

Labor and Delivery and Their Complications

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PRINCIPLES

Births in the emergency department (ED) are rare. In most cases, patients in labor are triaged directly to the obstetric suite for urgent management, maintaining a continuum of care with their primary providers. Because some births are precipitous and obstetric resources may not be immediately available, the emergency clinician must possess the basic skills for intrapartum management of normal and abnormal deliveries. In addition, a general knowledge of postpartum care is required in case of the occasional out-of-hospital delivery.

Limitations of the Emergency Department

The ED is a suboptimal location for the management of a complicated delivery. Unlike the obstetric suite, the ED may be lacking in appropriate resources, such as tocodynamometry, intrauterine pressure monitors, vacuum extractors, and forceps. In addition, the obstetrician typically has prenatal care information, including accurate gestational dates, presence of placental anatomy, and prior documented obstetric complications, which helps optimize maternal and fetal outcomes. It is difficult, if not impossible, to obtain these data in the ED while preparing for imminent delivery. Finally, cesarean section may be indicated to ensure a successful delivery. This option is not performed in the ED except in dire perimortem circumstances.

Epidemiology of Emergency Delivery

In 2011, the perinatal mortality rate in the United States was 6.26/1000 live births at 28 weeks of gestation or more.¹ Delivery complications and mortality occur with greater frequency in the ED, where the perinatal mortality rate is approximately 8% to 10%. There are multiple features of the high-risk ED delivery profile. The ED as a care environment is often selected by an obstetric population that subsequently may have unexpected complications. Psychosocial factors, such as drug or alcohol abuse, domestic violence, and lack of access to medical care, contribute to precipitous deliveries in pregnant women with little or no prenatal care. Antepartum hemorrhage, premature rupture of membranes (PROM), eclampsia, premature labor, abruptio placentae, malpresentation, and umbilical cord emergencies are overrepresented in the ED population.

Patient Transfer Considerations

Because of the high risk associated with ED delivery, patients should be transported to a facility that has obstetric and neonatal resources whenever possible. The transfer of a woman with an impending high-risk delivery to such a facility should be based on sound clinical and medicolegal judgment. Transfer, with an en route delivery, cannot only be disastrous for the mother and fetus,

but also violates federal law. Further consideration should be given to the type of nursery and level of care that the neonate will require after delivery, particularly in preterm (<36 weeks of gestation) deliveries, in which interval transfer for a higher level of care may be necessary.

NORMAL DELIVERY

Initial Presentation

Although the epidemiology and high complication rate associated with ED births demand caution, most are normal deliveries. Knowledge of normal labor and delivery mechanics aids safe vaginal delivery and facilitates the identification of complications.

Whenever a woman in the third trimester of pregnancy seeks treatment in the ED, the possibility that she is in labor must be considered. A wide array of nonspecific symptoms may herald the onset of labor. Abdominal pain, back pain, cramping, nausea, vomiting, urinary urgency, stress incontinence, and anxiety can be symptoms of labor. After 24 weeks' gestation, any medical assessment should include the mother and fetus because fetal viability becomes established near that time.

Distinguishing False From True Labor

Braxton Hicks contractions, or false labor, must be differentiated from true labor. After 30 weeks of gestation, the previously small and uncoordinated contractions of the uterus become more synchronous and may be perceived by the mother. Braxton Hicks contractions do not escalate in frequency or duration, in contrast to the contractions of true labor. By definition, these contractions are associated with minimal or no cervical dilation or effacement. Examination should also reveal intact membranes. Care not to rupture the membranes is important to avoid inducing labor prematurely. If the diagnosis remains in doubt, external electrical monitoring of uterine activity can rule out true labor. Any discomfort associated with false labor is usually relieved with mild analgesia, ambulation, or change in activity.

Unlike false labor, true labor is characterized by cyclic uterine contractions of increasing frequency, duration, and strength, culminating in delivery of the fetus and placenta. In contrast to Braxton Hicks contractions, true labor causes cervical dilation to begin, marking the first stage of labor.

Bloody Show

At the onset of labor, the cervical mucous plug may be expelled, resulting in what is termed a *bloody show*. The bleeding associated with this process is slight (usually only a few dark red spots admixed with mucus) and is due to the increase in cervical vascularity that occurs in pregnancy. Bloody show is not a contraindication to vaginal examination for the determination of cervical

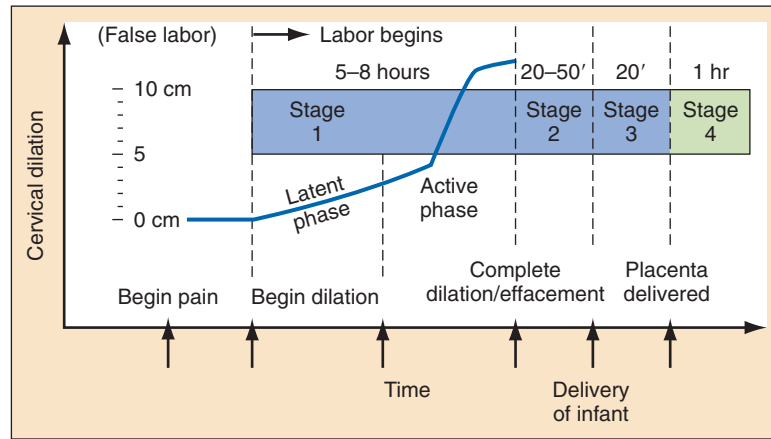


Fig. 181.1. Stages of labor and delivery. Stage 1, cervical stage; stage 2, fetal expulsion; stage 3, placental expulsion (20 minutes); stage 4, uterine contraction (1 hour postpartum).

effacement and dilation. If bleeding continues or is of a larger volume, more serious causes should be suspected, such as placenta previa and placental abruption, which are contraindications for a vaginal examination.

Stages of Labor

First Stage of Labor

The first stage of labor is the cervical stage, ending with a completely dilated, fully effaced cervix. It is divided into a latent phase, with slow cervical dilation, and an active phase, with more rapid dilation. The active phase begins once the cervix is dilated to 3 cm. Most women who deliver in the ED arrive while in the active phase of stage 1 or early stage 2 labor (Fig. 181.1). The duration of the first stage of labor averages 8 hours in nulliparous women and 5 hours in multiparous women. During this time, frequent assessment of fetal well-being is important, and continuous external electrical monitoring may help identify fetal distress, allowing for appropriate intervention.

The maternal examination provides a rough guide to gestational age. At 20 weeks' gestation, the uterine fundus reaches the umbilicus. Approximately 1 cm of fundal height is added per week of gestation until 36 weeks. At that time, the fundal height decreases as the fetus drops into the pelvis (Fig. 181.2). These estimates help establish gestational age rapidly.

The abdominal examination with Leopold's maneuvers may confirm the lie of the fetus (Fig. 181.3). After labor has begun, Leopold's maneuvers may not easily distinguish the lie due to uterine contractions. Other modalities of assessing the lie, such as ultrasonography, may be necessary if presentation remains in question.

The determination of the stage of labor depends on examination of the cervix. A sterile approach using sterile gloves, sterile speculum, and povidone-iodine solution is indicated to prevent ascending infection. On pelvic examination, the clinician should determine the following:

- Effacement refers to the thickness of the cervix. A paper thin cervix is 100% effaced. Dilation indicates the diameter of the cervical opening in centimeters. Complete, or maximum, dilation is 10 cm.
- Position describes the relationship of the fetal presenting part to the birth canal. The most common position of the head is occiput anterior.
- Station indicates the relationship of the presenting fetal part to the maternal ischial spines (Fig. 181.4).

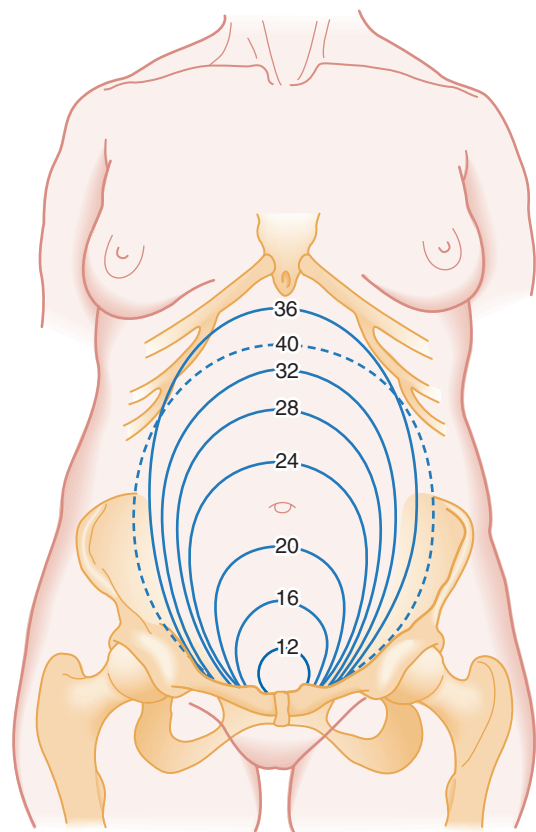


Fig. 181.2. Height of fundus by weeks of normal gestation with a single fetus. The dotted line indicates height after lightening. (Adapted from Barkaukas V, et al: Health and physical assessment. St. Louis, 1992, Mosby.)

- Presentation specifies the anatomic part of the fetus leading through the birth canal.

In 95% of all labors, the presenting part is the occiput, or vertex. On digital examination, a smooth surface with 360 degrees of firm bony contours and palpable suture lines is noted. Palpation of the suture lines and the fontanels where they join allows the examiner to determine the direction the fetus is facing. Three sutures radiate from the posterior fontanel, and four radiate from the anterior fontanel (Fig. 181.5). The lateral margins are examined carefully for fingers or facial parts that indicate compound or brow presentations.

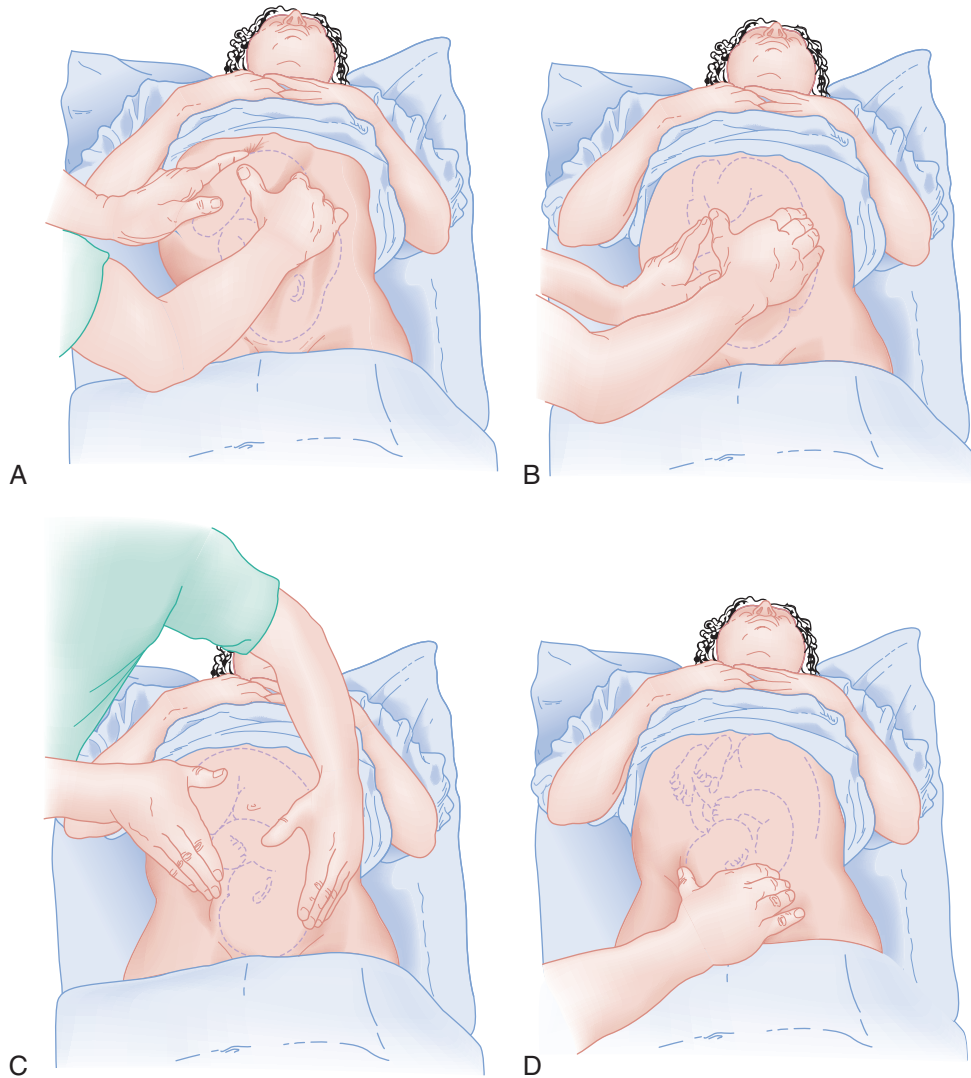


Fig. 181.3. Leopold's maneuvers. **A**, The first Leopold maneuver reveals which fetal part occupies the fundus. **B**, The second Leopold maneuver reveals the position of the fetal back. **C**, The third Leopold maneuver reveals which fetal part lies over the pelvic inlet. **D**, The fourth Leopold maneuver reveals the position of the cephalic prominence (Adapted from Willson JR, et al: *Obstetrics and gynecology*, ed 9, St. Louis, 1991, Mosby.)

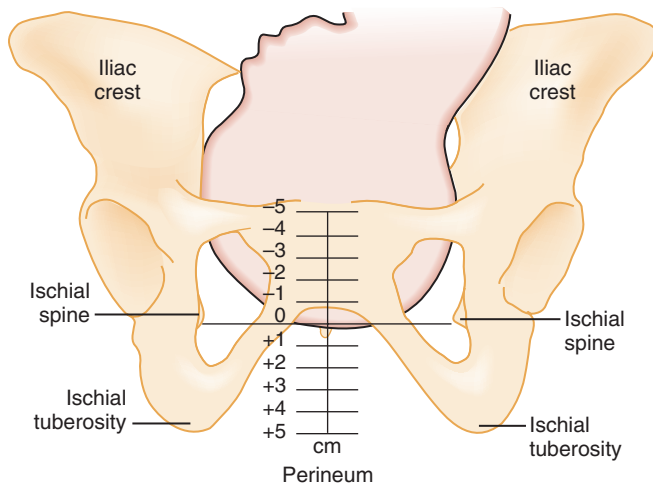


Fig. 181.4. Fetal stations. The level of the ischial spines is considered 0 station. The silhouette of the infant's head is shown approaching station +1. (Courtesy Ross Laboratories, Columbus, OH.)

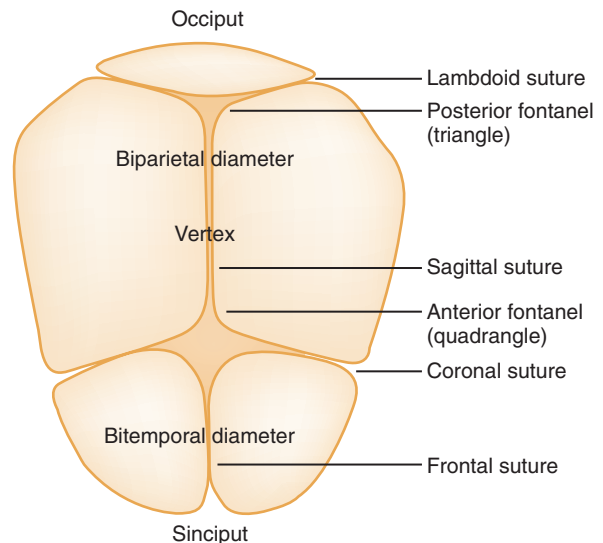


Fig. 181.5. Bony landmarks of the fetal skull. (Adapted from Willson JR, et al: *Obstetrics and gynecology*, ed 9, St. Louis, 1991, Mosby.)

When the clinician suspects rupture of membranes, a sterile speculum examination is performed. This may reveal pooling of amniotic fluid, a fernlike pattern when the fluid is allowed to dry on a microscope slide, and the use of Nitrazine paper, which should turn blue, indicating an alkaline amniotic fluid (pH > 6). Although vaginal blood, cervical mucus, semen, and infection can interfere with results, sensitivities of Nitrazine paper and ferning for the detection of amniotic fluid are nearly 90%.

Of note, if vaginal bleeding is evident, digital and speculum examination of the pelvis should be deferred until an ultrasound study can be obtained to rule out placenta previa.

Second Stage of Labor

The second stage of labor is characterized by a fully dilated cervix and accompanied by the urge to bear down and push with each uterine contraction. The median duration of this stage is 50 minutes in nulliparous women and 20 minutes in multiparous women, with the anticipation of a more rapid progression for low-birth-weight premature infants. A prolonged second stage of labor is associated with an increase in maternal complications, including postpartum hemorrhage, infection, and severe vaginal lacerations.

Antenatal Fetal Assessment. During labor and delivery, the identification of fetal distress and appropriate intervention can reduce fetal morbidity and mortality. There are currently three methods of assessing a fetus in utero: (1) clinical monitoring; (2) electrical monitoring; and (3) ultrasonography. External electrical monitoring and ultrasonography merit consideration for use in the care of women laboring in the ED. Both modalities provide real-time information that is helpful for the diagnosis of fetal distress and assistance with intrapartum decision making.

Electronic Fetal Monitoring. Electronic fetal monitoring uses tracings of the fetal heart rate and uterine activity. Documentation of organized cyclic uterine contractions helps confirm true labor and may help diagnose fetal distress. In combination with clinical data, this can portend fetal distress due to hypoxia and provide a window for intervention.

Uterine activity is measured transabdominally by a pressure transducer, creating a recording of the contraction frequency. Because the measurements are indirect, the strength of the contractions correlates poorly with the tracing. The tracings are position and placement sensitive.

Fetal heart rate tracings have several components that can be assessed—baseline heart rate, variability, accelerations, decelerations, and diagnostic patterns.

Baseline Heart Rate. This is the average fetal heart rate during a 10-minute period (in the absence of a uterine contraction) and is the most important aspect of fetal heart rate monitoring. Fetal bradycardia is defined as a baseline rate of less than 110 beats/min; fetal tachycardia is defined as a baseline rate of more than 160 beats/min.²

Variability. This can be instantaneous (beat to beat) or long term (intervals ≥ 1 minute). Both types of variability are indicators of fetal well-being. Accelerations occur during fetal movement and reflect an alert mobile fetus. Decreased variability may indicate fetal acidemia and hypoxemia or may be a side effect of a wide array of drugs, including analgesics, sedative-hypnotics, phenothiazines, and alcohol.

Decelerations. Decelerations in fetal heart rate are more complicated and should be interpreted according to the clinical scenario. There are three types of deceleration—variable, early, and late (Fig. 181.6). These terms refer to the timing of the deceleration relative to the uterine contraction.

Variable and early decelerations are common and normally represent physiologic reflexes associated with head compression

in the birth canal or intermittent cord compression. Variable decelerations that are persistent and repetitive usually indicate repeated episodes of umbilical cord compression. The resultant hypoxia and acidosis may cause fetal distress. Attempts to shift maternal and fetal weight off the umbilical cord by changing position are indicated. If variable decelerations continue, the situation warrants efforts to hasten the delivery or, if obstetric backup becomes available, to perform an emergency cesarean section.

Late decelerations are more serious and most often indicate uteroplacental insufficiency. The tracing contours are generally smooth, with the heart rate nadir occurring well after a maximal uterine contraction (typically, ≥ 30 seconds afterward).² The lag, slope, and magnitude of late decelerations correlate with increasing fetal hypoxia. Late decelerations are particularly ominous in association with poor variability, nonreactivity, and baseline bradycardia. When these findings are present, immediate obstetric consultation for delivery is indicated to prevent further hypoxia.

Diagnostic Patterns. Finally, the emergency clinician should be aware of the significance of sinusoidal tracings. Tracings of this type have low baseline heart rates and little beat to beat variability. The sinusoidal tracing is an ominous finding that is often premonitory. The differential diagnosis includes erythroblastosis fetalis, placental abruption, fetal hemorrhage (trauma), and amnionitis.

Ultrasonography. In the third trimester or during labor, ultrasonography can provide crucial information pertaining to impending delivery. When a technician and radiologist are available, and if time permits, the gestational age, biophysical profile, amniotic fluid index, and a survey of fetal and placental anatomy may be obtained. The American College of Obstetricians and Gynecologists (ACOG) has published recommendations regarding the indications for ultrasonography in the third trimester (Box 181.1). The parameters of immediate interest in the ED are fetal viability (specifically in utero gestation and fetal heart rate), lie, and presentation. The use of bedside transabdominal ultrasonography by emergency clinicians to evaluate such parameters expeditiously continues to rise as this modality becomes increasingly available and operator skill improves.³ Transvaginal ultrasonography is relatively contraindicated in the peripartum period, particularly in the cases of PROM and placenta previa.⁴

Delivery. As stage 2 of labor progresses, preparation for delivery should be under way. A radiant warmer should be available and heated. Neonatal resuscitation adjuncts should be available, including a towel, scissors, umbilical clamps, bulb suction, airway equipment (oxygen, bag-mask device with appropriately sized masks, and tools for endotracheal intubation), and equipment to achieve vascular access. Most deliveries require only basic equipment to cut and clamp the umbilical cord, suction the

BOX 181.1

Third-Trimester Ultrasonography: Possible Indications

- Determine number of fetuses.
- Establish fetal presentation.
- Identify fetal heart motion.
- Locate placenta.
- Measure amniotic fluid.
- Determine gestational age.
- Survey fetal anatomy.
- Diagnose cord prolapse.
- Diagnose cause of third-trimester bleeding.
- Rule out placental abruption.

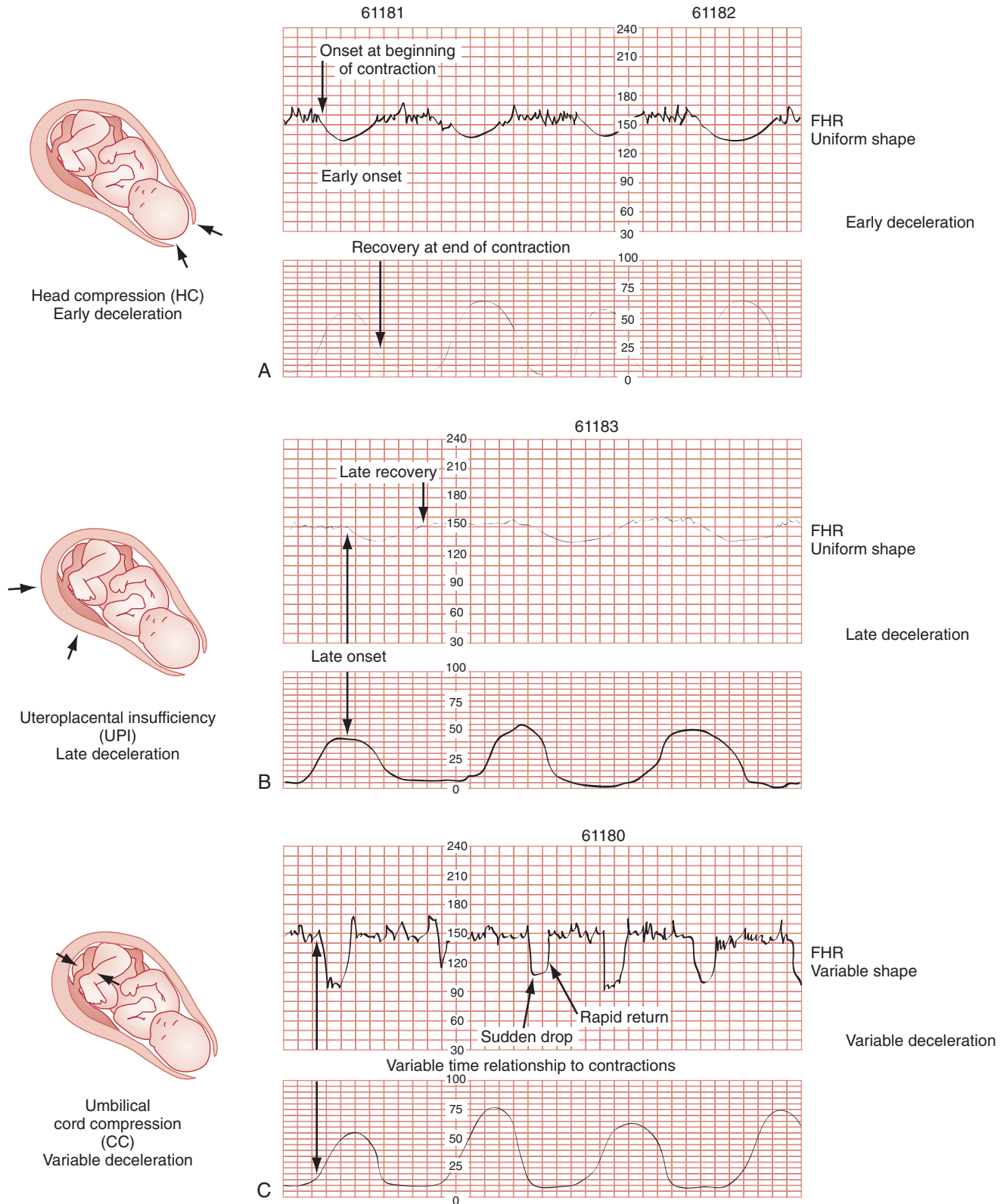


Fig. 181.6. Deceleration patterns of the fetal heart rate (FHR). **A**, Early deceleration caused by head compression. **B**, Late deceleration caused by uteroplacental insufficiency. **C**, Variable deceleration caused by cord compression. (Modified from Lowdermilk DL, et al: *Maternity and women's health care*, ed 6, St. Louis, 1997, Mosby.)

mouth and nose, and dry and stimulate the infant. A nurse should be at the bedside to coach and provide reassurance to the mother.

The mother is placed in the dorsal lithotomy position and prepared for delivery. The Sims position, or left lateral position

with knees drawn toward the mother's chest and back to the physician, is also an acceptable position. The vulva and perineum are cleared and gently scrubbed with sterile water or saline. A repeated sterile examination to assess labor progression and confirm presentation may be performed. Firm digital stretching

of the perineum, particularly posteriorly, may prevent tears and lacerations later in delivery.

Controlled coordinated expulsion with coaching to sustain each push aids with crowning and delivery of the head. The most vulnerable moment is when the fetal head begins to stretch and distend the perineum. Instructing the mother to pant and not push slows the passage of the head and shoulders. The modified Ritgen maneuver may be used to support the perineum and prevent maternal injury. In this technique, a towel-draped, gloved hand is used to stretch the perineum and gently exert pressure on the chin of the fetus. The second hand places pressure on the occiput superiorly, guiding the head into slight extension and positioning it so that its smallest diameter passes through the pelvic outlet. Calm communication between the physician and mother is the best way to maintain control of the delivery.

After the head is delivered, the physician allows the head to rotate toward the maternal thigh and clears the fetal face and airway. Next, the shoulders, usually anterior shoulder first, clear the perineum. The shoulders often deliver spontaneously, with little effort by the physician. Gentle downward traction on the head promotes delivery of the anterior shoulder. A subsequent upward motion pulls the posterior shoulder through the pelvic outlet. If delay occurs in delivery of the shoulders, the potential for shoulder dystocia should be considered.

As the infant clears the perineum, attention focuses on the umbilical cord. The infant should be kept low or at the level of the perineum to promote blood flow into the infant from the placenta. The cord is clamped and cut. Clamps should be placed 4 or 5 cm apart, with the proximal clamp 10 cm from the infant's abdomen. An adequate umbilical stump is important for venous access if the neonate requires resuscitation. Suctioning of the nose and mouth at this time may reduce secretions that can cause increased airway resistance.

The infant is now clear of the mother and can be wrapped in towels and moved to the warmer. Gentle drying with a towel and suctioning usually provide adequate respiratory stimulation. If not, flicking the soles of the feet and rubbing the back are other modalities. Apgar scores at 1, 5, and 10 minutes after birth should be documented.

Episiotomy. With a controlled delivery, routine performance of an episiotomy is not recommended. It should be performed only for specific indications, such as shoulder dystocia or breech delivery. An episiotomy should be done before excessive stretching of the perineal muscles occurs but near the time of delivery to avoid excessive bleeding. Common practice is to cut the episiotomy when the head is visible during a contraction and the introitus opens to a diameter of 3 or 4 cm. The literature currently recommends a mediolateral incision to avoid perineal tears and rectal involvement (Fig. 181.7).

Third Stage of Labor

The third stage of labor involves the delivery of the placenta and frequent checks of the tone and height of the uterine fundus. Signs of placental separation include the following: the uterus becomes firmer and rises; the umbilical cord lengthens 5 to 10 cm; or there is a sudden gush of blood.

These signs usually occur within 5 to 10 minutes of the delivery of the infant but may extend to 30 minutes. Beyond 18 minutes, the risk of postpartum hemorrhage increases and is up to six times more likely after 30 minutes. Although the placenta may be delivered expectantly, active management reduces the length of the third stage of labor and thereby decreases the risk of postpartum hemorrhage. Active management includes the administration of uterotonic gentle traction of the clamped umbilical cord with mild pressure applied above the symphysis pubis and uterine massage after delivery. Any attempt to deliver the placenta before it separates is contraindicated.

Examination of the umbilical cord and placenta is an essential part of the delivery process and any abnormalities should be noted at this time. The umbilical cord is normally a three-vessel structure, with two umbilical arteries on either side of the single umbilical vein. A two-vessel cord (one umbilical artery) occurs in 1 of 500 deliveries and is more prevalent in African Americans. Common abnormalities of the placenta include accessory lobes and abnormal cord insertion. Visible clots adherent to the uterine aspect may indicate placental abruption and the discovery of an incomplete placenta or membranes should alert the emergency clinician to the possibility of postpartum complications.

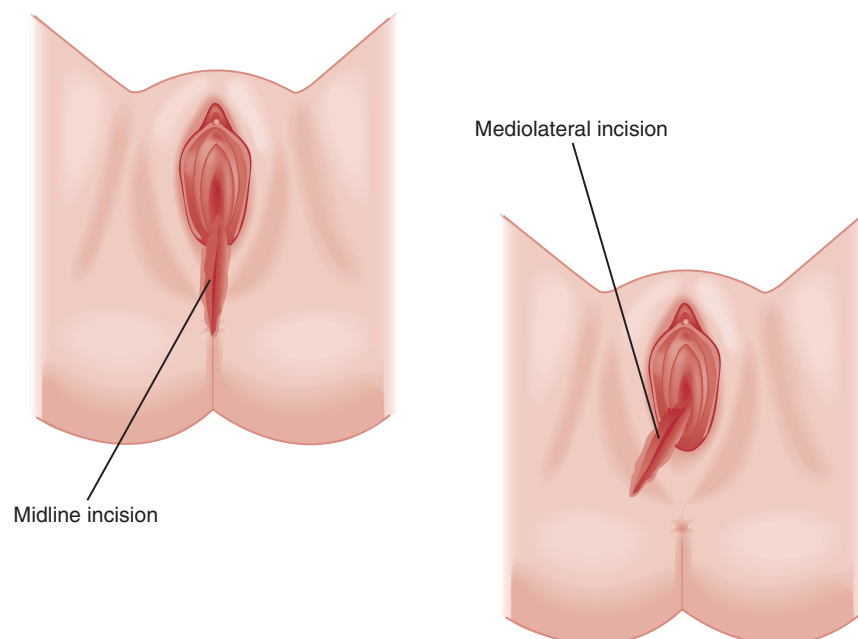


Fig. 181.7. A mediolateral episiotomy incision is preferred to a strictly midline incision. (Adapted from www.aurorahealthcare.org/healthgate/images/exh44028a_ma.jpg.)

Fourth Stage of Labor

The fourth stage of labor refers to the first hour after delivery of the placenta and is a critical period during which postpartum hemorrhage is most likely to occur. The cervix and vaginal fornices should be inspected for deep lacerations as a result of delivery, and repair of any vaginal lacerations should be performed at this time.

Finally, oxytocin is infused to promote contraction of the uterus and control hemorrhage. The uterus is evaluated frequently for tone and massaged transabdominally if any sign of relaxation exists. Oxytocin should not be given before delivery of the placenta because this could result in the trapping of placental fragments or may hinder the delivery of an undetected twin.

THIRD-TRIMESTER COMPLICATIONS ASSOCIATED WITH DELIVERY

Obstetric problems in the third trimester often result in the initiation of labor. Premature labor, PROM, and third-trimester bleeding are relatively common complications. The fundamental question to be addressed in these settings is whether the fetus would fare better in utero or delivered.

Premature Labor

Premature or preterm labor and fetal immaturity are the leading causes of neonatal mortality. Preterm labor is defined as uterine contractions with cervical changes before 37 weeks of gestation. Many underlying conditions result in preterm labor, which is associated with 5% to 18% of all pregnancies and is the leading cause of neonatal death.⁵ Factors linked to this problem include substance abuse, history of preterm delivery, multiple gestations, placental anomalies, infections, and lifestyle or psychosocial stressors (Box 181.2). The unexpected nature of premature labor

BOX 181.2

Factors Linked to Preterm Labor

DEMOGRAPHIC AND PSYCHOSOCIAL

Extremes of age (>40 yr, teenagers)
Lower socioeconomic status
Tobacco use
Cocaine abuse
Prolonged standing (occupation)
Psychosocial stressors

REPRODUCTIVE AND GYNECOLOGIC

Prior preterm delivery
Diethylstilbestrol exposure
Multiple gestations
Anatomic endometrial cavity anomalies
Cervical incompetence
Low pregnancy weight gain
First-trimester vaginal bleeding
Placental abruption or previa

SURGICAL

Prior reproductive organ surgery
Prior paraendometrial surgery other than genitourinary (appendectomy)

INFECTIOUS

Urinary tract infections
Nonuterine infections
Genital tract infections (bacterial vaginosis)

often results in an ED visit. When delivery is not imminent, the patient can be moved to the obstetrics unit for further care.

Clinical Features

The diagnosis of preterm labor requires the identification of uterine activity and cervical changes before 37 weeks of gestation. Early maternal signs and symptoms include an increase or change in vaginal discharge, pain resulting from uterine contractions (sometimes perceived as back pain), pelvic pressure, vaginal bleeding, and fluid leak.

Diagnostic Testing

If uterine contractions and cervical changes are present, and the estimated fetal weight on ultrasonography is less than 2500 g, the diagnosis of premature labor is likely. The differentiation of false labor from true labor is best done by electrical monitoring. The initial evaluation of a woman with possible preterm labor includes urinalysis, complete blood count, and pelvic ultrasonography. If delivery is not imminent, these studies can be performed under monitoring in the ED or obstetrics area. Whenever possible, these patients should be transferred to a perinatal center with an associated intensive care unit.

Management

A viable fetus and healthy mother are indications for medical management directed toward the prolongation of gestation. Preterm labor should not be postponed with medical management in the cases of fetal compromise, major congenital anomalies, intrauterine infection, placental abruption, eclampsia, significant cervical dilation, or PROM.

The treatment of preterm labor involves multiple modalities and is usually performed outside the ED. Tocolytics and fetal maturation therapy combined with bed rest and hydration are used with the hope of prolonging pregnancy (Box 181.3). When tocolytics are indicated, they should be used in coordination with an obstetric consultant because their initiation may arrest premature labor, delaying delivery for 48 to 72 hours.⁶ These patients optimally should be transferred to an appropriate center before delivery, whenever possible, because medical management fails in more than 25% of preterm patients for whom it is attempted. It is important to review the contraindications to tocolytics before initiation of these therapies (Box 181.4). Any patient receiving tocolytics should be monitored for signs of fetal distress.

BOX 181.3

Commonly Used Tocolytic Agents

Magnesium sulfate
4–6 g IV bolus over 20 min
2–4 g/hr IV infusion
Terbutaline
5–10 mg PO q4–6h
0.25 mg SC q20min
10–80 µg/min IV
Ritodrine^a
10 mg PO q2–4h
10 mg IM q3–8h
0.05–0.35 mg/min IV infusion
Isoxsuprine
20 mg PO q6h
0.2–0.5 mg/min IV infusion

^aRitodrine and Isoxsuprine have been discontinued in the United States.

BOX 181.4

Contraindications to Tocolysis

ABSOLUTE

Acute vaginal bleeding
 Fetal distress (not tachycardia alone)
 Lethal fetal anomaly
 Chorioamnionitis
 Preeclampsia or eclampsia
 Sepsis
 Disseminated intravascular coagulopathy

RELATIVE

Chronic hypertension
 Cardiopulmonary disease
 Stable placenta previa
 Cervical dilation > 5 cm
 Placental abruption

Premature Rupture of Membranes

Clinical Features

PROM is defined as rupture of the amniotic and chorionic membranes before the onset of labor. It affects 3% of all gestations. During pregnancy, the chorionic and amniotic membranes protect the fetus from infection and provide an environment that allows fetal growth and movement. The amniotic fluid is constantly exchanged by fetal swallowing and urination and umbilical cord transfer.

The word *premature* in PROM refers to rupture before labor, not to fetal prematurity. In 8% of PROM cases, the fetus is at or near term, and PROM may result in normal labor. When PROM occurs before 37 weeks, it is called preterm PROM and is associated with significant fetal morbidity and mortality. PROM is the inciting event in one-third of all preterm deliveries.

After the membranes rupture, the period from latency to the onset of labor varies. Longer latent periods are common earlier in pregnancy, and the latency shortens as gestational age increases. At term, labor is a desirable result of PROM, but with fetal immaturity, delivery would result in fetal complications.

Diagnostic Testing

The diagnosis of PROM can be established by the history and physical examination. In most cases, the patient suggests the diagnosis and usually is correct. The patient typically describes a spontaneous gush of watery fluid, followed by a mild persistent seepage. Urinary incontinence or excess vaginal or cervical secretions are occasionally confused with PROM.

Examination of women with potential PROM is performed under sterile conditions to prevent ascending infection. Direct digital examination of the cervix is avoided. The identification of amniotic fluid was previously discussed. Table 181.1 summarizes the bedside testing modalities available to confirm the diagnosis of PROM. Visualization of the cervix for a prolapsed cord or small fetal part is performed during the evaluation for effacement and dilation. Culture specimens for group B streptococci, *Chlamydia trachomatis*, and *Neisseria gonorrhoeae* should be obtained.

Management

When the diagnosis of PROM is established, management depends on several factors, including the gestational age and fetal maturity, presence of active labor, presence or absence of infection, presence

TABLE 181.1

Bedside Testing for Premature Rupture of Membranes

METHOD	RESULT
Nitrazine	Amniotic fluid (pH > 6.5) will turn nitrazine paper blue; normal vaginal secretions (pH < 5.5) leave nitrazine paper yellow
Ferning	Amniotic fluid crystallizes
Smear combustion	Amniotic fluid, when flamed, turns white and crystallizes; vaginal secretions caramelize, turn brown

of placental abruption, and degree of fetal well-being or distress. In all cases, fetal heart rate monitoring, obstetric consultation, and admission are indicated. In the immature fetus (24–31 weeks of gestation), the initiation of specific treatment decisions aimed at accelerating fetal maturity should be made in coordination with the receiving obstetrician. This includes the possible administration of corticosteroids to promote pulmonary maturation. Patients with PROM between 31 and 33 weeks' gestation are usually managed expectantly and those at or beyond 34 weeks of gestation are generally delivered.

All patients with PROM should be assessed for intraamniotic infection. Infectious complications should be diagnosed and treated before the mother demonstrates overt clinical signs. Preterm PROM is generally treated with intravenous ampicillin, clindamycin, or erythromycin.⁷ Treatment of term PROM is indicated when the patient is positive for group B streptococcus or has not been tested.

Chorioamnionitis

Chorioamnionitis occurs when vaginal or cervical bacteria ascend into the uterus, instigating an inflammation of the chorion and amnion layers of the amniotic sac. It occurs in 1% to 10% of all pregnancies; risk factors include prolonged labor, PROM, excessive vaginal examinations, and recent amniocentesis. Box 181.5 summarizes the findings and evaluation of chorioamnionitis. Chorioamnionitis may result in prolonged first- and second-stage labor and decreased responsiveness to oxytocin. Early aggressive treatment, even before evidence of infection occurs, decreases neonatal morbidity and delays delivery, allowing more time for fetal maturation.

Vertical Transmission of Human Immunodeficiency Virus

ED deliveries may involve women who are known to be positive for human immunodeficiency virus (HIV), in addition to women who are infected but have never been tested. The latter group generally includes pregnant women with little or no prenatal care who are at risk for precipitous delivery. In 2005, between 215 and 370 infants were born in the United States with HIV infection. Of these, approximately 30% were born to mothers undiagnosed with HIV infection before delivery.⁸ Transmission may occur in the antepartum, intrapartum, or postpartum (breast-feeding) period. Because intrapartum transmission accounts for up to 75% of vertically transmitted HIV infections, antiretroviral therapy on presentation, even while labor progresses, can decrease vertical HIV transmission. Risk factors for transmission include high viral loads, prolonged rupture of membranes, maternal drug use, vaginal delivery, and breast-feeding.

BOX 181.5**Chorioamnionitis Evaluation****FLUID IN VAGINAL VAULT**

Phosphatidylglycerol

CERVICAL CULTURES*Escherichia coli* and other gram-negative bacteria
*Neisseria gonorrhoeae***VAGINAL CULTURES***Chlamydia* spp.
Mycoplasma hominis
Group B streptococci
*Ureaplasma urealyticum***AMNIOCENTESIS STUDIES**Gram stain (group B streptococci)
Culture
Glucose
Lecithin to sphingomyelin ratio**MATERNAL SIGNS AND SYMPTOMS**Premature rupture of membranes
Uterine tenderness
Fever
Tachycardia (maternal or fetal)
Malodorous vaginal discharge
Leukocytosis**FETAL SIGNS AND SYMPTOMS**Decreased activity
Abnormal biophysical profile (ultrasonographic examination)
Fetal tachycardia
Decreased variability of fetal heart rate

Advances in point of care testing for HIV has resulted in the ability to make a preliminary diagnosis in a patient with HIV in the ED. In November 2002, the US Food and Drug Administration approved the OraQuick Rapid HIV-1 Antibody Test (OraSure Technologies, Bethlehem, PA).⁹ With a median turnaround time of 45 minutes, this test realistically allows an emergency clinician to initiate intrapartum and neonatal antiretroviral therapy when the test result is positive. Serologic confirmation is recommended, but emergent interventions can proceed on the basis of the bedside result. It has been shown that immediate treatment during labor can significantly decrease vertical transmission to the newborn. Moreover, a positive HIV test result may, in some cases, allow a change in the method of delivery, because cesarean section decreases the rate of HIV transmission compared with vaginal delivery methods.¹⁰ Decisions regarding initiation of antiretroviral therapy, as well as mode of delivery, should be made in consultation with an obstetrician and neonatologist, when available.

COMPLICATED DELIVERY**Background**

Complicated deliveries, involving dystocia, malpresentation, and multiple gestations, are potentially life-threatening emergencies. The emergency clinician cannot solve these obstetric problems with cesarean section and will therefore face the prospect of an extremely high-risk vaginal delivery. As expected, these abnormal deliveries increase the risk of fetal and maternal complications. Aggressive attempts to obtain obstetric, neonatal, and anesthesia

TABLE 181.2**Relative Incidence of Malpresentations**

MALPRESENTATION	INCIDENCE
Breech presentation	1/25 live births
Shoulder dystocia	1/300 live births
Face presentation	1/550 live births
Brow presentation	1/1400 live births

support are warranted. If the delivery proceeds in the ED, preparations for maternal and neonatal resuscitation should be made rapidly.

Knowledge of abnormal labor and its anatomy and physiology is important for the emergency clinician facing a complicated delivery. Intrapartum management skills will enable him or her to proceed with delivery in an efficient and capable manner.

Dystocia and Malpresentation

Dystocia, or abnormal labor progression, accounts for one-third of all cesarean sections and half of primary cesarean sections. Because rapid surgical resolution is unavailable to the emergency clinician, intrapartum management skills are important.

Dystocia can be divided into three categories of causative factors. Labor fails to progress when there are problems related to: the pelvic architecture (the passage), fetal size or presentation problems (the passenger), and inadequate uterine expulsive forces. Although it is useful to consider these causes independently, dystocia is usually caused by a combination of factors. Presentation problems are particularly important because they become apparent during stage 2 of labor and require immediate action.

In order of increasing incidence, brow, face, shoulder, and breech presentations are the most common malpresentations (Table 181.2). True fetopelvic disproportion is much less common. Cesarean section is indicated when labor arrest or cord prolapse coexists with these presentations.

Breech Delivery

Breech is the most common malpresentation, occurring in just less than 4% of all deliveries. Three types of breech presentation exist—frank, incomplete, and complete (Fig. 181.8; Box 181.6). The main mechanical problem with breech presentations is that the buttocks and legs do not provide a sufficient wedge, hindering cervical accommodation of the relatively larger head. In addition, because the presenting part does not occlude the cervical opening completely, umbilical cord prolapse may occur.

By convention, the presentation (frank, incomplete, and complete) is followed by the relationship of the fetus to the birth canal, with the fetal sacrum as a reference point. Correlated with this abnormal presentation are several factors, such as prematurity, multiparity, fetal abnormalities, prior breech presentation, polyhydramnios, and uterine abnormalities.

Overall, one-third of breech fetal deaths are believed to be preventable. Asphyxia is often due to umbilical cord prolapse or entrapment of the head. Other complications include labor arrest or brachial plexus injuries, and fetal head and neck trauma can occur if inappropriate delivery techniques are used. Scheduled cesarean section for these patients reduces the potential for an ED presentation. However, emergency clinicians should be prepared for vaginal delivery of breech presentations in the event of premature or unforeseen labor in the absence of immediate surgical services.

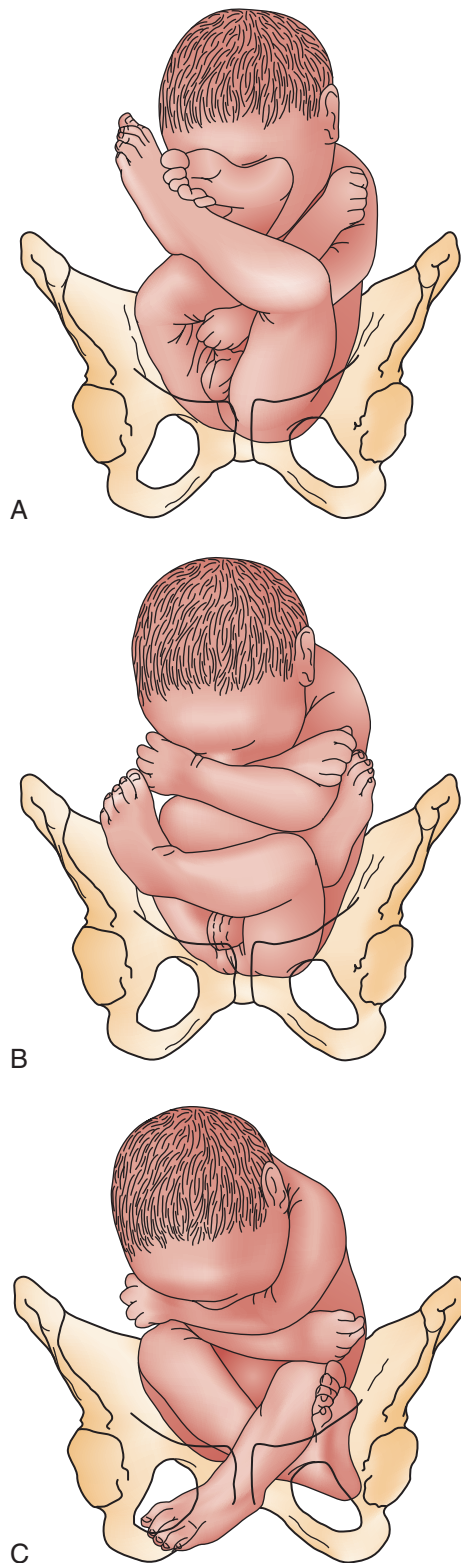


Fig. 181.8. Breech presentations. **A**, Frank breech presentation. **B**, Complete breech presentation. **C**, Incomplete breech presentation. (Adapted from Cunningham FG, et al: *Williams obstetrics*, ed 19, Norwalk, CT, 1993, Appleton & Lange.)

Diagnostic Testing

Before labor, Leopold's maneuvers facilitate the diagnosis of breech presentation. For the emergency clinician, however, active labor restricts the use of Leopold's maneuvers, and a vaginal examination is required. The differentiation of a vertex presenta-

BOX 181.6

Breech Presentations

FRANK BREECH

60%–65% of all breech presentations
Hips flexed, knees extended
Buttocks act as good dilating wedge
Incidence of cord prolapse \approx 0.5%

COMPLETE BREECH

Least common; occurs in \approx 5% of all breech presentations
Hips and knees flexed
Buttocks act as good dilating wedge
Incidence of cord prolapse is 5%–6%

INCOMPLETE BREECH

25%–35% of all breech presentations
Incomplete hip flexion, single or double footling
Poor wedge
Increased incidence of prolapsed cord (15%–18%)

tion from a breech presentation by tactile vaginal exam may be difficult. Whenever a fontanel is not identified on examination, a breech presentation should be suspected. It is helpful to remember that the face and skull have a complete circle of bone, whereas the anus is flanked by bone on only two sides.

If time permits, an ultrasound examination is indicated to distinguish the type of breech presentation, gestational age, fetal weight, and position of the fetal arms and neck. If the fetus has a hyperextended neck, vaginal delivery is associated with a high incidence of spinal cord injuries. If possible, labor should be delayed to allow cesarean section. Similarly, if the arms are over the head, they increase the dystocia when the head enters the birth canal.

Management

Premature infants in the breech position often deliver spontaneously without difficulty. As the infant comes to term, dystocia becomes increasingly common. With commitment to a vaginal delivery, knowledge of breech dystocia mechanics may allow atraumatic delivery. The key goals are to maximize the size of the passage and to minimize the dystocia of the after-coming head. [Box 181.7](#) summarizes the actions associated with successful vaginal breech delivery.

The Mauriceau maneuver is the use of the fetal oral aperture to flex the fetal neck and draw in the chin. Because fetal neck extension is associated with cord injuries and worsening dystocia, this maneuver is useful to ensure a successful vaginal delivery. This maneuver should only be attempted once the fetal elbows and chin have entered the pelvic inlet to avoid inducing the Moro reflex, in which fetal head flexion results in the arms being suddenly extended. During this maneuver, the fetal pelvis should be supported to avoid abdominal injuries. A generous episiotomy may be necessary to facilitate the maneuver in a full-term infant. If the after-coming head cannot be delivered quickly, the chances of good fetal outcome are poor.

Shoulder Dystocia

Shoulder dystocia is the second most common malpresentation, occurring in 1.4% of all deliveries.¹¹ In contrast to a breech presentation, which may be diagnosed in the antepartum period, shoulder dystocia develops in the intrapartum period. Maternal and fetal factors are associated with shoulder dystocia. Maternal

BOX 181.7

Vaginal Breech Delivery

ACTIONS TO DO AS ABLE

- Monitor fetal heart rate.
- Obtain a focused history.
- Diagnose a breech lie.
- Determine cervical dilation and station.
- Obtain an ultrasound or plain radiographic study.
- Evaluate for prolapsed cord if there is spontaneous rupture of membranes.
- Perform an episiotomy.
- Flex knees and sweep out legs.
- Pull out a 10- to 15-cm loop of cord (room to work) after the umbilicus clears the perineum.
- Use the bony pelvis as a means of holding the infant.
- Keep face and abdomen away from the symphysis and use rotation to deliver the more accessible arm.
- Perform the Mauriceau maneuver.

ACTIONS TO AVOID

- Inappropriate transfer with delivery en route
- Misdiagnosis of cervical dilation
- Iatrogenic rupture of membranes (cord prolapse)
- Moving of patients or leaving them unmonitored
- Traction on the fetus during delivery
- Grasping of the fetus by the waist, causing abdominal organ injury
- Arm entrapment over head
- Neck hyperextension

factors include diabetes, obesity, and precipitous or protracted labor; fetal factors include macrosomia, postmaturity, and erythroblastosis fetalis. Shoulder dystocia responds well to a variety of intrapartum maneuvers; therefore, the skill involved during delivery is an important determinant of fetal outcome.

The consequences of shoulder dystocia can be devastating. As with a breech presentation, infant complications are more common and severe than maternal complications. Traumatic brachial plexus injuries, clavicular fractures, and hypoxic brain injury are all well-documented complications. Maternal complications are related to traumatic delivery and include vaginal, perineal, and anal sphincter tears, as well as urinary incontinence.

Diagnostic Testing

Shoulder dystocia is diagnosed clinically by the inability to deliver either shoulder. The fetal head may appear to retract toward the maternal perineum, otherwise known as the turtle sign. Traction on the head extends and abducts the shoulders, increasing the bisacromial diameter and worsening the dystocia. Fig. 181.9 shows the normal and abnormal relationship of the shoulders to the birth canal and illustrates why the bisacromial diameter is an important element of fetal biometry.

Normally, the shoulders negotiate the maternal pelvis in sequential fashion, anterior shoulder first. With shoulder dystocia, both shoulders attempt to clear the maternal pelvis simultaneously. In addition to the turtle sign, examination often reveals that the fetal shoulders are on a vertical axis, rather than oblique. These findings, in combination with an arrested delivery, confirm the diagnosis of shoulder dystocia.

Management

When shoulder dystocia becomes evident, knowledge of intrapartum delivery maneuvers can be lifesaving. Successful vaginal

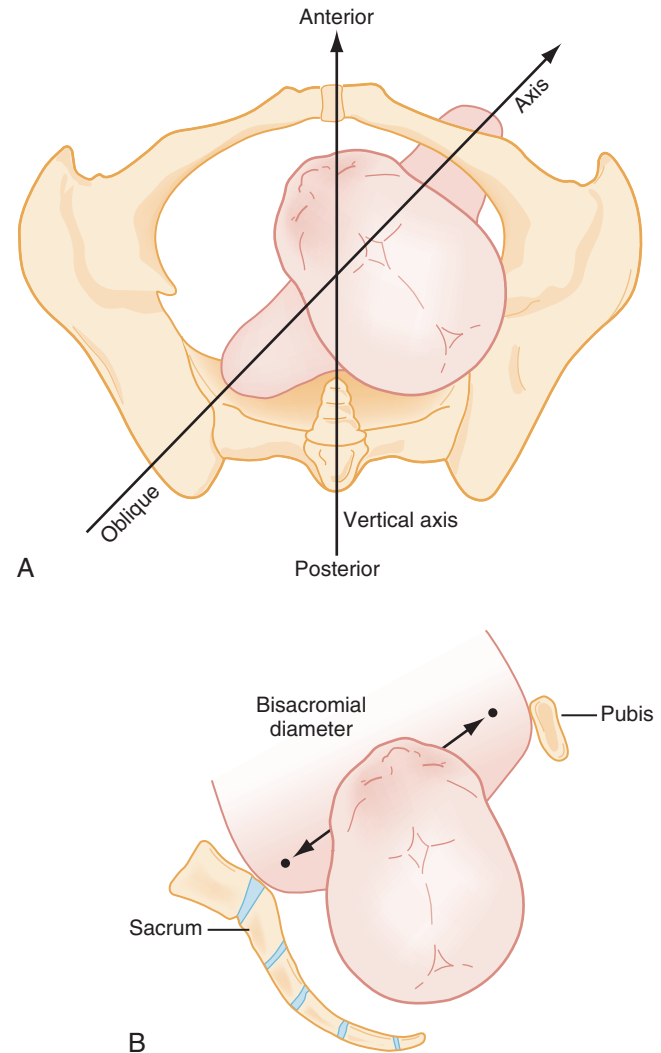


Fig. 181.9. **A**, Normal delivery. As the fetal head rotates, the shoulders assume an oblique position and enter the pelvis one at a time. **B**, Shoulder dystocia. Both shoulders attempt to clear the pelvis simultaneously, forcing the bisacromial diameter into the opening.

delivery is most likely when a directed sequential approach to each maneuver is used. A rapid resolution of shoulder dystocia is important to avoid fetal asphyxia and resultant central nervous system injury. Obstetric and neonatology assistance may improve the outcome, and aggressive attempts to obtain assistance are warranted.

Initial attempts to resolve shoulder dystocia involve increasing the anteroposterior diameter of the passage. An episiotomy may be used for fetal maneuvering by allowing access to the posterior shoulder. Anteriorly, draining the bladder with a Foley catheter can generate room.

The most important first step is to use McRoberts' maneuver (Fig. 181.10). Maternal leg flexion to a knee-chest position may disengage the anterior shoulder, allowing rapid vaginal delivery to follow. This maneuver "walks" the pubic symphysis over the anterior shoulder and flattens the sacrum, helping the fetus pass through the birth canal, one shoulder at a time. This method, although requiring very little effort, is often successful in alleviating shoulder dystocia.

If McRoberts' maneuver fails to free the anterior shoulder, the application of suprapubic pressure may accomplish this by forcing the anterior shoulder to slip beneath the pubis or posterior shoulder to retreat into the hollow of the sacrum. Digital pressure

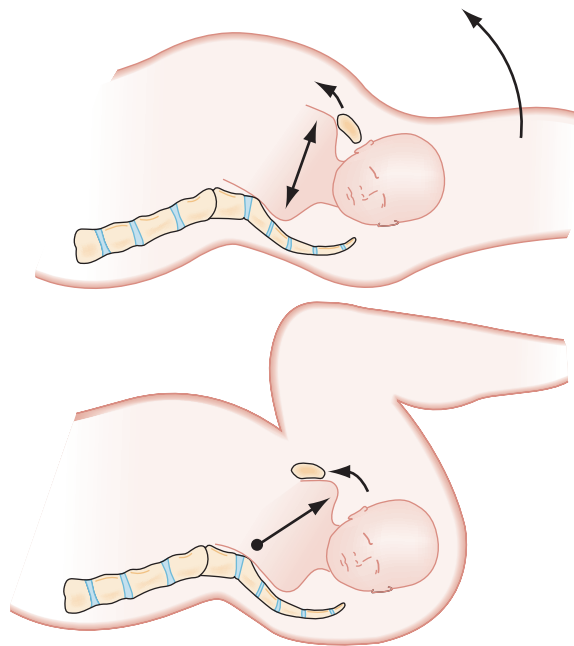


Fig. 181.10. McRoberts' maneuver. *Top*, Bisacromial diameter pinned behind pubic symphysis. *Bottom*, Removing the maternal legs from the stirrups and putting the knees up to the chest act as a fulcrum to the pubic symphysis over the impacted anterior shoulder.

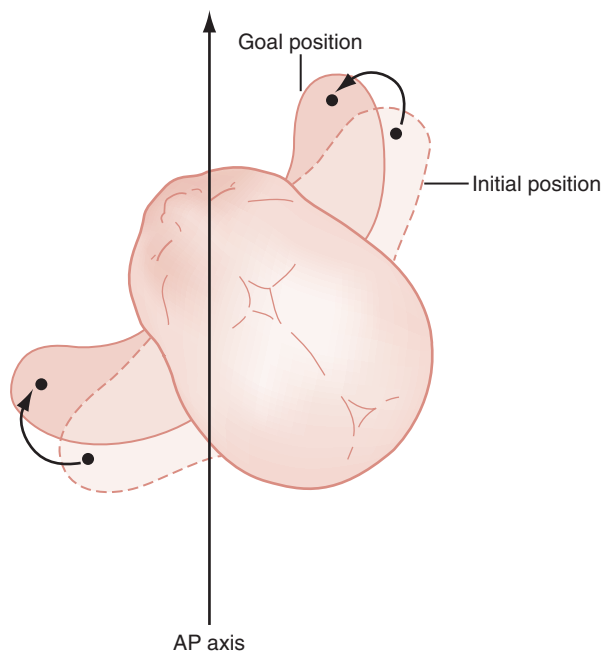


Fig. 181.11. Rubin's maneuver decreases the bisacromial diameter. AP, Anteroposterior.

on the posterior shoulder (through the episiotomy) may help facilitate posterior shoulder retreat. The use of the McRoberts' maneuver and suprapubic pressure resolve most cases of shoulder dystocia.

If delivery is still impossible, the next step is to attempt Rubin's maneuver (Fig. 181.11). The goal of this maneuver is to decrease the bisacromial diameter by pushing the most accessible shoulder toward the fetal chest. Often, both shoulders assume the same attitude, decreasing the bisacromial diameter and allowing delivery. Attempts to manipulate the shoulders for Rubin's maneuver

BOX 181.8

HELPER Mnemonic for Shoulder Dystocia

Help—obstetrics, neonatology, anesthesia
Episiotomy—generous, possibly even episiotomy
Legs flexed—McRoberts' maneuver
Pressure—suprapubic pressure, shoulder pressure
Enter vagina—Rubin's maneuver or Wood's maneuver
Remove posterior arm—Splint, sweep, grasp, and pull to extension.

may be transabdominal, through the introitus (anterior shoulder), or through the episiotomy (posterior shoulder).

If the shoulders remain undeliverable, the next step is to use Wood's corkscrew maneuver. In this process, the impacted shoulders are released through rotation of the fetus 180 degrees. Fetal rotation is achieved by pushing the most accessible shoulder in toward the chest. The fetal axilla can be snared with a digit, or a hand can be slid in along the fetal spine to sweep the hips and generate rotation. Wood's corkscrew maneuver is difficult to perform but should be attempted before reaching for an arm.

If the fetus remains trapped and several attempts have failed to yield delivery, consideration of delivery of an arm is appropriate. A hand is introduced along the posterior aspect of the posterior shoulder. The posterior arm is swept across the chest, bringing the fetal hand up to the chin. Attempts to splint the humerus may prevent fractures and brachial plexus injuries. The fetal hand is grasped and pulled out of the birth canal across the face, delivering the posterior shoulder.

The mnemonic HELPER (Box 181.8) has been proposed to help keep these steps organized and facilitate a sequential approach. These steps successfully deliver almost all cases of shoulder dystocia.

Face, Brow, and Compound Presentations

Face and brow presentations yield a larger engaging aspect of the fetal head and predispose to labor arrest. Although these abnormal presentations can be diagnosed with ultrasonography or Leopold's maneuvers, most are discovered during labor by vaginal examination. Approximately 50% are discovered during the second stage of labor.

The engaging diameter of the head in vertex position is approximately 0.8 cm less than a face presentation and 1.5 cm less than a brow presentation. Face presentations are described with the chin as a reference point (eg, mentum anterior). Face presentation is managed expectantly. The obstetric adage—"if a face presentation is progressing, leave it alone"—is based on the fact that mentum anterior presentations usually deliver vaginally, and mentum transverse presentations frequently rotate to become mentum anterior. Brow presentations, occurring when the fetal head is partially flexed, also spontaneously convert to a vertex or face presentation in more than 50% of cases.

A persistent mentum posterior face and brow presentation cannot be delivered vaginally if the fetus is full term. The resultant labor arrest requires symphysiotomy or cesarean section. Prolongation of the second stage is the most common outcome of both these malpresentations at term. For the emergency clinician, this prolonged second stage may provide a window during which obstetric help may arrive.

Compound presentations are those in which an extremity enters the birth canal with the head or breech. Small and premature fetuses generally proceed to vaginal delivery without incident.

Labor arrest and umbilical cord prolapse are accepted indications for cesarean section in the setting of face, brow, and

compound presentations. Manipulation of a compound presentation, including attempts to reduce the hand or arm, increases the rate of cord prolapse. Therefore, manipulation attempts are contraindicated. Cord prolapse rates are 10% to 20%, even without manipulation. Close monitoring and careful examination are indicated.

MULTIPLE GESTATIONS

Due to the increasing use and availability of fertility treatments, the incidence of multiple gestation pregnancies has been increasing. In 2013, twin deliveries accounted for 33.7/1000 births in the United States. Because multiple gestation deliveries have a higher incidence of preterm labor and low birth weights, maternal and fetal complication rates are correspondingly increased.¹²

Diagnostic Testing

Most women with multiple gestations have the situation identified well before the third trimester. In patients who have had little or no prenatal care, bedside ultrasonography allows for a rapid diagnosis. The stages of labor for twins and other multiple gestations are similar to the stages for a singleton. Of importance to the emergency clinician is a relatively short latent phase of labor, with rapid progression to the active phase. The active phase is usually longer, however, and may allow time for obstetric assistance to arrive.

Vertex twin A and vertex twin B occur in approximately 42% of deliveries. One of the twins presents in a nonvertex position in approximately 35% to 40% of cases.¹³

Management

The presentation of twins is an important determinant for the safety of vaginal delivery. Twins who are vertex-vertex can be delivered vaginally, barring any other obstetric complication. If twin B is nonvertex, many obstetricians recommend cesarean section to prevent delivery-related complications for twin B. External cephalic version and breech extraction are possible maneuvers to facilitate precipitous vaginal delivery. Generally, if twin A is nonvertex, cesarean section is preferred. In such cases, efforts should be made to delay delivery until an operative approach can be used. Proceeding vaginally can result in the interlocking of twins, associated with a high mortality.¹³

The interval between the delivery of twin A and twin B is variable. In most cases, twin B delivers in minutes. When twin B does not follow rapidly, in utero assessment is important to document fetal well-being. If fetal heart tracings are reassuring, the delivery of twin B (especially nonvertex) should not be hastened. Repeated ultrasonographic evaluation may also be used to confirm twin B's presentation and well-being.

After every ED delivery, particularly deliveries that are precipitous or that occur in the out-of-hospital setting, the mother should be examined for the possibility of twins. Ongoing labor may be confused with postpartum cramping, only to have twin B and all the potential complications surprise the emergency clinician. This is particularly relevant for women with inadequate prenatal care and low-birth-weight infants.

UMBILICAL CORD-RELATED EMERGENCIES

Umbilical cord-related complications can occur in normal and abnormal deliveries. Immediate intervention is required to prevent fetal morbidity and mortality. The spectrum of cord-related emergencies includes prolapsed cord, nuchal loops of the umbilical cord, body coils, cord knots, and entangled cords in monoamniotic twins. The cord length is believed to be proportional to fetal

activity in utero during the first and second trimesters. Excess cord length increases the potential for umbilical cord complications of all types. Because the umbilical cord supplies the fetus with all its oxygen, interruption of cord circulation before establishment of fetal respiration is a life-threatening emergency. Fetal asphyxia caused by cord circulation compromise is potentially preventable with appropriate delivery interventions.

Umbilical Cord Prolapse

Clinical Features

Umbilical cord prolapse occurs when the umbilical cord precedes the fetal presenting part or when the presenting part does not fill the birth canal completely. Most cases of cord prolapse are unexpected and develop during the second stage of labor.

Cord prolapse has a variable rate of association with different fetal presentations. Compound, shoulder, and breech presentations yield gaps and a relatively poor dilating wedge. Table 181.3 summarizes the rates of umbilical cord prolapse with various fetal presentations. Malpresentations account for 50% of all cord prolapse cases and the prolapsed cord itself may be the first indication of a malpresentation. The reported incidence of cord prolapse ranges from 1.4 to 6.2/1000 deliveries, and associated perinatal mortality is estimated to be just below 10%.¹⁴

Diagnostic Testing

Umbilical cord prolapse may be overt or occult, requiring a pelvic examination to reveal the umbilical cord lying beside the presenting part. The diagnosis may also be made with Doppler ultrasonography. In most cases, the diagnosis is obvious, and the cord is encountered at the perineum or introitus.

Management

When a prolapsed cord occurs with a viable infant, cesarean section is the delivery method of choice. If surgical delivery is available, maneuvers to preserve umbilical circulation should be instituted immediately. The mother should be placed in the knee-chest position, with the bed in the Trendelenburg position, because the presenting part is manually elevated off the umbilical cord. It is crucial that the mother be instructed to refrain from pushing to avoid further compression of the cord. Placement of a Foley catheter and instillation of 500 to 750 mL of saline into the bladder may help lift the fetus off the cord, particularly during the first stage of labor.¹⁴

Preparation for an emergency cesarean section should be under way. The time from prolapse to surgical intervention is an

TABLE 181.3

Conditions Associated With Umbilical Cord Prolapse

PRESENTATION	INCIDENCE (%)
Vertex	0.14
Breech	2.5–3.0
Frank breech	0.4
Complete breech	5
Incomplete breech	10
Shoulder	5–10
Compound	10–20
Face or brow	Rare

important factor in fetal outcome. Perinatal mortality rates are significantly higher for out-of-hospital cases versus those within a monitored setting, and outcomes correlate with time from diagnosis to delivery.

If timely surgical delivery cannot be performed, funic reduction—manual replacement of the cord into the uterus—and rapid vaginal delivery may be necessary. The same maneuvers to decrease cord compression should be used, pushing gently on the cord in a retrograde fashion, above the presenting part. Manipulation and cord trauma should be kept to a minimum because resultant vasospasm can cause fetal hypoxia. After funic reduction, the development of umbilical cord body coils or nuchal loops is common and should be anticipated.¹⁴

Cord Entanglement

The umbilical cord can also become entangled with itself, spontaneously knotting. Umbilical cord knots are related to intrauterine movements early in pregnancy. Approximately 5% of stillbirths are found to have knots that are believed to have caused fetal demise. Despite this association, cord knots can persist without problems as long as perfusion is maintained.

Loose umbilical cord knots pulled tight at delivery may cause fetal distress. As with cord prolapse, this situation must be resolved quickly to prevent fetal asphyxia. Rapid delivery with avoidance of further cord traction optimizes fetal outcome. No specific interventions have been identified to deal with this problem.

Long umbilical cords are associated with true knots, as well as with entanglements and prolapse. Umbilical cord loops can be single or multiple and can occur around the neck or body. Because the fetal limbs are short and flexed in most presentations, they are rarely involved. Although generally benign, umbilical cord loops may result in fetal complications, such as nonreassuring fetal status and respiratory distress.

During delivery, loose nuchal cords should be reduced at the perineum. Loose body coils usually disentangle spontaneously. The reduction process may be aided by slipping them over the extremities or forward over the head. On occasion, loops are tight enough to impede delivery and cannot be reduced. The solution is to cut the clamped cord and deliver the infant rapidly. The high frequency of nuchal loops (one in five births) means that the emergency clinician should expect to encounter this problem.

MATERNAL COMPLICATIONS OF LABOR AND DELIVERY

Maternal complications of labor and delivery include postpartum hemorrhage, uterine inversion and rupture, amniotic fluid embolism, and infections. Although some are managed medically, severe complications threaten the reproductive future and life of the mother, thereby requiring emergent surgical intervention.

Postpartum Hemorrhage

Clinical Features

Postpartum hemorrhage is the most common complication of labor and delivery. Defined as hemorrhage of more than 500 mL after vaginal delivery, it affects 5% to 10% of all deliveries and accounts for up to 25% of obstetric deaths. Postpartum hemorrhage is divided into two categories; the primary category includes blood loss that occurs within the first 24 hours, and the secondary category is hemorrhage 24 hours to 6 weeks after delivery. The clinical picture is as expected with any type of hemorrhage although, because of maternal adaptations during pregnancy, the patient may not show signs of shock until more than 1500 mL of volume has been lost.

Differential Diagnosis and Management

The differential diagnosis of primary postpartum hemorrhage includes uterine atony, genital tract trauma, retained placental tissue, and coagulopathies, or the “four Ts”—*t*one, *t*rauma, *t*issue, and *t*hrombin.

Uterine Atony. Accounting for 75% to 90% of cases, the most common cause of serious immediate postpartum hemorrhage is laxity of the uterus after delivery. Normally, postpartum bleeding from the placental implantation site is limited by contraction of the myometrium, constricting the spiral arteries. If the uterus does not contract, ongoing hemorrhage will occur. Predisposing factors include overdistention of the uterus (eg, multiple gestations, fetal macrosomia, polyhydramnios), prolonged labor, chorioamnionitis, use of tocolytics, and general anesthesia with halogenated compounds. As a diagnosis of exclusion, a physical examination to rule out obstetric trauma and retained products of conception should be performed before the diagnosis is reached. On examination, the uterus is palpable as a soft boggy mass.

After other causes have been excluded, therapy to augment myometrial contractions is instituted to prevent further hemorrhage. A two-handed uterine massage may stimulate uterine contractions. One hand exerts pressure transabdominally while the other supports the uterus through the introitus. Uterotonic in conjunction with massage usually provide enough stimuli to control bleeding. Blood is typed, crossmatched, and available for resuscitation should these measures fail.

Maternal Birth Trauma. Maternal birth trauma is the second most common cause of postpartum hemorrhage, accounting for up to 20% of cases. Associated factors include uncontrolled delivery, macrosomia, episiotomy, nulliparity, maternal coagulopathy, operative delivery, prolonged second stage of labor, pre-eclampsia, and malpresentation. Tears and lacerations may involve the perineum, rectum, cervix, vagina, vulva, and urethra. Blood vessels beneath the vulvar or vaginal epithelium can also be injured without frank hemorrhage, resulting in the formation of large contained hematomas. These hematomas may go unrecognized for hours, gradually enlarging and possibly resulting in hemorrhagic shock. Delayed postpartum hemorrhage at these sites can also occur and is often a diagnostic challenge. The physical examination may reveal uterine displacement (lateral or cephalad), and confirmation by radiologic means may be used in stable patients. Management, decided in conjunction with specialists, may be expectant, involve bedside repair with absorbable suture, or require vascular embolization or surgical intervention, depending on the severity of clinical presentation.

Tears are classified by depth. First-degree tears involve the perineal skin and vaginal mucous membranes only. Second-degree tears extend through the skin into the fascia and muscles of the perineal body. Third-degree tears extend into the anal sphincter, whereas fourth-degree tears extend through all layers, including the rectal mucosa. Third- and fourth-degree tears should be repaired by an obstetrician in the operating room.

Retained Products of Conception. Approximately 10% of postpartum hemorrhage cases are due to retained placental tissue. Normally, the plane of cleavage between the zona basalis and zona spongiosa results in a clean separation of the placenta from the uterus. When this occurs, the placental tissue delivers as a single unit, without evidence of fragmentation. Any placental defect or evidence of accessory placental tissue may signify a retained cotyledon (part of the embryo). Retained fragments prevent myometrial constriction and result in hemorrhage. Aggressive traction on the placenta during stage 3 of labor can

result in retained products of conception, which may cause immediate or delayed postpartum hemorrhage. Ultrasound may reveal an expanded endometrium or solid echogenic mass within the uterus, providing evidence of retention.

Treatment requires removal of the remnant placental tissue. Digital uterine exploration with blunt dissection of the fragments from the myometrium will also facilitate myometrial contractions. Abnormally adherent tissue will not be freed by this maneuver.

The terms *placenta accreta*, *placenta increta*, and *placenta percreta* describe various degrees of abnormal placental attachment to the uterus. When the placenta adheres to the myometrium without the intervening decidua basalis, it is termed *placenta accreta*. In *placenta increta*, the villi extend into the myometrium. In *placenta percreta*, the placenta penetrates the full thickness of the myometrium.

The current incidence of placenta accreta is approximately 3/1000 deliveries, a relative increase from past decades. Associated risk factors include multiparity, prior cesarean sections, placenta previa, previous curettage, and uterine anomalies.¹⁵

Coagulopathies. All women with severe postpartum hemorrhage should be evaluated for disseminated intravascular coagulation (DIC). DIC can occur as a consequence of placental abruption, eclampsia, amniotic fluid embolism, postpartum infections, and dilution of clotting factors caused by aggressive volume resuscitation. Also, retained products of conception and dead fetal tissue contain excess thromboplastin, which can precipitate DIC. As with DIC from nonobstetric causes, bleeding is associated with hypofibrinogenemia, thrombocytopenia, and elevated levels of fibrin split products and D-dimer.

Appropriate management entails hemodynamic support and correction of coagulopathies. Recent investigations have reported the successful use of recombinant factor VIIa for severe cases of postpartum hemorrhage.

Uterine Exploration and Removal of the Placenta. In the presence of ongoing hemorrhage and retained products of conception, attempts to remove the placenta manually are indicated. The procedure entails risk of infection, perforation, and increased hemorrhage but may be the most expeditious way to control bleeding. Before beginning, the patient is placed on a monitor, good vascular access is established, and blood products are available. Also, a Foley catheter may be placed to reduce bladder distention and monitor urinary output.¹⁶ The umbilical cord is traced through the cervical os to the placenta, allowing the identification of a placental margin. The placental membranes are digitally perforated, and the placenta is gradually divided from the myometrium. After removal of the placenta, the uterus is explored for retained cotyledons. Removal of fragments that are still present may require curettage of the uterine cavity by an obstetrician. Placenta accreta, percreta, and increta may be diagnosed in this way because they are not digitally dissectible.

Once it is emptied, the uterus should be stimulated to contract with uterine massage, oxytocin, and prostaglandins. Prophylactic antibiotic administration at the time of manual placenta extraction has been debated somewhat in the literature. If used, a single dose of metronidazole and ampicillin or cefazolin may be given.¹⁶

Uterine Packing. For the emergency clinician, this technique may be used to create tamponade, preventing further blood loss. The procedure has limited morbidity and is straightforward. The emergency clinician introduces 15 to 20 yards of 4-inch gauze with a ring forceps and packs it into the uterus by a layering technique. Another option is to place a Foley catheter or Sengstaken-Blakemore tube into the uterus and instill the balloon with saline.¹⁶

Opponents of packing have pointed out that an atonic uterus may accommodate a large volume of packing without effective tamponade. Packing may also increase the risk of postpartum infection, even when prophylactic antibiotics are given. As with all uterine manipulation and instrumentation, some risk of perforation also exists. Because pelvic embolization and hysterectomy sometimes are not immediately available to the emergency clinician, the importance of uterine packing as a temporizing measure is increased.

Pelvic Vessel Embolization. Pelvic bleeding postpartum can be difficult to control. Hysterectomy as a solution results in infertility and brings with it all the complications of general anesthesia and major surgery. Embolization of bleeding vessels by an interventional radiologist is another option. The procedure does not require an anesthesiologist, operating room, or obstetrician and may be readily available on an emergent basis. Reported success rates of embolization in control of postpartum hemorrhage range from 95% to 100%.¹⁶ Common sites of bleeding include the uterine artery, pudendal artery, and hypogastric artery. Because only the smallest involved branches are embolized, and recanalization usually occurs, future reproductive capability is generally preserved.

Uterotonic Agents. Although they are commonly applied on delivery of the placenta, uterotonic agents also have special application in the case of a postpartum hemorrhage. Uterotonics such as oxytocin, ergot alkaloids, and prostaglandins control bleeding by inducing myometrial contractions. Oxytocin is considered to be first-line treatment, given intramuscularly or intravenously. Ergot alkaloids, such as methylergonovine and ergotamine, may induce hypertension and are therefore contraindicated in patients with preeclampsia or other comorbid conditions. Finally, prostaglandins may also be used (eg, misoprostol), although they have shown no clear advantage over oxytocin or ergot alkaloids in published reports.¹⁶

Hysterectomy. Rarely, hemorrhage continues, despite the interventions outlined. In the case of life-threatening obstetric bleeding, an emergency hysterectomy should be performed.

Uterine Inversion

Perspective

Uterine inversion is an uncommon but serious complication of delivery that occurs during stage 4 of labor. The resultant postpartum hemorrhage can be severe and life-threatening, accounting for a maternal mortality rate of up to 15%. Uterine inversion complicates 1 in 2000 deliveries. Risk factors include excessive fundal pressure during delivery, forceful traction on the umbilical cord (especially in conjunction with a fundal placenta), placenta accreta, maternal congenital abnormalities of the uterus, use of magnesium sulfate in the antepartum period, and primiparity.

Clinical Features

The patient will complain of sudden, severe abdominal pain. The abdominal examination reveals tenderness and an absence of the uterine corpus, which is potentially visualized at the cervical os or bulging from the introitus. Profuse bleeding with hemodynamic instability can also occur. Ultrasound may assist in the diagnosis.

Management

Once uterine inversion is identified, the appropriate mobilization of resources should begin simultaneously with efforts to

reestablish the correct anatomic position of the uterus. As with other causes of postpartum hemorrhage, initial management involves aggressive fluid resuscitation.

The highest likelihood for successful repositioning of the inverted uterus is immediately after inversion occurs. If the placenta is still adherent, it should not be removed until after repositioning. Removal of the placenta while the uterus is inverted is associated with excessive blood loss. The initial attempt to reposition the uterus should be to push the fundus upward through the introitus. Contraction of the cervical uterine segments can create a muscular ring, preventing repositioning. Therefore, all uterotonic agents should be withheld immediately on diagnosis of uterine inversion.

If initial attempts fail and a cervical ring develops, pharmacologic attempts to relax the uterus with sedation and tocolytics are indicated. Terbutaline and magnesium sulfate have been used successfully to relax cervical rings. When the uterus has been repositioned, the muscle relaxants should be halted, and oxytocin and prostaglandin therapy should be initiated. Firm manual pressure through the introitus should be maintained until the cervical ring contracts. If all these measures fail, and surgical backup becomes available, halogenated anesthetics may be used to induce relaxation of the cervical rings, with or without an attempt at surgical repair. Once uterine inversion has resolved, an assessment must be made to screen for uterine perforation, adherent placenta, and vaginal lacerations.

Uterine Rupture

Criticism of the high rate of cesarean delivery in the United States has led to an advocacy of vaginal birth after cesarean (VBAC). The high success rate and relative safety of VBAC are countered partly by the risk of uterine rupture. Dehiscence of a surgical scar occurs in 0.3% of VBAC deliveries.¹⁷ As more women have an VBAC, emergency clinicians can expect to encounter uterine rupture, which is associated with high morbidity and mortality rates.

Clinical Features

Uterine rupture occurs late in pregnancy or as stage 1 of labor transitions to the active phase. Defined as a full-thickness uterine wall perforation, the severity of rupture ranges from simple scar dehiscence to complete fetal extrusion. It may be spontaneous but is most often linked to previous uterine surgery. Other risk factors for uterine rupture include multiple gestation, trauma, and prostaglandin administration.¹⁷ Minimal fetal extrusion results in a perinatal mortality rate of less than 1%, whereas complete extrusion results in a 10% to 20% mortality rate. Maternal death is rare, but significant hemorrhage complicates one-third of cases.

Diagnostic Testing

The diagnosis of uterine rupture may be difficult because pain is not always present. In fact, clinical presentation of uterine rupture ranges from nonreassuring fetal heart rate patterns to frank maternal hemorrhagic shock. Prolonged fetal heart rate deceleration, indicating fetal distress, is the most reliable sign of fetal extrusion. Ultrasound may reveal a protruding amniotic sac, hemoperitoneum, or the myometrial defect; however, good sensitivity data are lacking.

Management

If uterine rupture is suspected, delivery should be hastened to limit fetal hypoxia. Emergency cesarean section is the best method to speed delivery and repair the injury. ACOG guidelines for uterine rupture identify a 30-minute window of opportunity that

maximizes fetal outcome. Note that uterotonic agents may exacerbate the rupture and are contraindicated.

Amniotic Fluid Embolism

Amniotic fluid embolism is a rare and catastrophic complication of labor and delivery. The incidence rate is 1.9 to 6.1/100,000 maternities.¹⁸ Although the mechanism is not well understood, it is thought to involve the spread of amniotic fluid through the maternal vasculature, activating a complement or anaphylactic cascade. Cesarean delivery, forceps- or vacuum-assisted delivery, uterine rupture, eclampsia, placenta previa, and placental abruption have been found to have a significant association with amniotic fluid embolism. The diagnosis is clinically evident during labor, during delivery, or within 48 hours of delivery. It is characterized by the sudden onset of hypoxia, coagulopathy or hemorrhage, seizure, fetal compromise, or cardiovascular collapse. DIC occurs in approximately 50% of cases, and maternal and fetal mortality rates are high. Treatment is generally supportive and may include assisted ventilation, central hemodynamic monitoring, vasopressors, and the administration of blood products.¹⁹

Postpartum Endometritis

Puerperal infections affect 5% of all vaginal deliveries and 10% of all cesarean sections. Operative delivery, prolonged rupture of membranes, lack of prenatal care, prolonged stage 2 labor, use of intrauterine monitoring, and frequent vaginal examinations have been linked to these ascending gynecologic infections. It is estimated that sepsis results in up to 15% of maternal deaths worldwide.²⁰ Causative organisms for these infections include gram-positive cocci and gram-negative coliforms and, less commonly *Chlamydia* and *Mycoplasma* spp.

Endometritis is the most common puerperal infection, usually developing on the second or third day postpartum. Typically, the lochia has a foul odor, and the white blood cell count is elevated. Fever and abdominal pain indicate greater severity of infection, often warranting inpatient care and intravenous antibiotics. A coexistent surgical wound infection is often present. A search for retained products of conception is indicated, particularly if bleeding is ongoing.

Treatment is empirical and is directed at gram-positive, gram-negative, and anaerobic organisms. A combination of clindamycin and an aminoglycoside is recommended.²¹ Most patients with postpartum endometritis require admission.

POSTPARTUM PROBLEMS

Peripartum Cardiomyopathy

For unclear reasons, the peripartum period is associated with the relatively sudden onset of cardiomyopathy in healthy women without evidence of prior cardiac disease. Estimates indicate that peripartum cardiomyopathy (PPCM) occurs in 1 of 2229 pregnancies; reported risk factors include advanced maternal age, preeclampsia, gestational hypertension, multiparity, and being African American. The cause is unknown.²²

Onset usually occurs days to weeks after delivery; symptoms range from mild fatigue to florid pulmonary edema. PPCM is often unrecognized in its milder form, leading to the consensus that the condition may be more prevalent than reported. Dyspnea on exertion, orthopnea, and fatigue may be easily misinterpreted as normal in the postpartum period. The emergency clinician should not dismiss these symptoms because severe congestive heart failure, thromboembolism, and dysrhythmias may ensue.

Treatment includes the use of diuretics, vasodilators, and oxygen. Angiotensin-converting enzyme inhibitors are contraindicated

if PPCM occurs during the last month of pregnancy owing to teratogenicity but should be considered a mainstay of treatment postpartum. Hydralazine may be used before delivery to reduce afterload. Bromocriptine and pentoxifylline may also have roles in the treatment of PPCM.²³

Cardiac function returns to normal in 23% to 32% of patients with PPCM during the following 6 months. Complications result in a mortality rate of approximately 15% worldwide.²³

Postpartum Depression

Considered underdiagnosed, postpartum depression is estimated to affect 10% to 15% of new mothers. Although often self-limited, the condition has been recognized as having important consequences for the mother, infant, and family. Risk factors include previously diagnosed depression, inadequate spousal support, adverse socioeconomic factors, life stressors, and emergency delivery.

Clinical Features

Postpartum depression patients present similarly to those with other major depressive disorders. Symptoms include depressed

mood, anhedonia, loss of appetite, insomnia, fatigue, decreased concentration, feelings of guilt and worthlessness, and suicidal ideation. Most women with postpartum depression do not have vegetative signs or symptoms. Symptoms peak at 10 to 12 weeks postpartum, although some cases are diagnosed up to 1 year after delivery. When postpartum depression is unrecognized, these women are at high risk for suicide and may come to the ED with overdoses or other manifestations of a suicidal attempt.

Management

Early identification and referral are the key components of therapy. Dismissal of postpartum fatigue as normal, without consideration of the diagnosis of postpartum depression, can be disastrous. Not only does this condition contribute to marital discord, maternal risk for suicide, and even infanticide, but studies have shown that children of depressed mothers have an increased incidence of delayed cognitive, psychological, neurologic, and motor development.

KEY CONCEPTS

- All ED deliveries should be considered high risk. Antepartum hemorrhage, PROM, eclampsia, premature labor, precipitous delivery, malpresentation, and umbilical cord emergencies are overrepresented in emergency deliveries.
- Women in labor who present to the ED are generally best cared for in the obstetric suite. Women with the urge to push or with the head of the infant crowning are at imminent risk of delivery, which should take place in the ED. The benefits of transfer of a woman with an impending high-risk delivery to a perinatal center must be carefully weighed against potential clinical adverse events and possible subsequent medicolegal judgments.
- Most ED deliveries require only basic equipment to cut and clamp the umbilical cord and dry and suction the infant. However, the ED should have additional equipment and trained staff available to care for a newborn requiring further resuscitation.
- Maternal complications of labor and delivery include obstetric trauma, postpartum hemorrhage, uterine inversion and rupture, amniotic fluid embolism, coagulation disorders, and infections. Many of these problems can initially be managed nonsurgically in the ED.
- Deliveries complicated by dystocia, malpresentation, or multiple gestations are life-threatening emergencies. The emergency clinician should develop strategies to treat each of these potential complications of delivery.

The references for this chapter can be found online by accessing the accompanying Expert Consult website.

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CHAPTER 181: QUESTIONS & ANSWERS

181.1. A 23-year-old G2P1 at term presents to the ED with contractions. She has received no prenatal care. She is in moderate distress and feels the urge to push. Which of the following is indicated?

- Emergent delivery
- Emergent transfer to the obstetrics suite
- Formal abdominal ultrasound
- Magnesium sulfate 2 g intravenously
- Nitrazine testing of pooled vaginal fluid

Answer: A. Women with the urge to push or with the head of an infant crowning are at imminent risk of delivery, which should take place in the ED. Women in labor who present to the ED and are not at risk for imminent delivery are best cared for in the obstetrics suite.

181.2. A 28-year-old G3P3 presents 2 weeks after delivery with increasing dyspnea on exertion, pedal edema, orthopnea, and easy fatigue. Which of the following statements is true?

- Angiotensin-converting enzyme (ACE) inhibitors are contraindicated.
- Cardiac function returns to normal in 50% of cases.
- Treatment differs from ischemic cardiomyopathy.
- Onset is usually gradual.

Answer: B. Postpartum cardiomyopathy is associated with a fairly sudden onset of symptoms days to weeks after delivery. It may begin to occur during the end of pregnancy, at which time ACE inhibitors are contraindicated, but these agents are cornerstones of therapy after delivery. Fifty percent of patients will return to normal cardiac status. Mortality is high for those who do not.

181.3. Which of the following statements regarding uterine rupture is true?

- Emergency ultrasonography has little value.
- Emergent vaginal delivery is indicated.
- Maternal mortality is high.
- Pain is not always present.
- The absence of vaginal bleeding precludes rupture.

Answer: D. Pain is not always present with uterine rupture, nor is vaginal bleeding always associated. Women at risk are those with a prior classic cesarean section incision or who have had three or more cesarean deliveries. Emergency ultrasonography may show a protruding amniotic sac, hemoperitoneum, or the site of myo-

metrial rupture. Emergency cesarean delivery within 30 minutes is the indicated treatment. Maternal mortality rates in developed countries is less than 1%.

181.4. Which of the following statements is not associated with shoulder dystocia?

- Fetal complications include clavicular fractures and hypoxic brain injury.
- Shoulder dystocia can be overcome by placing traction on the fetal head.
- Signs of shoulder dystocia include the turtle sign and the presentation of fetal shoulders in a vertical axis.
- The McRoberts' maneuver frees the anterior shoulder by flexing the mother's legs to a knee-chest position.

Answer: B. Traction on the fetal head will extend and abduct the shoulders, which increases bisacromial diameter, thereby worsening the dystocia.

181.5. A 33-year-old G1P0 female at 38 weeks by dates presents to the ED with a chief complaint of "my water broke." The patient reports feeling a gush of fluid several hours earlier but has not yet had any contractions. Which of the following statements best describes issues important in the evaluation and management of this patient?

- Fetal tachycardia may be indicative of chorioamnionitis.
- Nitrazine paper applied to the patient's pooled vaginal fluid will confirm the presence of amniotic fluid by turning yellow.
- Steroids should be given to the mother without delay to accelerate fetal lung maturation.
- Tocolytics are indicated and should be administered if the patient develops contractions while in the ED.

Answer: A. This patient presents with premature rupture of membranes. Assuming that the fetal gestational age of 38 weeks is confirmed by ultrasound, steroids are unnecessary because fetal lung maturity has already taken place. The incidence of infection may be increased with steroid administration, so it should not be given in this case. Tocolytics are not clearly indicated in this patient because she is at term (ie, fetal lung maturity has taken place), and there is as yet no evidence of chorioamnionitis. Tocolytic use should be discussed with the obstetric consultant. Nitrazine paper should turn blue when it comes into contact with amniotic

fluid, indicating a pH over 6.5. Fetal tachycardia and decreased variability of fetal heart rate are both signs of chorioamnionitis.

181.6. Which of the following statements regarding fetal heart tracings is false?

- A. Accelerations of heart rate occur during fetal movement.
- B. Baseline heart rate is determined with a 10-minute tracing in the absence of contractions.

C. Late decelerations rarely result in suboptimal infant outcomes.

D. Persistent variable decelerations may indicate the need to hasten delivery.

Answer: C. Late decelerations indicate uteroplacental insufficiency and should prompt immediate obstetric consultation. Overall, 70% of infants with late decelerations have underlying pathologic conditions or hypoxia.