, should be transferred to the hospital's Labor and Delivery unit for maternal and fetal assessment. More commonly, a postpartum patient may present to an emergent care setting without immediately available Labor and Delivery facilities and will require initial assessment and stabilization in the emergency room [48]. If possible, however, patients within acute hypertension within 6 weeks postpartum should also be seen and assessed in a Labor and Delivery Triage unit, given obstetricians' expertise with this issue.

When You Arrive Review the full vital signs flow sheet. If severe range blood pressures are present (systolic blood pressure of at least 160 mmHg or diastolic blood pressure of at least 110 mmHg), repeat the blood pressure with a manual cuff to confirm. The length of an appropriately sized blood pressure cuff is 1.5 times the circumference of the upper arm. If severe blood pressure is confirmed, request IV access in anticipation of potentially administering parenteral medication.

History

Upon arrival, if the patient is conversant and well appearing, proceed with a full past obstetrics and medical history, including hypertensive, renal, hepatic, pulmonary, and autoimmune disease. Review any complications in this pregnancy or hypertensive diseases in a prior pregnancy. Review whether the patient has a history of epilepsy or recent head trauma. If the patient is postpartum, review her delivery date and course, and review any complications or hypertensive issues intrapartum.

Complete a review of systems, including questions about headache, visual disturbances, nausea, vomiting, shortness of breath, right upper quadrant (RUQ) pain, and acutely worsened edema, particularly in the face and hands [45]. In pregnant patients, obtain a routine obstetrical review of systems including fetal movement, vaginal bleeding, rupture of membranes, or abdominal pain.

Physical Examination

A complete physical exam should be performed, including cardiac and pulmonary exams, an abdominal exam assessing for RUQ and uterine tenderness, and a neurologic exam to assess for evidence of hyperreflexia and clonus; note edema of the upper and lower extremities and face. In pregnant patients with viable fetuses, continuous fetal monitoring is preferred during the acute assessment and blood pressure treatment. While the patient's transfer to a Labor and Delivery unit is facilitated, if possible, assessment with Doppler or ultrasound should be performed to document the fetal heart rate. An appropriate fetal heart rate is between 110 and 160 beats per minute [5].

Diagnosis

Initial laboratory assessment of a pregnant or postpartum patient presenting with new or acutely worsened hypertension

or seizure includes a complete blood count, complete metabolic panel (including liver function tests and creatinine), uric acid, lactate dehydrogenase, and a urine sample to allow for calculation of the protein to creatinine ratio. Also consider sending a urine toxicology screen as drugs of abuse can elevate blood pressure. Patients with acute focal neurologic symptoms may require emergent head computed tomography (CT) to assess for stroke. In women with preeclampsia, a CT scan may show hypodense lesions in the occipital lobes, at the gray-white matter junction [49]. In pregnant women with new-onset hypertension, a formal obstetrical ultrasound should be obtained to confirm normal fetal growth and umbilical artery Doppler flow, as fetal growth restriction is more common in hypertensive disorders of pregnancy [45].

Gestational Hypertension is diagnosed as systolic blood pressure greater than or equal to 140 mmHg or diastolic blood pressure greater than or equal to 90 mmHg on two occasions at least 4 h apart, after 20 weeks of gestation in a woman with previously normal blood pressure [45]. Women presenting with severely elevated blood pressures—a systolic blood pressure of 160 mmHg or more and/or a diastolic blood pressure of 110 mmHg or more—can receive the diagnosis within a shorter interval (minutes) to facilitate timely antihypertensive therapy. Patients diagnosed with gestational hypertension should have no other laboratory abnormalities or neurologic symptoms.

Preeclampsia is diagnosed by the same blood pressure limits as gestational hypertension, in combination with either a protein to creatinine ratio greater than or equal to 0.3 in a urine sample or a urine dipstick reading of 1+ if other quantitative methods are not available [45]. A 24-h urine collection can also be used—with 300 mg or more considered a positive finding—but this result is frequently not available in the setting of an acute presentation. In the absence of proteinuria, new-onset hypertension with the new onset of thrombocytopenia, renal insufficiency, or elevated liver enzymes is consistent with preeclampsia. Preeclampsia with

severe features, specifically, applies to patients with new-onset hypertension and any of the following:

- Thrombocytopenia: Platelet count less than 100,000/μL
- Progressive renal insufficiency: Serum creatinine concentration greater than 1.1 mg/dL or a doubling of baseline serum creatinine in the absence of other renal diseases
- Impaired liver function: Elevated serum concentrations of liver transaminases to twice normal levels, severe right upper quadrant or epigastric pain unresponsive to medication and not accounted for by alternative diagnoses, or both
- Pulmonary edema
- New-onset cerebral or visual disturbances

HELLP syndrome is further defined as the presence of thrombocytopenia with platelets less than 100,000 /μL, elevated liver enzymes with AST greater than or equal to 70 IU per liter (L), and evidence of hemolysis, including schistocytes on peripheral blood smear, lactate dehydrogenase greater than or equal to 600 IU/L, or bilirubin greater than or equal to 1.2 mg/dL [50].

Clarifying the etiology of a seizure acutely can be difficult. Idiopathic seizure disorders or intracranial pathology may be more likely as the cause of seizures after 48–72 h postpartum or if the patient is already receiving magnesium prophylaxis for the diagnosis of eclampsia [45]. In patients with known seizure disorders, serum levels of patients' antiepileptic medications should be sent to ensure serum levels are in the therapeutic range, though results are not immediately available.

Management

In pregnant patients presenting with acute or worsening hypertension, fetal considerations include reducing blood pressure to prevent placental abruption, while not reducing blood pressure so quickly as to cause placental hypoperfusion

and fetal distress. Continuous fetal monitoring during the acute diagnosis and treatment of severe hypertension or eclampsia is preferable. Of note, fetal bradycardia will often occur during maternal seizure activity and most often resolves with maternal stabilization [45].

In women with viable fetuses presenting before 34 weeks GA with preeclampsia with severe features or eclampsia, betamethasone (12 mg IM every 24 h for two doses) or dexamethasone (6 mg PO every 12 h for four doses) should be administered to promote fetal lung maturity. Delivery should not be delayed to allow for the full steroid course in the presence of uncontrollable hypertension, seizure, pulmonary edema, placental abruption, disseminated intravascular coagulation, or nonreassuring fetal status [45].

Recommendations for the timing and mode of delivery in women with hypertensive diseases of pregnancy are beyond the scope of this chapter. These guidelines are outlined in "Hypertension in Pregnancy," published by the American College of Obstetricians and Gynecologists' Task Force on Hypertension in Pregnancy [45]. In general, stable women with gestational hypertension or preeclampsia without severe features without other indications for delivery are delivered at 37 0/7 weeks GA. Delivery is usually recommended at 34 0/7 weeks GA in pregnant patients with preeclampsia with severe features without indications for earlier delivery. Delivery may be indicated prior to 34 0/7 weeks GA due to maternal or fetal instability, including uncontrollable hypertension, seizure, pulmonary edema, placental abruption, disseminated intravascular coagulation, or nonreassuring fetal status [45].

Hypertension

Pregnant patients with hypertension, particularly those at least 20 weeks of gestational age, should be transferred to the Labor and Delivery unit within the hospital for maternal and fetal assessment. On a Labor and Delivery unit, continuous

fetal monitoring can be performed while blood pressure medications are administered, which can result in decreased placental perfusion and fetal distress. Similarly, postpartum patients with acute hypertension within 6 weeks of their delivery are ideally assessed in a Labor and Delivery Triage unit, given obstetricians' expertise with this issue.

Once the diagnosis of a hypertensive disorder related to pregnancy is made in the emergent setting, the need for antihypertensives and intravenous magnesium sulfate for seizure prophylaxis should be determined, while arranging transfer to an appropriate obstetric service. Antihypertensive medications are indicated in women with blood pressures consistently in the severe range, defined as systolic blood pressures of 160 mmHg or more or diastolic pressures of 110 mmHg or more. The goal is to reduce blood pressure to below 160/110 mmHg, keeping in mind that an excessive decrease in blood pressure in pregnancy can restrict placental perfusion and cause fetal distress [48].

Labetalol is considered the first-line medication for the management of hypertensive diseases of pregnancy (Table 12.4) [45]. Drug choice should also be based upon maternal comorbid conditions, possible adverse effects, and clinician's comfort and experience with the medications.

The range of acceptable medications is broader in the postpartum period. In addition to these, please see Chap. 14, Common Postoperative and Inpatient Issues, for additional antihypertensives that could be used in postpartum patients. Angiotensin-converting enzyme inhibitors, in particular, are not recommended in pregnancy, but are safe for breastfeeding patients (as are labetalol, hydralazine, and nifedipine) [52].

For women with preeclampsia with severe features, seizure prophylaxis with magnesium sulfate is indicated [53]. Magnesium sulfate reduces the incidence of eclamptic seizures by 50 % in patients with preeclampsia [54]. Dosing regimens vary; commonly, a loading dose of 4–6 g IV is administered, followed by 1–2 g per hour as a continuous IV

Table 12.4 Antihypertensive medications in pregnancy

Antihypertensive	Dose	When to consider alternatives
Labetalol	10–20 mg IV, doubled up to 80 mg every 10–20 min, to a maximum daily dose of 300 mg	Heart block Bradycardia Acute heart failure Bronchoconstrictive disease
Hydralazine	5 mg IV or IM, redosed up to 10 mg every 20–40 min	Increased intracranial pressure Myocardial ischemia Aortic dissection May cause reflex tachycardia, headaches, hypotension
Nifedipine	10–20 mg orally, repeated in 30 min as needed	May cause reflex tachycardia or headaches

American College of Obstetricians and Gynecologists [45, 48], Johnson et al. [51], Duley et al. [54]

infusion. In pregnant patients, magnesium sulfate is continued during delivery and 24 h postpartum; in postpartum patients, magnesium sulfate is generally administered for at least 24 h [45]. In patients receiving magnesium sulfate, regular assessments of mental status, reflexes, respiratory status, and urine output should be performed to monitor for magnesium toxicity; altered mental status, loss of the patellar reflex, and depressed respiratory rate are signs of magnesium toxicity. Additionally, magnesium sulfate is contraindicated in women with heart block or myocardial damage and must be used with caution in patients with myasthenia gravis or significant renal impairment, as magnesium is renally excreted [55].

Seizure

Comprehensive management of a seizing patient is beyond the scope of this chapter, except to note that eclampsia should be very strongly considered in any pregnant patient or postpartum patient within 6 weeks of her delivery. Postpartum eclamptic seizures are more common in the first 48–72-h postpartum [45].

Eclamptic seizures are typically self-limited. Initial interventions include supportive care, airway protection to prevent aspiration, and prevention of maternal injury, while also initiating magnesium sulfate and blood pressure control. The goal is to stabilize the patient for transfer to an appropriate obstetric service.

Magnesium sulfate is administered for the indication of prevention of recurrent seizure and is a more effective prophylaxis against recurrent seizure in the eclamptic population than either phenytoin or diazepam [56]. In patients with IV access, magnesium sulfate is administered at a dose of 4–6 g IV, followed by 1–2 g per hour as a continuous IV infusion. If IV access is not yet established, deep IM administration of 10 g of magnesium sulfate (5 g IM into each buttock) can also be used [56]. Women with eclampsia should also receive antihypertensives to control elevated blood pressures to levels below 160/110 mmHg.

In rare cases, women have seizures despite magnesium sulfate treatment. An additional bolus of magnesium (2–4 mg IV) can be administered in the event of recurrent seizure, provided the patient does not have signs of magnesium toxicity [56]. In the event of refractory seizures, benzodiazepines can also be used, such as lorazepam (0.1 mg/kg IV, maximum 2 mg/min), allowing one minute to assess effect before redosing [57].

Trauma in Pregnancy with a Viable Fetus

Definitions

Trauma in Pregnancy Affects approximately 1 in 12 pregnancies and is the leading non-obstetrical cause of maternal death [58]. Trauma in pregnancy is also a considerable cause of fetal

morbidity and mortality, primarily through placental abruption and preterm birth [58, 59]. Motor vehicle collision (MVC) is a common cause of trauma, affecting 207 per 100,000 pregnancies [60]. The primary obstetrical concern with MVC is strain on the uterus, which may result in placental abruption through sheer force and tensile failure (countercoup) [61]. Intentional trauma during pregnancy is most commonly due to intimate partner violence, which increases the risk of preterm birth by 2.7-fold and of low birth weight by 5.3-fold [62].

The scope of this section is limited to non-catastrophic blunt trauma as well as a brief discussion of catastrophic trauma in pregnancy at gestational ages of fetal viability.

When You Get the Call Ask for the patient's gestational age and whether the patient is hemodynamically unstable or gravely injured. Consider enlisting available resources if significant or catastrophic injuries are suspected. Obtain a cesarean section operative kit to bring to the emergency room if the patient is reported to be gravely injured.

When You Arrive Assess the patient's mental status and hemodynamic stability. Review the patient's gestational age; if the fetus is viable, urgently request Doppler or ultrasound confirmation of fetal cardiac activity.

History

In a hemodynamically stable patient, obtain a history of the circumstances surrounding the trauma. After MVC, inquire about collision speed, whether airbags were deployed, and whether the patient was wearing a seatbelt or driving (as the steering wheel may cause direct trauma to the uterus). Ask where on her body the patient sustained impact, and inquire about ongoing symptoms of pain. Obtain an obstetrical review of systems including fetal movement, vaginal bleeding or loss of fluid, or contractions. Additionally, screen for intimate partner violence. Obtain a full past medical and surgical history as well as an obstetrical history including current gestational age and complications of the pregnancy.

Physical Examination

An initial evaluation of a pregnant woman who has suffered trauma should follow non-obstetric guidelines for trauma assessment. The patient should also be positioned in the left lateral position to reduce compression of the aorta by the gravid uterus. Assessment of fetal status should include confirming gravid state and evidence of ongoing fetal life, usually with bedside ultrasound.

Management

The primary management goal is to stabilize the condition of the mother, as fetal outcomes are directly correlated with early and aggressive maternal resuscitation (Fig. 12.5) [61, 63]. In pregnant patients who have sustained significant trauma, initial interventions include placing the patient in the full left lateral position, administering 100 % oxygen, and establishing IV access above the diaphragm [64]. Lateral positioning shifts the gravid uterus off the inferior vena cava, improving cardiac return. Hypotension, defined as a systolic blood pressure below 100 mmHg or less than 80 % of baseline, should be avoided, to ensure adequate placental perfusion.

For women who are clinically stable and well appearing following blunt trauma, an initial period of continuous fetal monitoring with fetal heart rate monitoring and tocometer to assess for contractions should be conducted over 4 h [61]. In the absence of worsening pain or evidence of six or more contractions per hour, the patient may be discharged with strict instructions to return if she develops worsening pain or vaginal bleeding. If six or more contractions per hour are documented, the patient should be observed with continuous fetal monitoring for a period of at least 24 h given the concern for possible evolving placental abruption or preterm labor. In these patients, consider checking a complete blood count, coagulation labs, and potentially a formal ultrasound, to assess for occult placental abruption.

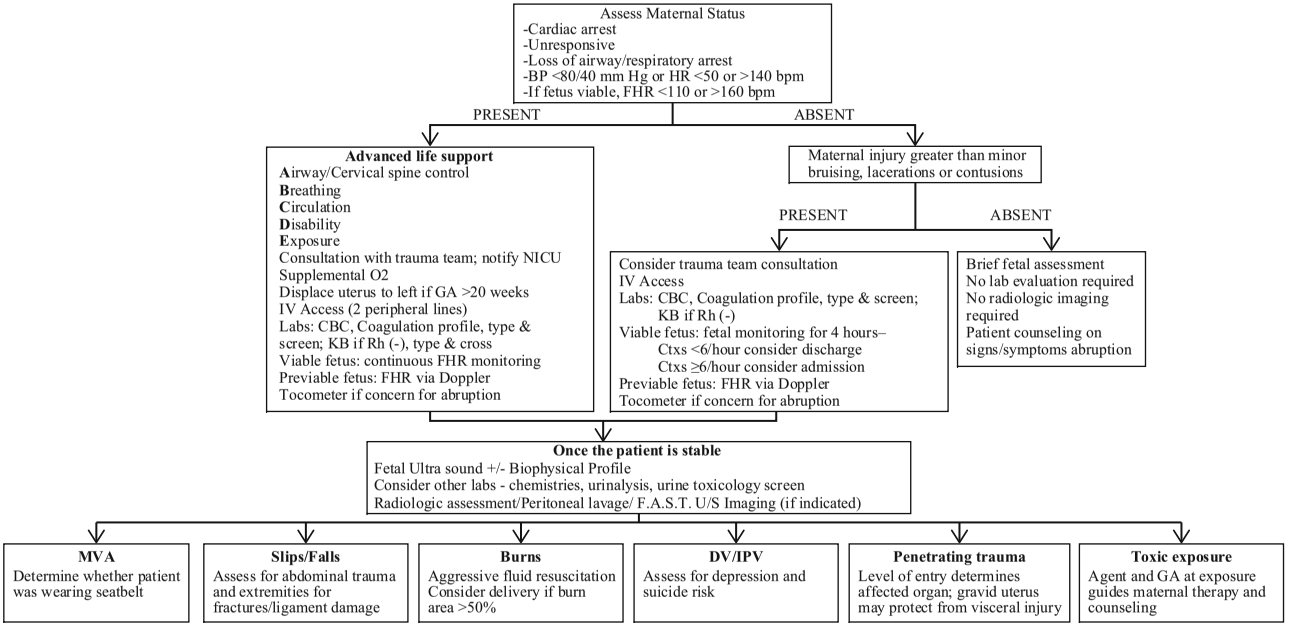

FIG. 12.5 Management algorithm for trauma in pregnancy. *BP* blood pressure, *CBC* complete blood cell count, *Ctxs* contractions, *DV* domestic violence, *FAST* focused assessment with sonography for trauma, *FHR* fetal heart rate, *GA* gestational age, *HR* heart rate, *IPV* intimate partner violence, *ISS* injury severity score, *IV* intravenous, *KB* Kleihauer-Betke, *MVA* motor vehicle accident, *NICU* neonatal intensive care unit, *O2* oxygen, *U/S* ultrasound (Reprinted from the Mendez et al. [61] with permission from Elsevier)

Women who are Rhesus factor (Rh) negative are at risk for isoimmunization if fetomaternal hemorrhage occurs. Though the true incidence is unknown, it is estimated that fetomaternal hemorrhage occurs in 8–30 % of pregnant women involved in trauma [65]. It is recommended that all Rh-negative mothers who present with a history of abdominal trauma should receive one 300 mg prophylactic dose of Rho(D) immune globulin within 72 h of the traumatic event, if they have not received a dose within the prior 12 weeks [61]. A Kleihauer-Betke (KB) test can be sent to quantify fetomaternal hemorrhage, chiefly to determine if additional doses of Rho(D) immune globulin are indicated [61].

In the event of cardiac arrest associated with catastrophic trauma, the 2010 American Heart Association guidelines account for the altered anatomy and physiology of pregnancy, recommending prompt airway management and performance of chest compressions slightly higher on the sternum than usual, in the supine position with manual left uterine displacement [64]. If manual leftward displacement of the uterus does not result in successful resuscitation, the patient can be positioned in a leftward tilt, up to 30° [66]. Defibrillation may be used as needed, as no studies have documented maternal or fetal harm from this intervention; recommended drug dosages need not be altered due to pregnancy [64].

If these interventions fail to resuscitate a patient after 4 min of chest compressions, the treatment team must move forward with cesarean delivery so as to optimize cardiopulmonary resuscitation (CPR) and survival of mother and infant. Cesarean section should be considered in any pregnancy at 20 weeks GA or more, or in any pregnancy in which the fundus reaches the umbilicus, due to aortocaval compression [64]. Effective maternal resuscitation is not possible until optimal cardiac output and venous return are restored by delivery of the fetus [67]. Given the possible need for emergent cesarean, preparations for the procedure should commence at the onset of CPR.

Postpartum Infectious Complications

Differential Diagnosis

Fever

- Wound infection (perineal or cesarean wound)
- Endomyometritis
- Pelvic hematoma or abscess
- Mastitis or breast abscess
- Cystitis
- Pyelonephritis
- Necrotizing fasciitis
- Septic pelvic thrombophlebitis
- Ovarian vein thrombosis
- Deep vein thrombosis (DVT)
- Pulmonary embolism (PE)
- Pneumonia
- Medication effect (drug fever)
- *Clostridium difficile* colitis
- Urinary tract or bowel injury at cesarean section
- Retained foreign body at cesarean section

Definitions

Endomyometritis A polymicrobial infection of the decidua or myometrium and parametrial tissues. Endomyometritis accounts for approximately 2 % of postpartum patient presentations to the emergency room [68]. Risk factors for postpartum endomyometritis include cesarean delivery, lower socioeconomic status, obesity, young maternal age, nulliparity, prolonged labor induction, and meconium-stained amniotic fluid [69].

Mastitis Occurs in up to 10 % of lactating women, usually occurring 2 weeks after delivery [70, 71]. Mastitis is most often caused by methicillin-sensitive *Staphylococcus aureus*,

though methicillin-resistant *Staphylococcus aureus*, *Streptococcus pyogenes, Escherichia coli*, and coagulase-negative staphylococci are also causal organisms [72]. Patients may report a history of difficult or inconsistent breastfeeding or cracked nipples, both of which predispose women to mastitis [73].

When You Get the Call Ask for a complete set of vital signs to assess for hemodynamic instability. Begin to formulate a differential diagnosis regarding the possible source of the infection.

When You Arrive Review the patient's vital signs to assess for hypotension, tachycardia, or hypoxia. Review the patient's discharge summary and cesarean section operative report if available, including the extent of dissection, complications, administration of perioperative antibiotics, and use of thromboprophylaxis.

History

Review with the patient when her primary symptoms began, and any associated symptoms, including but not limited to fever, localizing pain, nausea, vomiting, diarrhea, dysuria, urinary frequency, or foul-smelling vaginal discharge. Ask the patient for the date and mode of her delivery, and review any complications of the delivery including infections, retained products of conception, postpartum hemorrhage, postpartum dilation and curettage, or other interventions. For patients who had vaginal deliveries, review whether the patient had an episiotomy or perineal laceration. Ask whether the patient is breastfeeding and whether she recently stopped breastfeeding or changed the duration or frequency of feeding. Ask the patient whether she resumed sexual activity since her delivery, which is usually prohibited until 6 weeks postpartum due to risk of ascending infection.

Review the patient's obstetrical history and her full medical history, including risk factors for infection such as obesity, diabetes, and immunosuppression [74]. Ask the patient

whether she has a history of venous thromboembolism or known thrombophilia, though patients are hypercoagulable in the postpartum period regardless. Review her prior surgical history, as prior surgeries may increase the risk of adhesions and intraoperative injury to other organs. Make note of any current medications, including immunosuppressant medications or anticoagulant therapy.

Physical Examination

In the setting of fever, the patient should have a head-to-toe assessment, including assessments of the oropharynx, heart, lungs, abdomen, skin, and lower extremities. An abdominal exam should focus on the cesarean section incision, if applicable, assessing for erythema, drainage or fluctuance, and the uterine fundus, assessing for tenderness. A bimanual exam may be helpful in the assessment of endomyometritis—noting fundal tenderness, cervical motion tenderness, or malodorous discharge—but may be far too uncomfortable for recently postpartum patients. Any perineal laceration or episiotomy repair should be inspected, using a gynecology bed with stirrups for better visualization. In addition, a thorough breast exam should be performed to assess for erythema, skin breakdown, or fluctuance to suggest the presence of an abscess.

In some cases of wound breakdown, it may be necessary to administer topical or local anesthetics, or even light sedation, in order to fully explore the extent of wound breakdown. Cesarean incisions with significant drainage or skin separation should be probed for fascial dehiscence.

Diagnosis

A temperature of 100.4 °F (38 °C) on two occasions more than 4 h apart or a single temperature of 101 °F (38.5 °C) constitutes a fever [75]. Patients with significant complications, such as severe wound infection or pelvic abscess, may present with septic physiology—including tachycardia,

tachypnea, hypotension, and/or oliguria—which must be identified and treated quickly (Table 12.1) [76–78]. For further management of sepsis, see Chap. 1, Acute Pelvic Pain.

Laboratory testing should include a complete blood count with a differential and urinalysis. In patients with a fever of 38.5 °C (101 °F) or more, consider collecting blood cultures in addition to a urine culture, and cultures of any purulent wound exudate. Many diagnoses can be made without imaging in the postpartum population (including mastitis, endomyometritis and superficial wound complications). Abdominal CT may be indicated in ill-appearing patients, particularly after cesarean section, or those who have failed outpatient management. Of note, hemostatic agents (such as Gelfoam®, Pfizer, New York, NY) placed at the time of cesarean section may appear as an abscess on imaging. Diagnosis and management of the most common postpartum infectious complications—breast infections, endomyometritis and wound infections—are discussed together in the next section.

Management

Please see Chap. 16, Complications of Minimally Invasive Gynecologic Surgery, for the diagnosis and management of pelvic abscess and hematoma, cystitis, pyelonephritis, necrotizing fasciitis, septic pelvic thrombophlebitis, and ovarian vein thrombosis.

Breast Infections

Women with mastitis or breast abscess typically report tenderness and erythema of the affected breast, often associated with fever, fatigue, and headaches [73]. Women with breast engorgement, which is a noninfectious process, may present similarly. Breast engorgement is, however, typically a bilateral process characterized by breast firmness and warmth, without erythema or high fever [71]. Breast engorgement usually begins within 48–96 h postpartum [79].

Patients with the diagnosis of mastitis suggested by exam can be started on antibiotics. In patients with refractory or hospital-acquired cases of mastitis, a culture of the breast milk may help guide treatment [73]. Patients with refractory mastitis or palpable mass on exam should have a breast ultrasound to assess for abscess. Empiric treatment of uncomplicated mastitis is dicloxacillin (500 mg PO every 6 h), cephalexin (500 mg PO every 6 h), or amoxicillin-clavulanate (875 mg PO every 12 h) [73]. If MRSA is suspected, trimethoprim-sulfamethoxazole (160–800 mg, PO every 12 h) or clindamycin (300 mg PO every 6 h) can be prescribed. Optimal length of therapy has not been described; commonly antibiotics are prescribed for 10–14 days.

In patients diagnosed with mastitis, use of warm compresses and breast massage at initiation of breastfeeding may be helpful. Nonsteroidal anti-inflammatory medications can be used for pain. Patients with either mastitis or engorgement often stop breastfeeding due to concerns over infecting their infant, and this can exacerbate the problem. Women with mastitis should breastfeed or pump every 2–3 h [80].

Breast abscess is initially managed with needle aspiration and antibiotics [81]. The needle aspiration is increasingly performed by interventional radiologists [82]. Large, multiloculated, or refractory cases may require surgical consultation for incision and drainage.

Endomyometritis

Women with postpartum endomyometritis typically present with abdominal pain and fevers and may report vaginal bleeding or foul-smelling discharge. On physical examination, significant fundal tenderness along with fever is highly suggestive of endomyometritis, and the diagnosis is usually made clinically.

Most women with postpartum endometritis and fever generally require admission for IV antibiotic therapy. Commonly used regimens include (1) gentamicin (4–7 mg/kg IV daily), clindamycin (900 mg IV every 8 h), and ampicillin

(2 g IV every 6 h) and (2) ampicillin-sulbactam (3 g IV every 6 h) [83]. Improvement in symptoms typically occurs within 48–72 h of treatment in the majority of women. For women without improvement, pelvic ultrasound should be considered to assess for abscess or septic pelvic thrombophlebitis, and consultation with obstetrics, interventional radiology, or general surgery (depending on the suspected infectious source) may be indicated for further management.

Physicians should maintain a high index of suspicion for a rare but potentially lethal cause of postpartum endometritis: *Streptococcus pyogenes*, also called group A streptococcus (GAS), which is associated with a mortality rate of 2 % [84]. Once patients develop fulminate sepsis, mortality ranges from 30 to 70 % [85]. Most patients present within days of delivery, though patients may also develop GAS endometritis 2 weeks or more postpartum [86]. Patients with GAS endometritis usually have high fevers (above 102 °C) and flu-like symptoms, including myalgias, nausea, and vomiting [87]. Patients may have little fundal tenderness on exam, though they may report severe general abdominal pain [87]. An endometrial culture (or at least cervical/vaginal culture) should be obtained to confirm the diagnosis. Patients with GAS endometritis should receive penicillin (2–4 million units IV every 4–6 h) and clindamycin (600–900 mg every 8 h intravenously) for 10–14 days [88]. Patients with severe penicillin allergies can receive vancomycin (30 mg/kg per day IV in two divided doses) and clindamycin. Women without improvement, or who are developing signs of sepsis, require prompt surgical management—usually hysterectomy—to control the source of infection [86, 87].

Wound Infections

Worsening pain at an incision, accompanied by warmth, erythema, or induration, is suggestive of a surgical site infection. Complications of cesarean incisions, including infection, hematoma, and dehiscence, occur in 1–2 % of patients [89].

Forty percent of these wound infections present after discharge from the hospital [90]. In patients with possible infection of the cesarean incision, if examination or imaging suggests the presence of a fluid collection under the skin—seroma, hematoma, or purulence—or purulent fluid is expressed from the incision, a wound should be opened, irrigated, and managed with wet-to-dry dressings [91–93]. In instances of fluid collection and breakdown, the wound should be carefully probed to ensure that the fascia is intact. Fascial dehiscence may also be suggested by abdominal CT. If there is any concern for fascial dehiscence, the patient should be transferred to Labor and Delivery if available; otherwise, a general surgery consultation should be obtained, to arrange for wound exploration and repair [93].

While opening a superficial collection in a cesarean wound can be a sufficient management, if surrounding erythema is observed, or fever and/or leukocytosis is documented, antibiotics should be given. For mild symptoms, cephalexin (500 mg PO every 6 h) or trimethoprim-sulfamethoxazole double strength (160–800 mg PO every 6 h) can be used [88]. Trimethoprim-sulfamethoxazole and clindamycin (300–450 mg PO every 6 h) provide coverage for methicillin-resistant *Staphylococcus aureus* [94]. Evidence of severe or systemic infection requires admission for parenteral antibiotics.

Wound infections of the perineum can occur after laceration or episiotomy. The rate of perineal wound complications is estimated to be 0.5–6 % [51, 83]. Pain and dysuria are the most common presenting symptoms, with or without fevers and malaise. Thorough examination, including a rectal exam, is needed to determine the extent of the infection and/or breakdown; local or general anesthesia may be required to fully explore the wound.

Treatment of infected perineal wounds involves establishing drainage, typically through removing sutures and debriding the infected wound. Broad-spectrum antibiotic coverage should be initiated for severe perineal wound infections; regimens used for endomyometritis can be applied. In addition to IV antibiotics, further wound exploration may be warranted

with debridement of any necrotic tissue. There is currently insufficient evidence to determine whether healing by secondary intention or reoperation is superior [96]. If there is any clinical suspicion for severe, life-threatening infection such as necrotizing fasciitis, aggressive and immediate surgical exploration is warranted; please see Chap. 16, Complications of Minimally Invasive Gynecologic Surgery, for more information.

References

1. Leone A, Ersfeld P, Adams M, Schiffer PM, Bucher HU, Arlettaz R. Neonatal morbidity in singleton late preterm infants compared with full-term infants. Acta Paediatr. 2012;101:e6–10.
2. American College of Obstetricians and Gynecologists. Committee opinion No. 611. Method for estimating due date. Obstet Gynecol. 2014;124:863–6.
3. Stoll BJ, Hansen NI, Bell EF, Walsh MC, Carlo WA, Shankaran S, et al. Trends in Care Practices, Morbidity, and Mortality of Extremely Preterm Neonates, 1993-2012. JAMA 2015; 314:1039–51.
4. Zhang J, Landy HJ, Branch DW, Burkman R, Haberman S, Gregory KD, et al. Contemporary patterns of spontaneous labor with normal neonatal outcomes. Obstet Gynecol. 2010;116:1281–7.
5. American College of Obstetricians and Gynecologists. Practice bulletin no. 116: management of intrapartum fetal heart rate tracings. Obstet Gynecol. 2010;116:1232–40.
6. Cunningham F, Leveno KJ, Bloom SL, Spong CY, Dashe JS, Hoffman BL, Casey BM, Sheffield JS. Normal labor. In: Cunningham F, Leveno KJ, Bloom SL, Spong CY, Dashe JS, Hoffman BL, Casey BM, Sheffield JS, editors. Williams obstetrics. 24th ed. New York: McGraw-Hill; 2013. http://accessmedicine.mhmedical.com.ezp-prod1.hul.harvard.edu/content.aspx?bookid=1057&Sectionid=59789162. Accessed 25 Aug 2015.
7. Brookes C, Shand K, Jones WR. A reevaluation of the ferning test to detect ruptured membranes. Aust N Z J Obstet Gynaecol. 1986;26:260–4.
8. Department of Health and Human Services. Emergency medical treatment & labor act (EMTALA). https://www.cms.gov/Regulations-and-Guidance/Legislation/EMTALA/. Accessed 25 Aug 2015.

9. Siff JE. Chapter 298. Legal issues in emergency medicine. In: Tintinalli JE, Stapczynski J, Ma O, Cline DM, Cydulka RK, Meckler GD T, editors. Tintinalli's emergency medicine: a comprehensive study guide. 7th ed. New York: McGraw-Hill; 2011. http://accessmedicine.mhmedical.com.ezp-prod1.hul.harvard.edu/content.aspx?bookid=348&Sectionid=40381796.Accessed 25 Aug 2015.
10. Verani JR, McGee L, Schrag SJ, Division of Bacterial Diseases. National Center for Immunization and Respiratory Diseases, Centers for Disease Control and Prevention (CDC). Prevention of perinatal group B streptococcal disease – revised guidelines from CDC, 2010. MMWR Recomm Rep. 2010;59:1–36.
11. Maternal and Newborn Health/Safe Motherhood Unit, Division of Reproductive Health. "Basic Newborn Resuscitation: a practical guide". Geneva: World Health Organization; 1999. Available at http://apps.who.int/iris/bitstream/10665/63953/1/WHO_RHT_MSM_98.1.pdf. Accessed 29 Sep 2015.
12. Combs CA, Laros Jr RK. Prolonged third stage of labor: morbidity and risk factors. Obstet Gynecol. 1991;77:863–7.
13. Begley CM, Gyte GM, Devane D, McGuire W, Weeks A. Active versus expectant management for women in the third stage of labour. Cochrane Database Syst Rev. 2015;(3):CD007412.
14. Du Y, Ye M, Zheng F. Active management of the third stage of labor with and without controlled cord traction: a systematic review and meta-analysis of randomized controlled trials. Acta Obstet Gynecol Scand. 2014;93:626–33.
15. Jackson Jr KW, Allbert JR, Schemmer GK, Elliot M, Humphrey A, Taylor J. A randomized controlled trial comparing oxytocin administration before and after placental delivery in the prevention of postpartum hemorrhage. Am J Obstet Gynecol. 2001;185:873–7.
16. Combs CA, Murphy EL, Laros Jr RK. Factors associated with postpartum hemorrhage with vaginal birth. Obstet Gynecol. 1991;77:69–76.
17. American College of Obstetricians and Gynecologists. ACOG practice bulletin: number 76, October 2006: postpartum hemorrhage. Obstet Gynecol. 2006;108:1039–47.
18. Stones RW, Paterson CM, Saunders NJ. Risk factors for major obstetric haemorrhage. Eur J Obstet Gynecol Reprod Biol. 1993;48:15–8.
19. Dildy 3rd GA. Postpartum hemorrhage: new management options. Clin Obstet Gynecol. 2002;45:330–44.

20. Cunningham F, Leveno KJ, Bloom SL, Hauth JC, Rouse DJ, Spong CY. Chapter 35. Obstetrical hemorrhage. In: Cunningham F, Leveno KJ, Bloom SL, Hauth JC, Rouse DJ, Spong CY. editors. Williams obstetrics, 23rd ed. New York: McGraw-Hill; 2010. http://accessmedicine.mhmedical.com.ezp-prod1.hul.harvard.edu/content.aspx?bookid=350&Sectionid=41680602. Accessed 23 Aug 2015.
21. Tantbirojn P, Crum CP, Parast MM. Pathophysiology of placenta creta: the role of decidua and extravillous trophoblast. Placenta. 2008;29:639–45.
22. Silver RM, Landon MB, Rouse DJ, Leveno KJ, Spong CY, Thom EA, et al. Maternal morbidity associated with multiple repeat cesarean deliveries. Obstet Gynecol. 2006;107:1226–32.
23. Miller DA, Chollet JA, Goodwin TM. Clinical risk factors for placenta previa-placenta accreta. Am J Obstet Gynecol. 1997;177:210–4.
24. Landon MB, Hauth JC, Leveno KJ, Spong CY, Leindecker S, Varner MW, et al. Maternal and perinatal outcomes associated with a trial of labor after prior cesarean delivery. N Engl J Med. 2004;351:2581–9.
25. Levi M, Toh CH, Thachil J, Watson HG. Guidelines for the diagnosis and management of disseminated intravascular coagulation. British Committee for Standards in Haematology. Br J Haematol. 2009;145:24–33.
26. American College of Obstetricians and Gynecologists. ACOG practice bulletin: thrombocytopenia in pregnancy. Number 6, September 1999. Int J Gynaecol Obstet. 1999;67:117–28.
27. Rosenstein MG, Vargas JE, Drey EA. Ultrasound-guided instrumental removal of the retained placenta after vaginal delivery. Am J Obstet Gynecol. 2014;211:180.e1–3.
28. Committee on Trauma. Advanced trauma life support 1 student manual. Eighthth ed. Chicago: American College of Surgeons; 2008.
29. Vaknin Z, Maymon R, Mendlovic S, Barel O, Herman A, Sherman D. Clinical, sonographic, and epidemiologic features of second- and early third-trimester spontaneous antepartum uterine rupture: a cohort study. Prenat Diagn. 2008;28:478–84.
30. Riskin DJ, Tsai TC, Riskin L, Hernandez-Boussard T, Purtill M, Maggio PM. Massive transfusion protocols: the role of aggressive resuscitation versus product ratio in mortality reduction. J Am Coll Surg. 2009;209:198–205.
31. Pham HP, Shaz BH. Update on massive transfusion. Br J Anaesth. 2013;111 Suppl 1:i71–82.

32. Erber WN, Perry DJ. Plasma and plasma products in the treatment of massive haemorrhage. Best Pract Res Clin Haematol. 2006;19:97–112.
33. Levy JH, Szlam F, Tanaka KA, Sniecienski RM. Fibrinogen and hemostasis: a primary hemostatic target for the management of acquired bleeding. Anesth Analg. 2012;114:261–74.
34. Smith GN, Brien JF. Use of nitroglycerin for uterine relaxation. Obstet Gynecol Surv. 1998;53:559–65.
35. Watson P, Besch N, Bowes Jr WA. Management of acute and subacute puerperal inversion of the uterus. Obstet Gynecol. 1980;55:12–6.
36. American College of Obstetricians and Gynecologists. Patient safety checklist number 10: postpartum hemorrhage from vaginal delivery. 2013. http://www.acog.org/Resources-And-Publications/Patient-Safety-Checklists/Postpartum-Hemorrhage-from-Vaginal-Delivery. Accessed 25 Jul 2015.
37. O'Connell K, Jones H, Simon M, Saporta V, Paul M, Lichtenberg E. First-trimester surgical abortion practices: a survey of National Abortion Federation members. Contraception. 2009;79:385–92.
38. Meckstroth K, Whitaker A, Bertisch S, Goldberg A, Darney P. Misoprostol administered by epithelial routes: drug absorption and uterine response. Obstet Gynecol. 2006;108:582–90.
39. Mousa HA, Blum J, Abou El Senoun G, Shakur H, Alfirevic Z. Treatment for primary postpartum haemorrhage. Cochrane Database Syst Rev. 2014;2:CD003249.
40. Kauff ND, Chelmow D, Kawada CY. Intractable bleeding managed with Foley catheter tamponade after dilation and evacuation. Am J Obstet Gynecol. 1995;173:957–8.
41. Olamijulo J, Doufekas K. Intrauterine balloon tamponade for uncontrollable bleeding during first trimester surgical termination of pregnancy. J Obstet Gynaecol. 2007;27:440–1.
42. Hansch E, Chitkara U, McAlpine J, El-Sayed Y, Dake MD, Razavi MK. Pelvic arterial embolization for control of obstetric hemorrhage: a five-year experience. Am J Obstet Gynecol. 1999;180:1454–60.
43. Ojala K, Perälä J, Kariniemi J, Ranta P, Raudaskoski T, Tekay A. Arterial embolization and prophylactic catheterization for the treatment for severe obstetric hemorrhage. Acta Obstet Gynecol Scand. 2005;84:1075–80.
44. Lu MC, Fridman M, Korst LM, Gregory KD, Reyes C, Hobel CJ. Variants in the incidence of postpartum hemorrhage

across hospitals in California. Matern Child Health J. 2005; 9:297–306.
45. American College of Obstetricians and Gynecologists: task force on hypertension in pregnancy. Hypertension in pregnancy. 2013. http://www.acog.org/Resources-And-Publications/Task-Force-and-Work-Group-Reports/Hypertension-in-Pregnancy. Accessed 19 Jul 2015.
46. Sibai BM. Preeclampsia: 3 preemptive tactics. OBG Manage. 2005;17:20–32.
47. Sibai BM. Etiology and management of postpartum hypertension-preeclampsia. Am J Obstet Gynecol. 2012;206:470–5.
48. American College of Obstetricians and Gynecologists. Committee Opinion No. 623: Emergent therapy for acute-onset, severe hypertension during pregnancy and the postpartum period. Obstet Gynecol. 2015;125:521–5.
49. Zeeman GG. Neurologic complications of pre-eclampsia. Semin Perinatol. 2009;33:166–72.
50. Sibai BM, Ramadan MK, Usa I, Salama M, Mercer BM, Friedman SA. Maternal morbidity and mortality in 442 pregnancies with hemolysis, elevated liver enzymes, and low platelets (HELLP syndrome). Am J Obstet Gynecol. 1993;169:1000–6.
51. Johnson W, Nguyen ML, Patel R. Hypertension crisis in the emergency department. Cardiol Clin. 2012;30:533–43.
52. U.S. National Library of Medicine. Drugs and lactation database (LactMed). http://toxnet.nlm.nih.gov/newtoxnet/lactmed.htm. Accessed 23 Aug 2015.
53. Altman D, Carroli G, Duley L, Farrell B, Moodley J, Neilson J, et al. Do women with pre-eclampsia, and their babies, benefit from magnesium sulphate? The Magpie Trial: a randomised placebo-controlled trial. Lancet. 2002;359:1877–90.
54. Duley L, Gülmezoglu AM, Henderson-Smart DJ, Chou D. Magnesium sulphate and other anticonvulsants for women with pre-eclampsia. Cochrane Database Syst Rev 2010;(11):CD000025.
55. Critchfield AS, Heard AJ. Severe preeclampsia or eclampsia and hypertensive issues. In: LaFontaine D, Angelini DJ, editors. Obstetric triage and emergency care protocol. New York: Springer Publishing Company, LLC; 2013. p. 149–58.
56. Eclampsia Trial Collaborative Group. Which anticonvulsant for women with eclampsia? Evidence from the collaborative eclampsia trial. Lancet. 1995;345:1455–63.
57. Brophy GM, Bell R, Claassen J, Alldredge B, Bleck TP, Glauser T, et al. Guidelines for the evaluation and management of status epilepticus. Neurocrit Care. 2012;17:3–23.

58. Hill CC, Pickinpaugh J. Trauma and surgical emergencies in the obstetric patient. Surg Clin North Am. 2008;88:421–40.
59. Fildes J, Reed L, Jones N, Martin M, Barrett J. Trauma: the leading cause of maternal death. J Trauma. 1992;32:643–5.
60. Kvarnstrand L, Milsom I, Lekander T, Druid H, Jacobsson B. Maternal fatalities, fetal and neonatal deaths related to motor vehicle crashes during pregnancy: a national population-based study. Acta Obstet Gynecol Scand. 2008;87:946–52.
61. Mendez-Figueroa H, Dahlke JD, Vrees RA, Rouse DJ. Trauma in pregnancy: an updated systematic review. Am J Obstet Gynecol. 2013;209:1–10.
62. Weincrot A, Nannini A, Manning SE, Kennelly J. Neonatal outcomes and mental illness, substance abuse and intentional injury during pregnancy. Matn Child Health J. 2012;16:979–88.
63. Brown HL. Trauma in pregnancy. Obstet Gynecol. 2009;114:147–60.
64. Vanden Hoek TL, Morrison LJ, Shuster M, Donnino M, Sinz E, Lavonas EJ, et al. Part 12: cardiac arrest in special situations: 2010 American Heart Association Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care. Circulation. 2010;122:S829–61.
65. Chames MC, Pearlman MD. Trauma during pregnancy: outcomes and clinical management. Clin Obstet Gynecol. 2008;51:398–408.
66. Rees GA, Willis BA. Resuscitation in late pregnancy. Anaesthesia. 1988;43:347–9.
67. Suresh MS, Mason CL, Munner U. Cardiopulmonary resuscitation and the parturient. Best Pract Res Clin Obstet Gynaecol. 2010;24:383–400.
68. Ahnfeldt-Mollerup P, Petersen LK, Kragstrup J, Christensen RD, Sørensen B. Postpartum infections: occurrence, healthcare contacts and association with breastfeeding. Acta Obstet Gynecol Scand. 2012;91:1440–4.
69. Cunningham F, Leveno KJ, Bloom SL, Hauth JC, Rouse DJ, Spong CY. Chapter 31. Puerperal infection. In: Cunningham F, Leveno KJ, Bloom SL, Hauth JC, Rouse DJ, Spong CY, editors. Williams obstetrics, 23rd ed. New York: McGraw-Hill; 2010. http://accessmedicine.mhmedical.com.ezp-prod1.hul.harvard.edu/content.aspx?bookid=350&Sectionid=41680597. Accessed 23 Aug 2015.
70. Foxman B, D'Arcy H, Gillespie B, Bobo JK, Schwartz K. Lactation mastitis: occurrence and medical management among 946 breastfeeding women in the United States. Am J Epidemiol. 2002;155:103–14.

71. Mass S. Breast pain: engorgement, nipple pain and mastitis. Clin Obstet Gynecol. 2004;47:676–82.
72. Schoenfeld EM, McKay MP. Mastitis and methicillin-resistant Staphylococcus aureus (MRSA): the calm before the storm? J Emer Med. 2010;38:e31–4.
73. Spencer JP. Management of mastitis in breastfeeding women. Am Fam Physician. 2008;78:727–31.
74. Beilman GJ, Dunn DL. Surgical infections. In: Brunicardi F, Andersen DK, Billiar TR, Dunn DL, Hunter JG, Matthews JB, Pollock RE, editors. Schwartz's principles of surgery. 10th ed. New York: McGraw-Hill; 2014. http://accessmedicine.mhmedical.com.ezp-prod1.hul.harvard.edu/content.aspx?bookid=980&Sectionid=59610847. Accessed 11 Jun 2015.
75. Faro C, Faro S. Postoperative pelvic infections. Infect Dis Clin North Am. 2008;22:653–63.
76. Clarke-Pearson DL, Geller EJ. Complications of hysterectomy. Obstet Gynecol. 2013;121:654–73.
77. Fischerova D. Urgent care in gynaecology: resuscitation and management of sepsis and acute blood loss. Best Pract Res Clin Obstet Gynaecol. 2009;23:679–90.
78. Dellinger RP, Levy MM, Rhodes A, Annane D, Gerlach H, Opal SM, et al. Surviving sepsis campaign: international guidelines for management of severe sepsis and septic shock: 2012. Crit Care Med. 2013;41:580–637.
79. Keister D, Roberts KT, Werner SL. Strategies for breastfeeding success. Am Fam Physician. 2008;78:225–32.
80. Gartner LM, Morton J, Lawrence RA, Naylor AJ, O'Hare D, Schanler RJ, et al. Breastfeeding and the use of human milk. Pediatrics. 2005;115:496–506.
81. Lam E, Chan T, Wiseman SM. Breast abscess: evidence based management recommendations. Expert Rev Anti Infect Ther. 2014;12:753–62.
82. Trop I, Dugas A, David J, El Khoury M, Boileau JF, Larouche N, et al. Breast abscesses: evidence-based algorithms for diagnosis, management, and follow-up. Radiographics. 2011;31:1683–99.
83. Pizzarello M, LaFontaine D. Secondary postpartum hemorrhage and endometritis. In: LaFontaine D, Angelini DJ, editors. Obstetric triage and emergency care protocol. New York: Springer Publishing Company, LLC; 2013. p. 259–302.
84. Chuang I, Van BC, Beall B, Schuchat A. Population-based surveillance for postpartum invasive group A Streptococcus infections, 1995–2000. Clin Infect Dis. 2002;35:665–70.

85. Stevens DL, Group A. Streptococcal sepsis. Curr Infect Dis Rep. 2003;5:379–86.
86. Hamilton SM, Stevens DL, Bryant AE. Pregnancy-related group a streptococcal infections: temporal relationships between bacterial acquisition, infection onset, clinical findings, and outcome. Clin Infect Dis. 2013;57:870–6.
87. Rimawi BH, Soper DE, Eschenbach DA. Group A streptococcal infections in obstetrics and gynecology. Clin Obstet Gynecol. 2012;55:864–74.
88. Stevens DL, Bisno AL, Chambers HF, Dellinger EP, Goldstein EJ, Gorbach SL, et al. Practice guidelines for the diagnosis and management of skin and soft tissue infections: 2014 update by the Infectious Diseases Society of America. Clin Infect Dis. 2014;59:e10–52.
89. Hammad IA, Chauhan SP, Magann EF, Abuhamad AZ. Peripartum complications with cesarean delivery: a review of Maternal-Fetal Medicine Units Network publications. J Matern Fetal Neonatal Med. 2014;27:463–74.
90. Olsen MA, Butler AM, Willers DM, Devkota P, Gross GA, Fraser VJ. Risk factors for surgical site infection after low transverse cesarean section. Infect Control Hosp Epidemiol. 2008; 29:477–84.
91. Jaiyeoba O. Postoperative infections in obstetrics and gynecology. Clin Obstet Gynecol. 2012;55:904–13.
92. Hodges KR, Davis BR, Swaim LS. Prevention and management of hysterectomy complications. Clin Obstet Gynecol. 2014;57: 43–57.
93. Fitzwater JL, Tita AT. Prevention and management of cesarean wound infection. Obstet Gynecol Clin North Am. 2014;41: 671–89.
94. Pallin DJ, Binder WD, Allen MB, Lederman M, Parmar S, Filbin MR, et al. Clinical trial: comparative effectiveness of cephalexin plus trimethoprim-sulfamethoxazole versus cephalexin alone for treatment of uncomplicated cellulitis: a randomized controlled trial. Clin Infect Dis. 2013;56:1754–62.
95. Webb S, Sherburn M, Ismail KM Managing perineal trauma after childbirth. BMJ. 2014;349:g6829.
96. Dudley L, Kettle C, Ismail K. Secondary suturing compared to non-suturing for broken down perineal wounds following childbirth. Cochrane Database Syst Rev 2013:(9):CD008977.