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CHAPTER 8.3

Obstetric Surgery

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Cesarean Section—Lower Segment and Classic

Surgical Considerations

Description: Cesarean section (C-section) is the delivery of the fetus through a horizontal or, more commonly, through a vertical incision in the lower uterine segment. The skin incision is made either as a Pfannenstiel's (transverse in the crease above the pubis), a Maylard (in extremely obese patients), or vertical midline from umbilicus to pubis. The peritoneal cavity is entered as in any laparotomy. A retractor is placed inferiorly and the reflection of visceral peritoneum from the bladder dome to the anterior lower segment of the uterus (bladder flap) is incised and displaced inferiorly, along with the bladder. The uterus is entered sharply and the incision extended with digital pressure and/or bandage scissors. The fetal head is elevated out of the pelvis and delivered through the uterine incision. In cases of nonvertex lie, the infant's breech or foot is grasped and brought out of the incision. After the delivery of the fetus, the cord is double-clamped and cut, and cord blood is obtained for analysis. The placenta is removed manually and the uterine cavity cleared of all debris and clots. The uterine incision is closed with a running, interlocking stitch, followed by a 2nd imbricating layer. The bladder flap and parietal peritoneum do not require closure. Finally, the fascia is closed and the skin reapproximated with staples. **Classic C-section** usually involves a fundal vertical uterine incision ([Fig. 8.3-1](#)). Patients with a history of prior classical C-section should be delivered abdominally via a repeat C-section, because their risk of uterine rupture with labor and vaginal delivery is 12%.

Usual preop diagnosis: Failure to progress in labor; elective repeat C-section; fetal distress; malpresentation

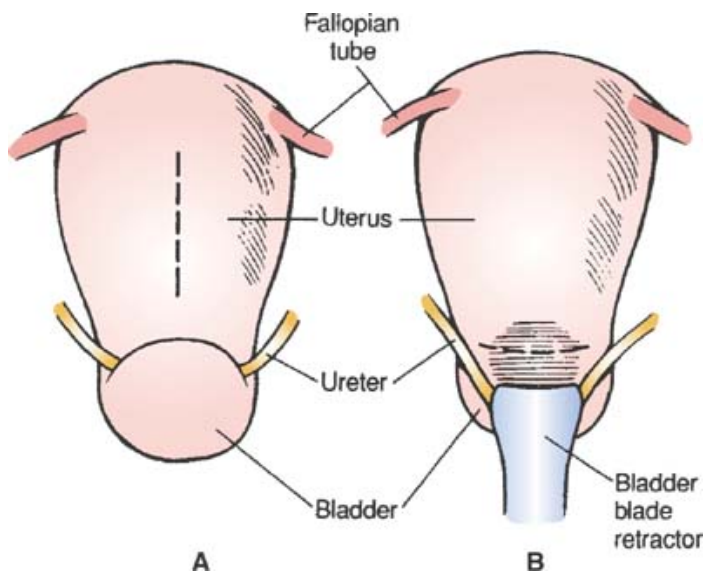


Figure 8.3-1. 1. Typical C-section incisions. **A:** Classic incision, in upper uterine segment. **B:** Low transverse incision.

Summary of Procedures





Lower-Segment C-Section

Classic C-Section

Position	Supine with left lateral tilt. (In obese patients, the pannus may be lifted superiorly by tape or towel clips.)	
Incision	Skin: transverse low abdominal (Pfannenstiel's) or repeat vertical. Uterus: Skin: Pfannenstiel's or, more commonly, transverse (Kerr) or low vertical (for premature infants or nonvertex lie)	vertical midline. Uterus: vertical fundal
Special instrumentation	Bladder blade retractor; small ring forceps; bandage scissors; suction bulb; DeLee suction trap (if meconium)	
Unique considerations	fetal heart tones before procedure. If for CPD: vaginal exam within last 15 min before procedure. If for fetal distress: continuous monitoring until skin incision. If in labor or membranes ruptured:	
Antibiotics	continue prophylactic antibiotics or cefazolin 1–2 gm iv (prior to incision or 30 minutes prior to delivery)	
Surgical time	20–90 min	40–90 min
Closing considerations	Low transverse: closed in 2 layers. Low vertical: 2 layers; may require additional operative time for control of incision bleeding or repair of incision extension into cervix.	3-layer closure requires additional time.
EBL	750–1,000 mL	1,000–2,000 mL
Postop care	Observation for bleeding and ↓ BP	Special attention to VS needed due to additional blood loss.
Mortality	< 0.1%	
Morbidity	Infection: Not in labor: < 5% In labor/ruptured membranes: 50% (antibiotics reduce incidence to 15%) Small-bowel obstruction (SBO): Rare	
Pain Score	4	7

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Patient Population Characteristics

Age range	14–45 yr
Incidence	10–30%
Etiology	Failure to progress (30%); repeat C-section (30%); fetal anomaly/other (20%); abnormal presentation (10%); fetal distress (10%)
Associated conditions	Preeclampsia/eclampsia; DIC; hemolysis, elevated liver enzyme, low Plt count (HELLP) syndrome; obstetrical hemorrhage/shock; chorioamnionitis

Anesthetic Considerations

(Procedures covered: C-section; emergent obstetrical hysterectomy; repair of uterine rupture)





Preoperative

In general, patients are young and healthy, although the pregnant patient has undergone profound physiologic changes that affect the conduct of anesthesia. Patients present for emergency C-section for nonreassuring fetal heart rate tracing and/or hemorrhage (placenta previa, abruptio placenta, and, rarely, uterine rupture).

Respiratory

The pregnant patient has a compensated respiratory alkalosis ($\text{PCO}_2 = 32\text{--}34$), \uparrow minute ventilation (MV) ($\uparrow 50\%$), and \downarrow FRC ($\downarrow 20\%$). \uparrow O_2 consumption ($\uparrow 20\%$) with \downarrow FRC results in rapid onset of hypoxemia if ventilation is compromised. Small airway closure due to elevation of diaphragm (exaggerated by obesity and supine position) can \rightarrow shunting and \downarrow PaO_2 . \uparrow MV and \downarrow FRC enhance uptake of inhalational anesthetics. Mucosal capillary engorgement in upper airways may necessitate a smaller ETT and mandates careful airway suctioning to avoid bleeding.

Tests: As indicated from H&P.

Typically, there is a \downarrow SVR ($\downarrow 15\%$), \downarrow diastolic pressure and \downarrow MAP ($\downarrow 15\%$) with \uparrow HR ($\uparrow 20\%$) and \uparrow CO ($\uparrow 30\text{--}40\%$, higher in multi-fetal pregnancy, higher in labor). Use left lateral tilt to minimize aortocaval compression and supine hypotension.

Immediately postpartum, 600–800 mL blood enters the central circulation, due to placental transfusion, with further \uparrow in CO.

Tests: As indicated from H&P.

These patients have \uparrow red cell mass ($\uparrow 300\text{--}400$ mL), \uparrow plasma volume ($\uparrow 1,200\text{--}1,300$ mL), \uparrow blood volume ($\uparrow 1,500\text{--}1,600$ mL), \uparrow more with multifetal pregnancy. WBC count may \uparrow to 15,000/mm³. Iron deficiency anemia often is superimposed on the dilutional anemia of pregnancy (Hct 33%). The typical blood loss of 500–800 mL is usually well tolerated. Excessive blood loss is possible with multiple gestation, previous C-section, PIH, placenta previa, abruptio placenta, prolonged labor, and uterine atony. Repeat C-section associated with placenta previa poses high risk for hemorrhage because of placenta accreta.

Tests: Hgb/Hct

Abnormalities, including \downarrow gastric motility (after onset of labor), gastroesophageal reflux, raised intragastric pressure, and gastric hyperacidity, predisposes to aspiration pneumonitis. All parturients should be considered to have full stomachs and should receive clear antacid (e.g., 0.3 M Na citrate 30 mL) immediately prior to general or regional anesthesia. Administer iv metoclopramide 10 mg and ranitidine 50 mg before emergent C-section. Before elective C-section, parturients at high risk for aspiration (e.g., planned or potential GA, difficult airway, or any patient with esophageal reflux or obesity) should receive an H_2 blocker (e.g., ranitidine 150 mg po) the night before and the morning of surgery.

Liver enzymes can be mildly elevated and plasma protein concentration is diminished (\uparrow unbound drug levels).

Tests: As indicated from H&P

These patients have \uparrow renal blood flow ($\uparrow 50\%$), \uparrow GFR, and \uparrow creatinine clearance, and \downarrow serum creatinine and \downarrow BUN.

Dependent edema results from increased water and Na^+ retention 2° resetting of the osmotic threshold for thirst and vasopressin secretions.

Tests: As indicated from H&P.

Cardiovascular

Hematologic

Gastrointestinal

Hepatic

Renal





Laboratory

Premedication

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Special Considerations

Pregnancy- induced hypertension (PIH)

Eclampsia

Massive maternal hemorrhage:

- Placenta previa
- Abruptio placenta
- Ruptured uterus

T&S maternal blood if risk factors for blood loss are present (e.g., third C-section). Cross-match unnecessary unless significant blood loss is anticipated. Routine autologous blood donation is not recommended. Coagulation studies and Plt count recommended with PIH, abruptio placenta, heavy maternal bleeding. BUN; Cr; UA; fasting blood glucose; others as indicated from H&P.

Agents to decrease risk of aspiration pneumonitis include a clear antacid (e.g., Na citrate 30 mL po), ranitidine 50 mg iv and metoclopramide 10 mg iv. Sedatives are not routinely administered. In extremely anxious patients, however, 0.5–1.0 mg midazolam iv is an excellent anxiolytic, without apparent effect on maternal memory or alertness or neonatal condition.

PIH is characterized by generalized vasoconstriction with relative intravascular volume depletion and, occasionally, diffuse capillary leak. There may be ↑ risk of hypotension with regional anesthesia. Cautious hydration prior to regional anesthesia is necessary to prevent hypotension or pulmonary edema. Hepatic dysfunction may be present (HELLP syndrome). Epidural, spinal, and combined spinal-epidural (CSE) are all considered safe techniques in PIH. Cardiovascular stability is better with regional than GA, provided intravascular volume is adequate. Abnormal coagulation (↓ Plt count or dysfunctional Plt) contraindicates regional anesthesia. If GA is necessary, control BP with small doses of labetalol (5–20 mg iv over 3–5 min) and/or low doses of a short-acting opioid (e.g., fentanyl 50–100 mcg) prior to induction to blunt hypertensive response to laryngoscopy. There is a potential for difficult intubation in PIH due to airway edema; therefore, a small ETT (6.0 mm) should be available. MgSO₄ potentiates neuromuscular blocking agents; avoid defasciculating dose of muscle relaxant before induction, use smaller than normal doses of nondepolarizing agents, and monitor neuromuscular function.

Tests: PT; PTT; Plt; TEG or bleeding time; LFTs

Treat eclamptic Sz with adequate oxygenation and a small dose of STP (50–100 mg) or diazepam (5 mg). Intubate if necessary to protect airway. Initiate MgSO₄ therapy (loading dose: 4–6 g iv over 20–30 min; then infuse @ 1–2 g/h).

Insert 2 large-bore iv catheters (14–16 ga). Assure immediate availability of cross-matched blood. Rapidly restore intravascular volume with crystalloid, colloid, or both. Induction of GA with ketamine (1–1.5 mg/kg) is preferred in hypovolemic patients. DIC can follow abruptio placenta or amniotic fluid embolism. Dilutional thrombocytopenia following massive blood loss might require Plt transfusion. Uterine atony is treated with oxytocin 20–40 U/L in NS @ rate sufficient to control atony (risk of ↓ BP with boluses); methylergonovine, 0.2 mg im (risk of HTN); or 15-methyl prostaglandin F₂α, 0.25 mg im or intramyometrially (risk of pulmonary HTN, bronchospasm). Uterine artery embolization is often effective in controlling continued postpartum bleeding and may be considered before surgical artery ligation or hysterectomy. Emergency hysterectomy, however, may be the only solution to continued bleeding. Induction of GA may be necessary if massive bleeding occurs during regional





Diabetes

Response to anesthetic drugs

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Intraoperative

Anesthetic technique: General considerations involve primarily the choice of anesthetic. Compared with regional anesthesia, the risks of aspiration and difficult intubation with GA increase maternal morbidity and mortality. Anesthetic choice in specific circumstances depends on maternal and fetal conditions and degree of urgency. Properly conducted GA or regional anesthesia probably are equally safe for the fetus.

Spinal anesthesia is preferred for elective or semielective C-section (unless patient has an existing epidural) when no contraindications to regional anesthesia exist (e.g., patient refusal, coagulopathy, active neurological disease, hypovolemia, sepsis). With the use of a pencil-point needles (e.g., Sprotte, Whitacre), the risk of headache is low (1–2%). Advantages of spinal over epidural anesthesia include: technical ease, rapid onset of block, and more solid anesthesia, and less shivering. ↓ BP, however, is more common with spinal anesthesia. Fluid loading (1–1.5 L crystalloid/500 mL colloid), leg wrapping (e.g., compression stockings), and vasopressors reduce the incidence and severity of ↓ BP, but do not eliminate it. Pressors (e.g., ephedrine [5–10 mg], phenylephrine [50–100 mcg], and atropine [0.4 mg iv]) should be used as appropriate to treat ↓ BP and ↓ HR. Ephedrine, even in large doses, may not reverse severe ↓ BP, and may ↑ fetal acidosis. Consider using epinephrine (50–100 mcg iv) if other pressors/fluids are unsuccessful.

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General anesthesia normally is used when regional anesthesia is contraindicated or when there is inadequate time to institute regional blockade. Obstetric emergencies for which rapid induction of GA may be indicated include: severe maternal hemorrhage, prolapsed umbilical cord, severe fetal bradycardia, severe persistent fetal decelerations, or the need for intrauterine manipulation. Less dire situations often permit the performance of a “quick spinal” or extension of a functioning epidural block with an agent having a rapid onset (e.g., 15–20 mL 3% 2-chloroprocaine or 2% lidocaine with epinephrine). Continuous monitoring of the fetal heart rate (FHR) in the OR may allow use of regional anesthesia if the FHR tracing is reassuring. Constant communication with the obstetrician regarding maternal and fetal condition is essential. Although situations exist in which a GA is preferable to regional, the risks must be weighed against the benefits for patients with greater potential for complications. If difficult intubation is anticipated, rapid-sequence induction of GA should not be undertaken. Alternative approaches include awake intubation, spinal anesthesia, or local infiltration by the obstetrician. Sometimes, a nonreassuring FHR pattern is diagnosed as “fetal distress” and the fetus is delivered immediately. Fetal distress is an imprecise and nonspecific term with little positive predictive value. The severity of any FHR abnormality should be considered when the urgency of delivery and type of anesthesia are determined. C-section performed for a nonreassuring FHR pattern does not necessarily preclude the use of regional anesthesia.

Regional anesthesia:

anesthesia.

Diabetic patients have an increased propensity to ↓ BP following regional anesthesia, with the fetus becoming more acidotic than normal as a result. Determine blood glucose hourly and maintain at 80–100 mg/dL. Insulin requirements decrease drastically after delivery, and insulin dosage must be reduced to prevent maternal hypoglycemia.

Tests: Fasting blood glucose; UA

In pregnant patients, MAC is ↓ 40% for inhaled agents; combined with more rapid uptake, this predisposes to anesthetic overdose. Sensitivity to local anesthetics also is increased. Epidural space capacity is decreased 2° engorgement of epidural veins; this decreases requirements for local anesthetics and increases possibility of intravascular injection of drugs. Increased sensitivity to nondepolarizing muscle relaxants (especially in patients receiving MgSO₄) mandates careful monitoring and use of reduced doses. Decreased protein binding may increase toxicity of highly protein-bound drugs such as bupivacaine.

Apply monitors, fluid load, and place the patient in the sitting or lateral decubitus position. A 3 mL test dose of 1.5–2% lidocaine (45–60 mg) with 1:200,000 epinephrine (15–20 mcg) is given





Epidural

through the epidural needle or catheter to exclude intravascular injection (Sx: tachycardia, palpitations, dizziness, tinnitus, new taste in mouth) or subarachnoid placement (motor/sensory block in lower extremities). After 3–5 min, inject 15–20 mL 2% (300–400 mg) lidocaine with 1:200,000 epinephrine (75–100 mcg) incrementally over 5 min. Sodium bicarbonate, 1 mEq/10 mL lidocaine, hastens onset of block, but increases risk of ↓ BP. Bupivacaine, levobupivacaine, or ropivacaine 0.5%, 15–20 mL (75–100 mg), with or without epinephrine 1:200,000 and/or fentanyl (50–75 mcg), or 3% 2-chloroprocaine, 15–20 mL (450–600 mg) can also be used. To ensure a T4 level of anesthesia throughout surgery, additional local anesthetic often is needed. If a functioning epidural catheter is in place and an urgent C-section becomes necessary, 15–20 mL 3% 2-chloroprocaine (450–600 mg) or 2% lidocaine with epinephrine should produce adequate surgical anesthesia within 5–10 min.

Tilt table or use left hip elevation. Administer O₂ by mask or nasal cannula, and check FHR prior to abdominal prep. Monitor BP every min until stable, then every 3–5 min. Treat ↓ 20% in BP or SBP < 95–100 mmHg with further uterine displacement, additional fluids, and ephedrine 5–10 mg or phenylephrine 50–100 mcg iv. For inadequate anesthesia, give additional epidural local anesthetic, 50–100 mcg fentanyl iv or epidurally, 50% N₂O/O₂ ketamine 5–10 mg iv and/or infiltrate with local anesthetic. The patient must remain conscious to avoid risk of aspiration. If anesthesia is still inadequate, induce GA (see below).

After delivery of infant and placenta, rapidly infuse oxytocin 20–30 U/L. Observe for excessive blood loss. Chest pain, mild oxyhemoglobin desaturation, and SOB after delivery may be due to irritation of diaphragm by blood or packs, too high or inadequate level of anesthesia, or venous air or amniotic fluid embolization. S-T segment changes on ECG occur, but do not usually signify myocardial ischemia.

Apply monitors, administer fluid, and position as for epidural anesthesia. Metoclopramide 10 mg iv, 5–10 min prior to block decreases intraop N/V. Insert 24–25-ga pencil-point needle and verify free flow of CSF. In urgent situations, a larger pencil-point needle (e.g., 22-ga Sprotte) is easier and faster to place with minimal increase in headache. Inject hyperbaric 0.75% spinal bupivacaine 11.25–12.0 mg (1.5–1.6 mL) ± fentanyl 10–15 mcg and preservative-free morphine 0.1–0.2 mg, and position the patient with left uterine displacement. Monitor and treat ↓ BP as for epidural. Adjust operating table position to insure a T4 level of anesthesia. If anesthesia is inadequate and time permits, consider repeating block with CSE, repeat spinal (caution with dosing), or placement of an epidural catheter. Treat persistent inadequate anesthesia as for epidural. Induce GA if other measures fail.

An alternative technique combining the rapid onset and density of spinal anesthesia with the flexibility of continuous epidural anesthesia (e.g., if necessary to extend the duration or intensity of the block). Apply monitors, administer fluid, and position as for spinal/epidural. The most common technique is the needle-through-needle. When the epidural space is located with a 17-ga Tuohy needle, insert a 26–27 ga pencil-point spinal needle through it and administer 11.25–12 mg of spinal bupivacaine. Secure the epidural catheter and use if needed. (An epidural test dose is advisable.)

Spinal

Combined spinal- epidural (CSE)





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General anesthesia:

Induction

Tilt table or use left hip displacement and administer 500–750 mL dextrose-free crystalloid before induction. Preoxygenation for 3 min is optimal; however, 4 maximal inspiratory breaths in 30 sec is a satisfactory substitute in an emergency. Place patient in maximal “sniff” position with elevation of shoulders, if necessary, to optimize position for intubation. After patient is prepped and draped and obstetric team is ready to begin, perform rapid-sequence induction with cricoid pressure. Administer STP 4–5 mg/kg or propofol 2–3 mg/kg (or ketamine 1–1.5 mg/kg in hypovolemic patients) and succinylcholine 1–1.5 mg/kg to induce GA and facilitate intubation. Inflate cuff of ETT and verify tracheal placement by ETCO₂ waveform and auscultation of bilateral breath sounds.

If tracheal intubation is unsuccessful, monitor O₂sat and mask ventilate, maintaining cricoid pressure. Summon experienced help and quickly decide whether surgery must proceed. The risks of continuing with mask GA and cricoid pressure must be weighed against the risk of allowing the mother to awaken. If mask ventilation is impossible, quickly attempt ventilation with an LMA. If this succeeds, either continue to use throughout the case or place an ETT (6 mm ID) through LMA blindly or with FOL; alternatively, use an intubating LMA. A Pro-seal LMA has been used in this situation and may negate the necessity for ET intubation. If LMA fails to allow ventilation, attempt emergency transtracheal ventilation using a 12–14 ga iv catheter and appropriate tubing to connect to a high-pressure O₂source (e.g. jet ventilator). If these measures are unsuccessful, an emergency cricothyrotomy or tracheostomy should be performed by experienced personnel. **Planning for a failed intubation must occur before it actually happens.** A difficult-intubation tray, including equipment for emergency jet ventilation, must be immediately accessible in or very near the delivery room.

Failed intubation

50% N₂O/O₂ with isoflurane or sevoflurane (limit MAC < 1.5 to prevent uterine atony). Control ventilation, avoiding extreme hypocapnia (PCO₂ < 30 mmHg), which decreases umbilical blood flow. After delivery, substitute an opioid (e.g., fentanyl 50–100 mcg) for volatile agent and increase concentration of N₂O to 70%. Administer small doses of muscle relaxants (e.g., vecuronium 2–3 mg) as needed. Reverse with neostigmine 0.05 mg/kg and glycopyrrolate 0.01 mg/kg or atropine 0.02 mg/kg. Midazolam (1–2 mg), given after delivery, helps avoid maternal awareness, which occasionally occurs with this anesthetic technique.

Maintenance

Delay extubation until patient is fully awake and muscle strength has returned to normal.

Emergence

Infuse 1–2 L dextrose-free crystalloid (± colloid 500 mL) immediately prior to regional anesthesia. Typical blood loss = 500–800 mL. A rapid-fluid infuser and blood warmer should be available in the event that large-volume blood transfusion is required. Arterial BP monitoring via

Blood and fluid requirements

Moderate blood loss
IV: 16–18 ga × 1
NS/LR 1–3 L typical replacement





Monitoring	Standard monitors (see p. B-1) FHR monitor ±CVP or PA catheter ±arterial line	automated BP device, or arterial line for severe or labile HTN. CVP useful in PIH for oliguric patients unresponsive to fluid challenges. Occasionally, a PA catheter is indicated (e.g., for pulmonary edema, unresponsive oliguria).
	Left uterine displacement (blanket under right hip and/or table tilt)	Minimizes aortocaval compression.
Complications	Amniotic fluid embolism	Rare cause of hemodynamic instability, hypoxemia, and DIC. Often fatal. Rx: supportive: 100% O ₂ PEEP, and vasopressors. Correct Plt, clotting factors, and metabolic disturbances. CPB has been used successfully.

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Postoperative

Complications	VTE	DX: pleuritic chest pain, cough, hypoxemia, ↑ RR, ↑ HR, ↑ A-a gradient. Rx: supportive: 100% O ₂ volume expansion, and vasopressors. See p. B-7 . See Anesthetic Considerations for Removal of Retained Placenta, p. 825 .
	Postpartum hemorrhage	Common side effects include: pruritus 70%, nausea 30–40%, and, rarely, respiratory depression. Nalbuphine (5–10 mg) and naloxone (0.1–0.4 mg) are used for reversal of these side effects. Metoclopramide (10 mg iv) and/or ondansetron (4 mg iv) may be needed for persistent nausea. Risk of delayed respiratory depression in healthy patients is small; however, adequately trained nursing staff and a protocol for treatment of complications are mandatory if intraspinal opioids are used. These patients should not routinely receive sedatives or other systemic opioids for 12 h, and close monitoring of RR every hour and level of consciousness is necessary. Pulse oximetry is recommended in high-risk patients.
Pain management	Epidural: 4–5 mg preservative-free morphine in 10 mL after delivery. Intrathecal: Morphine (preservative-free) 0.1–0.2 mg given with spinal local anesthetic. Chloroprocaine interferes with analgesia from epidural opioids	
	Parenteral opioids: iv or im opioids or PCA instituted in recovery room. Oral analgesics: NSAIDs (e.g., ibuprofen), acetaminophen ±codeine (or equivalent oral narcotics), after the patient can tolerate oral medication.	
Tests	As indicated	

Suggested Readings





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Medical and Surgical Management of Postpartum Hemorrhage



Surgical Considerations

Description: The most common indication for **postpartum uterine devascularization and hysterectomy** is **intractable postpartum hemorrhage (PPH)**. PPH is clinically defined as any uncompensated postpartum blood loss → tissue hypoperfusion. There are four major causes of PPH: retained products of conception (POC), laceration of the genital tract, uterine atony, and coagulopathies. Inherited coagulopathies include von Willebrand's disease, hemophilia, and factor XI deficiency. Acquired coagulopathies are most often related to thrombocytopenia 2° preeclampsia/eclampsia, hypofibrinogenemia 2° long-standing fetal demise, placental abruption, and DIC related to massive blood loss.

Postpartum blood loss can be reduced by prophylactic use of oxytocin, methylergonovine, or prostaglandins and these same agents are used as the first line of treatment for PPH. A concentrated oxytocin infusion (e.g., 80–100 U in 500 mL over 30 min) may be used. Methylergonovine should be given im only (0.2 mg q 2–4 h up to 1 mg), since iv infusion has been reported to cause acute HTN, stroke, and Sz. Ergot derivatives are contraindicated in patients with Hx of HTN, asthma, Raynaud's syndrome, or migraine. PGF_{2α} (Hemabate) may be injected im (intramyometrial) at a dose of 0.25 mg, up to a total of 2 mg. Misoprostol, an inexpensive PGE, may be given rectally (up to 800 mcg).

Simultaneously, the surgeon should explore the cause of PPH and apply a specific treatment. If PPH is not controlled with treatment





of uterine atony, and after volume replacement and correction of any coagulopathy, temporizing measures should be applied while preparing the patient for definitive invasive treatments. Temporizing measures include packing of uterine cavity with a long gauze and use of balloon tamponade. Extensive experience on non-pneumatic anti-shock garment (ASG) on non-pregnant patients is applied to post partum patients with remarkable success in temporizing hypovolemic shock from abdominal and pelvic bleeding. ASG can be applied quickly and results in an immediate 1,500–2,000 mL autotransfusion. ASG should not be used with fetus in situ or thoracic site of hemorrhage. After stabilization, patient should be transferred to Radiology for uterine artery embolization under fluoroscopic control where uterine arteries are selected and absorbable Gelfoam pledgets are introduced. Treatment may be repeated until bleeding is stopped. In known cases of placenta accreta, in anticipation of PPH, catheters have been placed in uterine arteries before C-section.

If selective embolization is not available, or fails to stop hemorrhage, more invasive surgical intervention should be employed, including uterine compression sutures, iliac artery ligation, **uterine devascularization**, and **hysterectomy**. The decision for surgical intervention is made when other options (i.e., medical, interventional radiology) have not been successful in decreasing the hemorrhage. Volume and coagulation factor replacement should continue while proceeding with surgery.

The technique for an **emergent obstetrical hysterectomy** is largely similar to a hysterectomy for other indications. Of note is the engorged and prominent nature of the vessels supplying the gravid uterus. The edematous tissues surrounding the uterus are very friable and may bleed profusely if improperly manipulated. A **supracervical** or **total hysterectomy** may be performed. Through a midline or Pfannenstiel's incision, the uterus is elevated out of the abdominal cavity. The round ligaments are clamped, transected, and ligated; and the anterior leaf of the broad ligament is incised bilaterally from the transected round ligaments to the vesicouterine reflection. The posterior leaf of the broad ligament adjacent to the uterus is entered at a level just below that of the fallopian tubes and uteroovarian ligaments. These are then clamped, transected, and ligated. Next, incision of the posterior leaf of the broad ligament toward the cardinal ligaments is performed. With gentle blunt dissection, the bladder and attached vesicouterine peritoneal flap are dissected off the lower uterine segment. The ascending uterine arteries and veins are identified bilaterally, then clamped, transected, and ligated. If a **subtotal hysterectomy** is planned, the body of the uterus is amputated at this level, and the cervical stump is closed with interrupted sutures. If a total hysterectomy is planned, dissection of the bladder off the cervix is continued until the cervicovaginal margin is identified. The cardinal and uterosacral ligaments are clamped, transected, and ligated, with clamps placed as close to the cervix as possible without including cervical tissue. After the level of the lateral vaginal fornix is reached, a clamp is swung below the cervix, across the lateral vaginal fornix. The cervix is then amputated off the vaginal cuff. Throughout the procedure, it is vital to clamp and ligate any bleeding vessels and to take extra care to avoid damage to the ureter or bladder. Following removal of the uterus and cervix, the vaginal cuff angles are sutured to the ipsilateral cardinal ligament stumps, and the vaginal cuff is closed with a running locked stitch. The abdominal wall is closed in layers.

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Usual preop diagnosis: Intractable postpartum bleeding; rupture of gravid uterus

Summary of Procedures

Position	Supine, with left lateral tilt
Incision	Pfannenstiel's or midline longitudinal
Unique considerations	Monitoring of coagulation parameters and correction of DIC. Consider central venous hemodynamic monitoring. Pediatrics team present, if indicated.
Antibiotics	Cefazolin 1 g iv q 8 h; total 3 doses
Surgical time	2–3 h
Closing considerations	Subcutaneous intraperitoneal drains, if indicated.
EBL	3,000–4,000 mL
Postop care	ICU if blood loss severe; patient may require continued intubation and mechanical ventilatory support. Monitor for infectious morbidity and acute renal failure.
Mortality	< 1%
	Hemorrhage
	Postop febrile morbidity
	DIC
	Wound infection
	Sheehan's syndrome





Morbidity

Bladder injury
Intraperitoneal bleeding requiring reoperation
Vesicovaginal fistula
Ureterovaginal fistula
Transfusion-related complications

Pain score

7

Patient Population Characteristics

Age range

Reproductive age

Incidence

0.11% of obstetric patients

Etiology

Unknown

Associated conditions

Placenta accreta; uterine atony nonresponsive to medical or other surgical intervention; extension of cervical tear to lower uterine segment; placenta previa; uterine rupture; uterine inversion



Anesthetic Considerations

See [Anesthetic Considerations following Cesarean Section, p. 819](#).

Suggested Readings

1. AbdRabbo SA: Stepwise uterine devascularization: a novel technique for management of uncontrolled postpartum hemorrhage with preservation of the uterus. *Am J Obstet Gynecol* 1994; 171:694–700.
2. B-Lynch C, Coker A, Lawal AH, et al: The B-Lynch surgical technique for the control of massive postpartum haemorrhage: an alternative to hysterectomy? Five cases reported. *Br J Obstet Gynecol* 1997; 104:372–5.
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- (Print pagebreak 827)
7. Hensleigh PA: Anti-shock garment provides resuscitation and haemostasis for obstetric haemorrhage. *BJOG* 2002; 109(12):1377–84.
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Repair of Uterine Rupture

Surgical Considerations

Description: **Rupture of the gravid uterus** is considered a true obstetric emergency and can be catastrophic, with significant maternal and fetal mortality. The classic symptoms are “shearing” pain, cessation of uterine contractions, loss of fetal heart tones, and the onset of vaginal bleeding. Unfortunately, these warning symptoms occur only in a minority of uterine rupture cases. Extrusion of the placenta through the uterine rupture may result in late decelerations due to uteroplacental insufficiency. Extrusion of the umbilical cord may be manifested by recurrent variable decelerations. Suprapubic pain as the only symptom has not been associated with uterine rupture. Causes of **uterine rupture** include breakdown of a previous uterine scar, obstructed labor, or uterine trauma. In cases where the uterine rupture occurs at the site of a prior uterine scar, the clinical course is usually less severe and the blood loss less than in cases of primary rupture of an intact uterus. The incidence of uterine rupture at the site of the old scar is 0.5% for lower-uterine transverse C-sections, and 12% for classic C-sections.

Total abdominal hysterectomy (see [p. 804](#)), or **supracervical hysterectomy** ([p. 825](#)), is the definitive therapy; however, depending on the clinical situation and the patient's wishes for future fertility, a **uterine repair** may be undertaken. This consists of a 2- to 3-layered closure of the defect, using synthetic absorbable sutures. A transverse abdominal incision is made 3 cm above the symphysis pubis and carried to the anterior rectus fascia. The fascia is incised and the muscles of the anterior abdominal wall separated sharply and bluntly from the midline. The peritoneum is elevated and entered sharply. Because of the emergent nature of this condition and the possible massive blood loss associated with rupture of a gravid uterus, the anesthesiologist must act quickly. Prompt O₂ administration, together with aggressive iv fluid resuscitation, is indicated. Serious consideration should be given to the use of unmatched O(-) or type-specific blood until cross-matched blood becomes available. Intraop hypogastric or uterine artery ligation may help minimize blood loss. Patient's coagulation parameters must be monitored, because hypoxia and massive blood loss are associated with DIC.

Usual preop diagnosis: Uterine rupture

Summary of Procedures

Position	Supine with left-lateral tilt
Incision	Pfannenstiel's (low, transverse abdominal) or midline longitudinal
Unique considerations	Pediatrics team present for infant resuscitation, if necessary. Thorough surgical exploration of the urinary tract (bladder and ureters), because 10% of cases are associated with bladder lacerations. Cell Saver may be helpful.
Antibiotics	Cefazolin 1 gm iv q 8 h × 3 doses
Surgical time	1–2 h
EBL	500–3,000 mL
Postop care	ICU if blood loss severe; continued intubation and mechanical ventilatory support if aggressive fluid resuscitation results in pulmonary edema. Acute renal failure may occur 2° hypoxic and hypovolemic renal injury at time of acute uterine rupture with massive bleeding; monitor UO and serial renal function tests.
Mortality	Fetal : 35–45% Maternal: 5%
Morbidity	Blood transfusion > 5 U: 58% Postop wound infection: 33% Pelvic abscess: 8%
Pain score	Repeat uterine rupture with subsequent pregnancies: 5% 6





(Print pagebreak 828)

Patient Population Characteristics

Age range	Reproductive age
Incidence	1/1,400 deliveries
Etiology	Prior uterine surgery; grand multiparity; obesity; manual removal of placenta; injury from tools of abortion; direct or indirect violence; oxytocin use; intraamniotic or vaginal prostaglandins; breech extractions; internal or external version; forceps rotation; shoulder dystocia; fundal pressure; neglect (cephalopelvic disproportion, etc.); congenital uterine anomaly; cornual pregnancy; gestational trophoblastic neoplasia; placenta percreta; abruptio placenta

Anesthetic Considerations

See [Anesthetic Considerations following Cesarean Section. p. 819.](#)

Suggested Readings

1. Chazotte C, Cohen WR: Catastrophic complications of previous cesarean section. *Am J Obstet Gynecol* 1990; 163(3):738–42.
2. Cunningham FG, MacDonald PC, Gant NF, et al: Surgical sterilization. In *Williams Obstetrics*, 22nd edition. Appleton & Lange, Stamford: 2005.
3. Eden RD, Parker RT, Gall SA: Rupture of the pregnant uterus: a 53-year review. *Obstet Gynecol* 1986; 68(5):671–74.
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5. Plauche WC, VonAlmen W, Muller R: Catastrophic uterine rupture. *Obstet Gynecol* 1984; 64(6):792–97.
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7. Walsh C, Baxi L: Rupture of the primigravid uterus: a review of the literature. *Obstet Gynecol Surv* 2007; 62(5):327–34.

Postpartum Tubal Ligation

Surgical Considerations

Description: Postpartum tubal ligation (PPTL) is female surgical sterilization performed at the time of cesarean section (C-section) after delivery of the infant and repair of the uterine incision or within the first several days after a vaginal delivery. Although PPTL can be performed immediately postpartum, problems in the neonate may not be immediately evident, and a delay in surgery may be appropriate. If performed after a vaginal delivery, a small infraumbilical incision is made in the skin and carried down through the parietal peritoneum. The fallopian tubes are identified and brought out of the incision. It is important to identify the fimbriated end of the tube to ensure that the structure ligated is not the round ligament. A midsegment portion of the tube over an avascular portion of mesosalpinx is selected and tubal patency is disrupted by a variety of methods (**Pomeroy, Parkland, Irving, Uchida**, etc.). The Pomeroy, or a modification of it, is the most common technique used. The segment of tube grasped is ligated





with absorbable suture and the knuckle of tube formed is excised. The cut ends of the tubes should be hemostatic before replacing the tubes into the abdomen. The wound is closed in layers in the usual fashion.

The consent for sterilization requires special consideration. The procedure is strictly elective and voluntary and must be considered permanent, even though reversal may be possible. Some patients will eventually regret the decision to undergo permanent sterilization. The risk of sterilization failure and an increased risk of ectopic pregnancy in (*Print pagebreak 829*) case of failure must be reviewed. The full range of alternatives to PPTL, including an interval sterilization procedure (sterilization performed remote from pregnancy) must also be considered.

Usual preop diagnosis: Desire for permanent sterilization

Summary of Procedures

Position	Supine; steep Trendelenburg often required to allow bowel to fall away for exposure.
Incision	Infraumbilical
Special instrumentation	Small Richardson and Army/Navy retractors; Babcock clamps; vein retractor
Unique considerations	A special consent form for sterilization must be signed by the patient in advance of the surgery. The bladder must be drained prior to the procedure.
Antibiotics	None recommended
Surgical time	15–25 min (Uchida technique may ↑ operative time)
EBL	10 mL
Postop care	Routine postpartum care after recovery from anesthesia
Mortality	3/100,000
Morbidity	Hemorrhage Infection Incidental damage to bowel or bladder
Pain score	3

Patient Population Characteristics

Age range	Reproductive age
Incidence	The most common contraceptive procedure in the United States.

Anesthetic Considerations

Preoperative

Optimal timing of tubal ligation is controversial. The patient with a functioning epidural catheter may benefit from having surgery immediately after delivery. Many surgeons, however, favor waiting 8–24 h, when adequate assessment of the neonate should be complete and risk of maternal hemorrhage lessened. Alternatively, the epidural catheter can be left in place and reinjected later (successful epidural reactivation within 24 h is possible in > 92% of patients). Because pulmonary aspiration remains a theoretical risk, initiation of GA or spinal anesthesia often is delayed 8–24 h until the acute GI changes of pregnancy have regressed. There is no benefit to delaying surgery beyond this time. Shorter hospital stays after vaginal delivery are encouraging more tubal ligations during the first 12 h after delivery. It is unknown whether this will affect morbidity or mortality.





Respiratory

FRC returns to normal almost immediately after delivery. Laryngeal edema may persist in preeclamptic and postpartum patients after protracted expulsive efforts during labor → requirement for a small ETT.

Tests: As indicated from H&P.

Cardiovascular

The physiologic changes of pregnancy return to normal at varying intervals after delivery. For example, risk of aortocaval compression disappears immediately. Blood volume returns to pre-pregnant values over several days. Postpartum hemorrhage can occur without warning.

Tests: As indicated from H&P.

Gastrointestinal

Postpartum patients continue to be at risk for acid aspiration, although it is not known exactly when normal GI function returns. If elective PPTL is planned within 8 h of delivery, patient should have no oral intake of solid foods during labor and the postpartum period. Precautions for prevention of acid aspiration should be followed as discussed in Cesarean Section, p. 820.

Neurological

Local anesthetic requirements for spinal anesthesia remain decreased after delivery but are greater than for pregnant patients.

Laboratory

Hct; other tests as indicated from H&P.

Premedication

Precautions should be taken to ↓ risk of aspiration pneumonitis, as discussed in Cesarean Section, p. 820.

(Print pagebreak 830)

Intraoperative

Anesthetic technique: Spinal anesthesia is preferred, if a functioning epidural catheter is not in place. Epidural catheters frequently become dislodged after a patient becomes ambulatory. GA is acceptable if patient has a strong preference or if contraindications to regional anesthesia exist. These patients may be at risk for aspiration of gastric contents at least 8–24 h postdelivery.

Regional anesthesia:

Spinal

For technique and monitoring for spinal anesthesia, see [Cesarean Section, p. 822](#). Hyperbaric bupivacaine (7.5–12 mg) ± fentanyl (10–25 mcg). With the patient supine, adjust position of the operating table to obtain a T6 level of anesthesia. Sedate patient as necessary with small doses of iv midazolam 0.5–1.0 mg or opioid.

Epidural

A 3 mL epidural test dose, followed after 3–5 min by 15–20 mL of 1.5–2% lidocaine with 1:200,000 epinephrine injected incrementally. Additional local anesthetic as needed to ensure adequate level of anesthesia.

General anesthesia:

Induction

Rapid-sequence induction with STP (4–5 mg/kg) or propofol (1.5–2 mg/kg) and succinylcholine (1 mg/kg) for ET intubation.

Maintenance

Standard maintenance ([p. B-2](#))

Emergence

Extubation should be delayed until patient is fully awake and protective airway reflexes have returned.

Blood and fluid requirements

Minimal blood loss

IV: 18 ga × 1

NS/LR @ 2–4 mL/kg/h

1–1.5 L dextrose-free crystalloid immediately prior to regional anesthesia

Monitoring

Standard monitors ([p. B-1](#))

Positioning

and pad pressure points
eyes





Complications None specific

Postoperative

Complications	Minimal bleeding Intraspinal opioids 10–25 mcg fentanyl Parenteral opioids: IV or im opioids (e.g., morphine 2–4 mg iv up to 20 mg), or meperidine 10–20 mg iv q 10–15 min, titrated to RR and patient's level of pain and instituted in the recovery room.	Intrathecal fentanyl 10–25 mcg, given with spinal local anesthetic, enhances intraop anesthesia, particularly with low doses of bupivacaine, and provides several h postop analgesia.
Pain management		
Tests	None routinely indicated.	

(Print pagebreak 831)

Suggested Readings

1. Abouleish EI: Postpartum tubal ligation requires more bupivacaine for spinal anesthesia than does cesarean section. *Anesth Analg* 1986; 65(8):897–900.
2. American College of Obstetricians and Gynecologists: ACOG Committee Opinion, Committee on Ethics: Sterilization of women, including those with mental disabilities. No 371, 2007 (replaces No 63, 1988, No 73, 1989, and No 216 1999). *Obstet Gynecol* 2007;110(1):217–20.
3. American College of Obstetricians and Gynecologists: ACOG Committee Opinion, Committee on Obstetrics, Maternal and Fetal Sterilization: Postpartum tubal sterilization. No 105, 1992. *Int J Gynaecol Obstet* 1992; 39(3):244.
4. American College of Obstetricians and Gynecologists: ACOG technical bulletin. Benefits and Risks of Sterilization. No 46, 2003 (replaces No 222, 1996 and No 113, 1988). *Obstet Gynecol* 2003; 102(3):647–58.
5. Bucklin BA: Postpartum tubal ligation: timing and other anesthetic considerations. *Clin Obstet Gynecol* 2003; 46(3):657–66.
6. Cunningham FG, MacDonald PC, Grant NF, et al., eds: Surgical sterilization. In *Williams Obstetrics*, 22nd edition. Appleton & Lange, Stamford: 2005.
7. Goodman EJ, Dumas SD: The rate of successful reactivation of labor epidural catheters for postpartum tubal ligation surgery. *Reg Anesth Pain Med* 1998; 23(3):258–61.
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11. Viscomi CM, Rathmell JP: Labor epidural reactivation or spinal anesthesia for delayed postpartum tubal ligation: a cost comparison. *Anesthesiology* 1994; 81:A1160.
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Repair of Vaginal/Cervical Lacerations

Surgical Considerations

Description: Vaginal and cervical lacerations may occur 2° trauma of spontaneous and operative vaginal delivery. Adequate repair requires optimal surgical assistance, exposure, and patient comfort. Repair may be performed in a birthing bed, or may require patient positioning, lighting, anesthesia, or monitoring capabilities available only in an OR. Vaginal and cervical lacerations can extend into the perineum, rectum, urethra, bladder, lower uterine segment, broad ligament, or peritoneal cavity.

Lacerations of the lower vagina generally are easy to identify and repair. Small, superficial lacerations that do not bleed often do not need repair, whereas larger ones should be approximated. Deep lacerations may cause profuse bleeding; if it persists despite placement of multiple stitches, brief tamponade may be adequate to achieve hemostasis or vaginal packing may be required. Lacerations involving the perineum are classified as follows: First degree—involves break in mucosa and skin. Second degree—involves deeper tissue (bulbocavernosus and levator ani fascia and muscle). Third degree—involves anal sphincter. Fourth degree—extends into rectal mucosa. First- and second-degree lacerations are repaired in layers with continuous or interrupted stitches. The skin usually is closed with a subcuticular stitch. When the anal sphincter is lacerated, it often retracts. The ends are grasped with Allis clamps and approximated with multiple stitches. When the laceration extends into the rectum, the rectal mucosa usually is (*Print pagebreak 832*) closed in two layers, with the second layer imbricating the first. With periurethral lacerations, a catheter may need to be placed in the urethra to prevent passing a stitch through it. A laceration involving the urethra or bladder should be closed in multiple layers, followed by bladder drainage for several days.

Lacerations of the upper vagina are often difficult to visualize. Uterine bleeding and the umbilical cord of an undelivered placenta can obscure the field, and it can be difficult to determine if bleeding is vaginal or uterine. It is helpful to deliver the placenta and control uterine bleeding before proceeding. After visualization is adequate, it is important to place the first stitch above the apex of the laceration to control bleeding from vessels that may have retracted. Again, vaginal packing may be required if oozing of blood persists.

Superficial **lacerations of the cervix** occur with most deliveries but usually do not require treatment. Deep lacerations can cause significant blood loss, especially when they involve larger branches from the uterine artery or extend into the lower uterine segment. Again, the first stitch must be placed above the apex of the laceration to control bleeding from vessels that may have retracted. A **laparotomy** may be necessary if a laceration extends into the lower uterine segment or broad ligament and is causing significant bleeding that cannot be controlled otherwise. Alternatively, uterine artery embolization may be considered.

Usual preop diagnosis: Vaginal or cervical laceration

Summary of Procedures

Position	Dorsal lithotomy
Incision	None (unless exploratory laparotomy is performed)
Special instrumentation	Right-angle retractors; ring forceps; Allis clamps; Gelpi retractor; vaginal packing
Antibiotics	May be used for lacerations involving entry into the peritoneal cavity or the rectal mucosa.
Surgical time	10–45 min (possibly longer if exploratory laparotomy is performed)
EBL	Variable. Possible need for transfusion. Areas that persistently ooze after repeated placement of suture may be managed with vaginal packing.
Postop care	PACU ↑ ward
Mortality	Rare
Morbidity	Hemorrhage Hematoma Infection Rectovaginal fistula





Vesicovaginal fistula

Pain score

3

Patient Population Characteristics

Age range	Reproductive age
Incidence	Not uncommon
Etiology	Trauma 2° spontaneous or operative vaginal delivery (98%); other vaginal/pelvic trauma (2%)
Associated conditions	Major blood loss possible; with non-obstetric etiology, the possibility of sexual assault needs to be explored.



Anesthetic Considerations



Preoperative

Vaginal and cervical lacerations may go undetected until considerable blood loss has occurred. Patients should be examined carefully for Sx of hypovolemia with appropriate volume resuscitation prior to anesthesia.

(Print pagebreak 833)

Respiratory

FRC returns to normal almost immediately after delivery.

Tests: As indicated from H&P.

The physiologic changes of pregnancy return to normal at varying intervals after delivery. For example, risk of aortocaval compression disappears immediately. Blood volume returns to pre-pregnant values over several days. Postpartum hemorrhage can occur without warning. Ensure adequate fluid resuscitation prior to induction of GA or regional anesthesia.

Tests: As indicated from H&P.

Postpartum patients continue to be at risk for acid aspiration, although it is not known exactly when normal GI function returns. Precautions for prevention of acid aspiration should be followed as discussed in Cesarean Section, p. 820.

Local anesthetic requirements for spinal anesthesia remain decreased after delivery.

Hct; other tests as indicated from H&P.

Precautions should be taken to ↓ risk of aspiration pneumonitis, as discussed in Cesarean Section, p. 820.

Cardiovascular

Gastrointestinal

Neurological

Laboratory

Premedication



Intraoperative

Anesthetic technique: In many patients, a functioning epidural catheter will be in place, and supplemental doses of anesthetic may be given to provide adequate analgesia for the surgery. If no epidural is placed and the patient is hemodynamically stable, a spinal anesthetic may be satisfactory. Occasionally, GA may be required.

Regional anesthesia:

Epidural

Supplemental doses of local anesthetic (2-chloroprocaine or 1.5–2% lidocaine 10–15 mL) injected incrementally with patient in sitting position (if tolerated) to promote perineal anesthesia. Hyperbaric bupivacaine 0.75% 7.5–10 mg with patient in sitting





Spinal

Combined spinal-epidural (CSE)

General anesthesia:

Induction

Maintenance

Emergence

Blood and fluid requirements

IV: 16–18 ga × 1
NS/LR @ 2–4 mL/kg/h

Monitoring

Complications

Standard monitors (see [p. B-1](#))

Bleeding

Positioning

and pad pressure points
eyes

position, if tolerated. 24–25 ga pencil-point needle (e.g. Sprotte or Whitacre) to ↓ incidence of spinal headache. Anesthesia to T10 is usually adequate. Repair of more extensive lacerations may require a higher level and, consequently, a higher dose of anesthetic.

An alternative technique combining the rapid onset and density of spinal anesthesia with the flexibility of continuous epidural anesthesia (e.g., if necessary to extend the duration or intensity of the block). Apply monitors, administer fluid, and position as for spinal/epidural. The most common technique is the needle-through-needle. When the epidural space is located with a 17-ga Tuohy needle, insert a 26–27 ga pencil-point spinal needle through the Tuohy needle and administer 7.5–10 mg of spinal bupivacaine. Secure the epidural catheter and use if needed. (An epidural test dose is advisable.)

Rapid-sequence induction (see [p. B-4](#)) with STP (4–5 mg/kg) or propofol (2–3 mg/kg) and succinylcholine (1 mg/kg) for ET intubation. If significant blood loss, ketamine 1.5 mg/kg is preferred for induction.

Standard maintenance (see [p. B-2](#)).

Extubation should be delayed until patient is fully awake and protective airway reflexes have returned.

1–1.5 L dextrose-free crystalloid immediately prior to regional anesthesia. Blood loss may be extensive until laceration is repaired.

* **NB:** peroneal nerve compression at lateral fibular head → foot drop.

(Print pagebreak 834)



Postoperative

Complications

Bleeding

Peroneal nerve injury (2° lithotomy position)

Nerve injury manifests as foot drop and loss of sensation over dorsum of foot.

Intraspinal opioids: 10 mcg fentanyl

Pain management

Parenteral opioids: iv or im opioids (e.g., morphine 2–4 mg iv analgesia up to 20 mg, or meperidine 10–20 mg iv q 10–15 min up to 100 mg) instituted in the recovery room.

Tests

Hct

Suggested Readings

1. American College of Obstetricians and Gynecologists: ACOG Educational Bulletin: Postpartum hemorrhage. No 76, 2006 (replaces No 243, 1998 and No 143, 1990). *Obstet Gynecol* 2006;108(4):1039–47.

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Cervical Cerclage-Elective and Emergent

Surgical Considerations

Description: Cervical cerclage is the reinforcement of the cervix to prevent premature cervical dilation in a patient with an incompetent cervix. With cervical incompetence, there is painless dilation of the cervix in the midtrimester of pregnancy. The membranes bulge through the cervix and rupture, followed by delivery of a severely premature infant.

An **elective cerclage** is performed prophylactically before pregnancy or usually after the first trimester of pregnancy on a patient with a Hx of cervical incompetence. If cerclage is performed before pregnancy, it may need to be removed because of spontaneous abortion or fetal anomalies. It generally is performed between 14–16 wk gestation, but may be performed as early as 10 wk gestation. An **emergent (rescue) cerclage** is performed in a patient who presents in the second trimester with painless cervical dilation and/or effacement. Ultrasound is performed before the procedure to confirm viability and to r/o major congenital anomalies. An emergent cerclage should not be performed if there is advanced cervical dilation or any evidence of infection, contractions, or uterine bleeding.

There are two types of cerclage procedures generally performed: the McDonald and the Shirodkar. The **McDonald cerclage** is technically easier, and the one most commonly performed. A purse-string stitch with nonabsorbable monofilament suture is placed high around the cervix near the level of the internal os and tied at the twelve o'clock position. The end of the suture is cut long to facilitate removal. The cerclage is removed electively at term or earlier if there is rupture of membranes, persistent contractions, bleeding, or evidence of infection. The **Shirodkar cerclage** involves incising the cervix transversely, anteriorly, and posteriorly, and advancing the bladder off the cervix. A nonabsorbable monofilament suture is placed submucosally between the incisions, and the mucosa is closed, burying (*Print pagebreak 835*) the stitch. A Shirodkar cerclage may be left for future pregnancies if abdominal delivery is performed. If the cervix cannot be adequately accessed through the vagina, cerclage may be attempted through laparotomy or laparoscopy.

Usual preop diagnosis: Cervical incompetence

Summary of Procedures

Position	Dorsal lithotomy, with use of cane stirrups. Left lateral pelvic tilt (if performed during pregnancy); Trendelenburg
Incision	None with McDonald cerclage; transverse cervical with Shirodkar cerclage
Special instrumentation	Right-angle retractors; monofilament, nonabsorbable stitch
Unique considerations	For emergent cerclage, when prolapsing membranes are present, they may be reduced by filling the bladder and/or possibly removing amniotic fluid transabdominally.
Antibiotics	None recommended.
Surgical time	30 min–1 h (may be longer for Shirodkar cerclage)
EBL	25–50 mL (may be higher with the Shirodkar cerclage)
Postop care	PACU → ward; tocolysis with indomethacin or other agent can be considered.
Mortality	Rare
	Morbidity is increased for emergent cerclage, especially when performed later in 2nd trimester. The McDonald cerclage is





Morbidity

associated with less trauma and bleeding than the Shirodkar cerclage.

Cervical trauma

Rupture of membranes

Chorioamnionitis

Preterm labor

Spontaneous abortion

Pain score

McDonald—2; Shirodkar—3

Patient Population Characteristics

Age range

Reproductive age

Incidence

Not uncommon

Etiology

Cervical trauma from previous vaginal delivery; cervical trauma at time of previous D&C; previous treatment for cervical dysplasia (laser therapy, cryotherapy, loop electrosurgical excision procedure [LEEP]/large loop excision of transitional zone [LLETZ], cone biopsy); congenital anomalies; idiopathic



Anesthetic Considerations



Preoperative

This is a generally fit and healthy patient population. Little will need to be done other than routine tests, unless otherwise indicated. Cerclage is usually performed between 14–24 wk of pregnancy. When performed after 20 wk, relevant physiologic changes are as discussed under Cesarean Section, [p. 819](#). Patient may receive drugs such as β -sympathomimetics (e.g., terbutaline), nifedipine, or indomethacin to decrease uterine irritability.

Laboratory

Hct; other tests as indicated from H&P.

Premedication

None usually. If >18 wks gestation, precautions should be taken to decrease risk of aspiration pneumonitis, as discussed in Cesarean Section, [p. 820](#).

(Print pagebreak 836)



Intraoperative

Anesthetic technique: Drug exposure during the critical period of organogenesis (15–56 d) should be minimized, although no particular anesthetic techniques or agents have proven teratogenic in humans. Through an action on vitamin B₁₂, N₂O inhibits methionine synthase, which is involved in thymidine and methionine synthesis. This may explain why N₂O is teratogenic in rodents. There is no evidence, however, that N₂O is teratogenic when used for cervical cerclage or other operations in humans. Large, retrospective analysis has shown no increase in congenital abnormalities following surgery under anesthesia. Avoid diazepam during the period of organogenesis (may ↑ cleft lip). Ensure adequate uteroplacental perfusion and fetal oxygenation by maintaining normal maternal BP and oxyhemoglobin saturation. Use left uterine displacement after 20 wk gestation. Maternal hyperventilation and IPPV may diminish uteroplacental and umbilical blood flow. Monitoring FHR may permit optimization of fetal well-being by adjustment of anesthetic technique or patient position. Spinal anesthesia is ideal as it minimizes fetal drug exposure and provides good operating conditions. Risk of headache is low with the use of small gauge pencil-point needles (e.g., Spotte, Whitacre). Epidural anesthesia is an appropriate alternative for this procedure. GA may be used if regional anesthesia is contraindicated.

Regional anesthesia:





Spinal

Hyperbaric bupivacaine 7–10 mg ± fentanyl 10–15 mcg. Position patient to obtain T8 block. Monitor BP every min until stable, then every 3–5 min. Treat >20% ↓ in BP or SBP < 95–100 mmHg with additional fluids and ephedrine 5–10 mg iv.

General anesthesia:

Induction

Standard induction (see [p. B-2](#)). If > 18 wk gestation, rapid-sequence induction is indicated (see [p. B-4](#)).

Maintenance

Standard maintenance ([p. B-2](#)). If < 15–18 wk gestation, use of LMA or mask anesthesia with O₂/N₂O/volatile agent/opioid is appropriate. If > 18 wk gestation, ET intubation will be necessary.

Emergence

If > 18 wk gestation, extubate patient when fully awake and protective airway reflexes have returned.

Blood and fluid requirements

Minimal blood loss
IV: 18 ga × 1
NS/LR @ 4 mL/kg/h

1–1.5 L dextrose-free crystalloid immediately prior to regional anesthesia

Monitoring

Standard monitors (see [p. B-1](#))
±FHR monitor

Consider FHR monitoring for viable fetuses and in earlier gestation, as the FHR may indicate inadequate placental perfusion and can guide BP management.

Positioning

Left uterine displacement, if > 20 wk gestation and pad pressure points eyes

Left uterine displacement with a wedge under mattress should be used for pregnant patients.
* **NB:** peroneal nerve compression at lateral fibular head → foot drop.

Postoperative

Complications

Preterm labor

Observe for preterm labor in recovery area.

Maternal dysrhythmias Hypotension

Tocolytic agents β-adrenergic agents) given to inhibit uterine contractions can cause maternal dysrhythmias or ↓ BP.

Peroneal nerve injury

Nerve injury manifests as foot drop and loss of sensation over dorsum of foot.

Pain management

Intraspinal opioids: 10–15 mcg fentanyl
Parenteral opioids: iv or im opioids (e.g., morphine 2–4 mg iv up to 20 mg or meperidine 10–20 mg q 15 min up to 100 mg) instituted in the recovery room.
Oral analgesics: NSAIDs (e.g., ibuprofen), acetaminophen ± codeine (or equivalent oral narcotics), once patient can tolerate oral medication.

Intrathecal fentanyl given with spinal improves intraop analgesia and provides short-period postop analgesia. Risk of delayed respiration depression minimal in healthy patients.

(Print pagebreak 837)

Suggested Readings

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Removal of Retained Placenta



Surgical Considerations

Description: In most deliveries, the placenta is easily removed with gentle cord traction and uterine massage. If, after 30 min, the placenta remains undelivered, **manual removal**, following either parenteral analgesia or GA, must be initiated. NTG (100–200 mcg iv or 0.4 mg sublingually) may induce uterine relaxation during manual removal. A possible alternative to manual removal involves injection of 10 mL of oxytocin (10 U/mL) into the umbilical vein; however, the success of this procedure is unpredictable. A retained placental fragment may cause immediate or late postpartum hemorrhage. An ultrasound evaluation of the uterus may help





in the detection of a retained fragment. If retained products are found, **curettage** is recommended. Frequently, the retained product will already have been flushed out of the uterus by brisk bleeding. In such cases, iv oxytocin, rectal misoprostol, im prostaglandins or methylergonovine may be administered to contract the uterus prior to curettage.

Bleeding from a retained placenta or fragment is frequently brisk, so the anesthesiologist must be ready to administer iv fluids and O₂, and to correct any coagulopathy. Cross-matched blood must be available. Placenta accreta, if extensive, can cause profuse bleeding at delivery, and a hysterectomy is often necessary.

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Oxytocin 20–40 U in 1,000 mL of LR should be administered at a rate sufficient to maintain uterine tone after manual removal of the placenta or after sharp/suction curettage of a retained placental fragment.

Usual preop diagnosis: Retained placenta

Summary of Procedures

Position	Dorsal lithotomy
Incision	None
Special instrumentation	Banjo curette/suction cannula
Unique considerations	IV fluids; use of blood and blood products, as needed; monitoring of VS
Antibiotics	Cefazolin 1 g iv q 8 h; 3 total doses
Surgical time	30 min
EBL	300–900 mL
Postop care	PACU → ward. Monitor for infection and further bleeding.
Mortality	Rare
	Hemorrhage
	Endometritis
Morbidity	Uterine perforation 2° curettage
	Asherman's syndrome
	Transfusion-related morbidity (hepatitis, HIV, transfusion reactions)
Pain score	5

Patient Population Characteristics

Age range	Reproductive age
Incidence	0.25–0.8% of vaginal deliveries
Etiology	Unknown
Associated conditions	Placenta accreta; avulsed cotyledon; succenturiate lobe

Anesthetic Considerations

Preoperative

The degree of urgency associated with these patients may vary dramatically. Some patients may be hemodynamically unstable as a result of continued bleeding in the postpartum period; others may have a retained placenta with minimal bleeding. Patient's volume status should be carefully assessed.

FRC returns to normal almost immediately after delivery.





Respiratory

Cardiovascular

Gastrointestinal

Neurological

Hematologic

Laboratory

Premedication

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Intraoperative

Anesthetic technique: Anesthesia for the removal of a retained placenta may vary from MAC to GA performed as an emergency. In the multiparous patient, MAC may be sufficient to enable the obstetrician to empty the uterus. If better analgesia and additional uterine relaxation are needed, however, then GA may be required. The incidence of retained placenta is about 1%. If intravascular volume has been restored and an existing epidural catheter is in place, the block can be extended to provide adequate anesthesia. Initiating spinal anesthesia is also an option if intravascular volume status is adequate, there is no active bleeding, and uterine relaxation is not required. Small doses of opioids and midazolam sometimes provide sufficient analgesia and sedation to allow removal of a retained placenta without compromising maternal safety. If this proves inadequate or hemorrhage is severe, however, GA with ET intubation is required. Anecdotal experience indicates that NTG in 100–200 mcg iv boluses or sublingual NTG 400 mcg provides uterine relaxation and delivery of a retained placenta in normovolemic patients receiving iv analgesia.

Regional anesthesia:

Spinal

Epidural

MAC

General anesthesia:

Tests: As indicated from H&P.

Restore intravascular volume prior to institution of analgesia or anesthesia. Extension of existing lumbar epidural blockade may aggravate hypovolemia and should proceed with caution. Consider possibility of placenta accreta (placental villi are attached to myometrium).

Postpartum patients continue to be at risk for acid aspiration, although it is not known exactly when normal GI function returns. Precautions for prevention of acid aspiration should be followed as discussed in Cesarean Section, p. 820.

Local anesthetic requirements for neuraxial anesthesia remain decreased after delivery.

Coagulopathy can develop with retained placenta if bleeding is severe and persistent.

Tests: Hct, PT, PTT, Plt, FSP, as indicated.

Other tests as indicated from H&P. T&C for 2 U+ if time permits.

Emergency transfusion with Type O(-) or type-specific blood may be necessary.

Precaution should be taken to decrease risk of aspiration, as discussed in Cesarean Section, p. 820.

For technique and monitoring of spinal anesthesia, see [Cesarean Section, p. 822](#). Hyperbaric bupivacaine 8–10 mg; adjust the position of operating table to obtain T8 level of anesthesia.

For technique and monitoring, see [Cesarean Section, p. 822](#).

Administer increments of 3% 2-chloroprocaine or 2% lidocaine with 1:200,000 epinephrine and bicarbonate until block level adequate. Additional local anesthetic as needed to ensure adequate level of anesthesia.

Titrate small doses of opioids (e.g., fentanyl 25–50 mcg) and midazolam 0.5–1.0 mg or ketamine 0.1 mg/kg. Sedation and analgesia should be titrated carefully, due to the potential risk of pulmonary aspiration in the parturient with an unprotected airway. Ensure patient is awake and responsive throughout. Consider NTG 100–200 mcg iv for uterine relaxation, repeated as necessary to obtain the desired effect. Transient ↓ BP may follow vasodilation due to NTG, and should be treated with volume and pressors if necessary.

Preoxygenation, rapid-sequence induction with cricoid pressure





Induction

Maintenance

Emergence

Blood and fluid requirements

Anticipate large blood loss
IV: 16–18 ga \times 1–2
NS/LR @ 6–8 mL/kg/h

Monitoring

Standard monitors (see [p. B-1](#))

Complications

Bleeding

Positioning

and pad pressure points
eyes

(see [p. B-4](#)), and hydration, as discussed in Cesarean Section ([p. 823](#)). Ketamine (1 mg/kg) is preferred for induction of hypotensive patient; but, in larger doses (> 1.5 mg/kg), it theoretically may increase uterine tone and make removal of placenta more difficult. Anesthesia with N_2O/O_2 + opioid (but no volatile agent) often permits delivery of the placenta.

If uterine relaxation is necessary, administer volatile agent (> 1 MAC) or NTG (see above) until uterine tone decreases.

Extubation should be delayed until patient is fully awake and protective airway reflexes have returned.

Infuse crystalloid solution (1–1.5L) to maintain BP prior to regional anesthesia. Treat \downarrow BP with fluids and ephedrine, and by decreasing concentration of volatile agent. Surgery is usually brief; additional muscle relaxation not usually necessary.

Uterine atony: Rectal misoprostol, concentrated oxytocin infusion, 277–1667 mU/min. (50–300 U in 500 mL 1/2 normal saline over 3 h), uterine massage, \pm methylergonovine 0.2 mg im (may $\rightarrow \uparrow$ BP), or $PGF_{2\alpha}$ (Hemabate) 250 mcg iv/im/intrauterine (may \rightarrow cardiovascular collapse/bronchospasm).

***NB:** peroneal nerve compression at lateral fibular head \rightarrow foot drop.

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Postoperative

Complications

Peroneal nerve injury (2° lithotomy position)
Bleeding

Nerve injury manifested as foot drop and loss of sensation over dorsum of foot.
See uterine atony, above.

Pain management

IV or im opioids, titrated to effect, as usual, instituted in recovery room.

Tests

Hct

Suggested Readings

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Management of Uterine Inversion



Surgical Considerations

Description: Uterine inversion is associated with fundal implantation of the placenta whereby a thinning of the uterine wall, together with placental separation, causes an invagination of the myometrium, resulting in inversion. Vigorous fundal pressure or cord traction also can contribute to uterine inversion, which can be complete or (*Print pagebreak 841*) incomplete. **Complete inversion** results in the inverted fundus extending beyond the cervix and appearing at the vaginal introitus, whereas in an **incompletely inverted uterus**, the fundus does not extend beyond the external cervical os. Uterine inversion can cause hemorrhage and shock out of proportion to observed bleeding, and must be managed as an obstetrical emergency. An anesthesiologist must be called to the delivery room as soon as a diagnosis of uterine inversion is made. The ready availability of GA is paramount. IV access with two infusion systems and appropriate fluid resuscitation must be initiated emergently. Blood and blood products should be available for administration as indicated.

Frequently, **uterine replacement** can be accomplished with iv tocolytics, such as terbutaline, MgSO₄, and, more recently, NTG; however, GA with a volatile agent may be necessary. Three primary methods for uterine replacement are the Johnson, Huntington and Haultain procedures. Normally, the **Johnson method** is attempted first. Persistent pressure applied to the fundus is used to elevate the uterus into the vagina. The placenta, if attached, is not removed until iv resuscitation has been initiated, and iv tocolytics (or anesthesia) have been administered. Oxytocin is given when the uterus has been replaced. Laparotomy must be performed if uterine replacement with the Johnson method is unsuccessful. The **Huntington procedure** involves grasping the round ligaments and applying upward traction on them, while an assistant exerts upward pressure on the uterus via a hand in the vagina. If the inverted uterus is trapped below the cervical ring, the **Haultain procedure** is used. This procedure involves making a longitudinal fundal incision posteriorly to allow easier reinversion of the fundus. Hydrostatic and laparoscopic reduction of uterine inversion have also been described.

Usual preop diagnosis: Uterine inversion





Summary of Procedures

	Manual Reversion	Huntington/Haultain
Position	Dorsal lithotomy	Supine
Incision	None	Pfannenstiel's or midline longitudinal
Unique considerations	Prompt O ₂ and iv fluid resuscitation; use of blood and blood products as necessary.	
Antibiotics	Cefazolin 1 g iv q 8 h; total 3 doses	
Surgical time	30 min	1–2 h
EBL	150–4,000 mL	
Postop care	±ICU. ARDS may necessitate mechanical ventilation. Monitor for acute renal failure 2° hypoxia and hypovolemia.	
Mortality	Rare	
Morbidity	Febrile morbidity Clinical shock Infectious morbidity from blood transfusion	
Pain score	5	7

Patient Population Characteristics

Age range	Reproductive age
Incidence	1/2,000–6,000 deliveries
Etiology	Unknown
Associated conditions	Fundal implantation of the placenta; primiparity; intrapartum oxytocin; placenta accreta; therapy of preeclampsia with MgSO ₄ macrosomic fetus

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Anesthetic Considerations

Preoperative

These patients often present in shock out of proportion to blood loss; and immediate resuscitation may be necessary. Since patient condition will improve as soon as the uterus is replaced, however, surgical treatment should not be delayed.

Respiratory

FRC returns to normal almost immediately after delivery.

Tests: As indicated from H&P.

Cardiovascular

Massive hemorrhage and pain usual with complete inversion. Prior to induction, insert large-bore iv and rapidly infuse fluids, including colloid, to treat ↓ BP. Blood transfusion may be necessary, although is seldom available until after surgery.

Gastrointestinal

Postpartum patients continue to be at risk for acid aspiration, although it is not known exactly when normal GI function returns. Precautions for prevention of acid aspiration should be followed as discussed in Cesarean Section, p. 820.

Neurological

Local anesthetic requirements for neuraxial anesthesia remain decreased after delivery.





Laboratory

Hct; Plt; other tests as indicated from H&P. T&C for 2 U; keep 2 U ahead.

Premedication

Na citrate 30 mL po within 30 min of induction. If time permits, other agents to decrease risk of aspiration pneumonitis, as discussed in Cesarean Section, p. 820.

Intraoperative

Anesthetic technique: Attempted uterine replacement and induction of anesthesia should not await intravascular volume replacement. Bleeding usually stops when uterus is replaced. IV NTG (50–200 mcg) is very effective in providing uterine relaxation to facilitate replacement, and can be given immediately in the patient's room. Other tocolytics, such as terbutaline or Mg^{++} , also may help. **Do not give oxytocin before uterine replacement.** Sometimes, however, GETA is required, often with increasing concentrations of volatile agents to facilitate uterine replacement. If regional anesthesia (e.g., epidural or spinal) was used for delivery, replacement of uterus may be accomplished with little further anesthetic intervention, with or without NTG. If regional anesthesia was not used for delivery, iv analgesia with small doses of fentanyl (25–50 mcg iv) occasionally allows reduction.

Induction

Rapid-sequence induction (see [p. B-4](#)) with ketamine (1.0 mg/kg) preferred. Higher dose may adversely increase uterine tone.

Maintenance

Halothane, isoflurane and sevoflurane are all effective uterine relaxants, but sevoflurane is most rapidly eliminated. ↓ BP should be treated with fluids + vasopressors.

Emergence

Extubation should be delayed until patient is fully awake and protective airway reflexes have returned.

Blood and fluid requirements

Significant blood loss
IV: 16–18 ga × 1 or 2

Possible continued blood loss after reduction of uterus due to uterine atony.

Monitoring

Standard monitors (see [p. B-1](#))

Arterial line may be useful, if time allows.

Positioning

and pad pressure points
eyes

Complications

Uterine atony
Massive blood loss

Rx: ↓ volatile anesthetic concentrations. Oxytocin infusion, uterine massage, ±methylergonovine 0.2 mg im (may ↑ BP), PGF_{2α} (Hemabate) 250 mcg iv/im/intrauterine (may → cardiovascular collapse/bronchospasm)

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Postoperative

Complications

Bleeding

Pain management

Parenteral opioids, titrated to effect, as usual, instituted in recovery room.

Tests

Hct

Suggested Readings

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