

# Gynecological Trauma and Emergencies

### Introduction

The current active duty population consists of 16% women (approximately 202,849 women were documented in 2016; DoD has a goal to achieve 25% of the force female by 2025), many of whom are subject to the same risks of combat injury as their male colleagues, especially now that all combatant roles have been opened to females. This chapter deals with OB/GYN emergencies that may present to a deployed medical treatment facility, particularly in military operations other than war. In a civilian epidemiologic study of childbearing-age women undergoing hospitalization for injuries, 4.6% of these women were identified as being pregnant (many were previously unrecognized). Up to 6% to 7% of pregnancies are complicated by trauma, and nearly 50% of maternal deaths are related to trauma.

### Gynecological Trauma

#### Vulva

- Vulvar injuries include lacerations and hematomas.
  - **Lacerations** that are superficial, clean, and less than 6 hours old can be primarily closed with absorbable suture. Debridement of obviously devitalized tissue is recommended.
    - ◆ Deep lacerations should be examined and explored to rule out urethral, anal, rectal mucosa, or periclitral injuries.
    - ◆ Placing a urethral catheter will assist in determining urethral injury, and can protect the urethra during repair of nearby injuries. If urethral injuries are identified, single-layer closure with fine (4-0 or smaller), absorbable

sutures, leaving the catheter in place, is recommended. Rectal and periclitoreal injuries are closed in a similar fashion.

- ◆ Anal lacerations should be repaired by approximating the cut ends of the anal sphincter with size 0 or 1 absorbable suture. Consideration for diversion of fecal stream should be included in the setting of anorectal injury.
- ◆ Antibiotics (second-generation cephalosporin) are recommended with contaminated wounds.
- Vulvar trauma may cause **infrascial** (below the pelvic diaphragm) **hematoma**.
  - Because the deeper layer of subcutaneous vulvar fascia is not attached anteriorly to the pubic rami, hematoma can spread freely into the anterior abdominal wall.
  - **Most vulvar hematomas are treated conservatively.**
  - **External compression** and ice packs should be applied until hemostasis is ensured by serial examination of the vulva, vagina, and rectum.
  - Hematoma may preclude adequate urination, and an indwelling catheter may need to be placed.
  - Large hematomas may need to be incised and bleeding vessels ligated (usually venous) to avoid skin necrosis.
  - **Signs of shock in association with a decreasing hematocrit should prompt consideration of an extraperitoneal expansion.** Ultrasound or CT is useful for detecting extraperitoneal expansion not diagnosed by clinical exam.

## **Vagina**

- Trauma to the vagina can cause **lacerations**, and less commonly, suprafascial (above the pelvic diaphragm) **hematoma**.
- Vaginal trauma has been reported in **approximately 3.5% of women with traumatic pelvic fractures. Concomitant urological trauma, most often involving the bladder and/or urethra, has been described in about 30% of patients with vaginal trauma.**
- Thorough inspection and palpation of the vagina and rectovaginal exam are necessary to detect vaginal trauma and to determine the need for further urological evaluation/imaging. **Due to pelvic instability (in fracture cases) or pain, examination under sedation or anesthesia may be necessary.**

- Patients with vaginal lacerations typically present with bleeding, sometimes profusely, from the well-vascularized vagina.
- Lacerations are repaired using the guidelines given previously for vulvar lacerations. Larger suture and needles such as 2-0 absorbable suture on a CT or CT-1 with locking stitches can be beneficial.
- A vaginal hematoma is usually accompanied by severe rectal pressure and is diagnosed by palpation of a firm, tender mass bulging into the lateral vagina. **Vaginal hematomas should be treated by incision, evacuation, ligation, and packing.** A urinary catheter should be used while a vaginal pack is left in place during prolonged periods of observation.
- Unrecognized vaginal trauma can result in dyspareunia, pelvic abscess, and fistula formation.

### **Uterus/Cervix**

- Trauma to the uterus and cervix is most commonly found in association with pregnancy, but may be seen as a result of penetrating vaginal or abdominal trauma.
- Non-infected simple cervical lacerations should be repaired to optimize restoration of normal anatomy (and possibly decrease the risk of cervical incompetence or stenosis with dysmenorrhea from poor healing). Absorbable size 2-0 or 0 grade suture can be used.
- Acute penetrating trauma involving the uterine fundus usually causes little bleeding and can be managed expectantly without repair. Damage to the uterine wall with bleeding can be repaired with size 0 absorbable suture.
- **Trauma involving the lateral wall of the uterus may cause significant bleeding,** but can usually be controlled by successive ligation of the ascending and descending branches of the uterine artery, as described in the obstetrical section Uterine Atony.

**Hemorrhage not responding to ligation, or extensive mutilating damage to the cervix or uterus, should be treated by hysterectomy.**

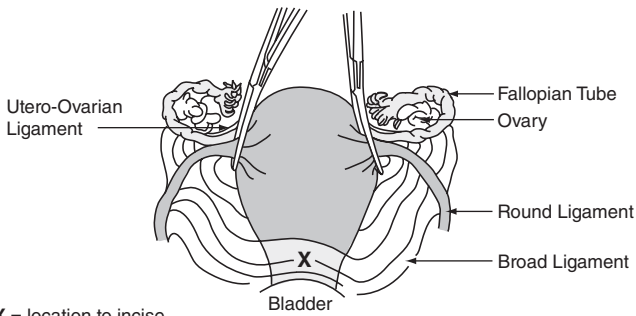
- Prophylactic antibiotics should be given if proceeding to hysterectomy (first-generation cephalosporin).

## Basic Steps for Performing an Emergent Total Abdominal Hysterectomy

- Ligate/cauterize round ligaments (Fig. 19-1).
- Incise anterior leaves of broad ligaments bilaterally, then continue across the midline to incise the vesicouterine fold.
- Mobilize bladder downward by blunt dissection (and sharp dissection if necessary) from the lower uterine segment and cervix.\*
- To **retain** adnexa, clamp/cut/ligate utero-ovarian ligaments and fallopian tubes near their connections to the uterine fundus (Fig. 19-2).
- **Adnexa should be retained unless there is an indication for removal.**
- To **remove** adnexa with the uterus, clamp/cut/ligate infundibulopelvic ligaments after making windows in the posterior leaves of the broad ligaments above the ureters.
- Incise posterior peritoneum to mobilize adnexa either away from (if being retained) or toward (if being removed) the uterus.
- Incise peritoneum overlying rectovaginal space, then mobilize rectum downward and away from the posterior vagina by blunt dissection (Fig. 19-3).\*
- Clamp/cut/ligate uterine arteries along the lateral surface of the uterus at the uterocervical junction, staying close to (within 1 cm of) the uterus to avoid damaging ureters.
- Clamp/cut/ligate the remainder of the cardinal ligaments, paracervical tissue, and uterosacral ligaments by taking successive inferior bites until the cervicovaginal junction is reached; each bite should be placed medial to the previous bite to avoid injuring the ureter and bladder.
- Cross-clamp the vagina below the cervix.
- Transect vagina, removing uterus (and attached adnexa, if applicable).
- Suture vaginal cuff closed, ensuring that the bladder and/or rectum are not incorporated.

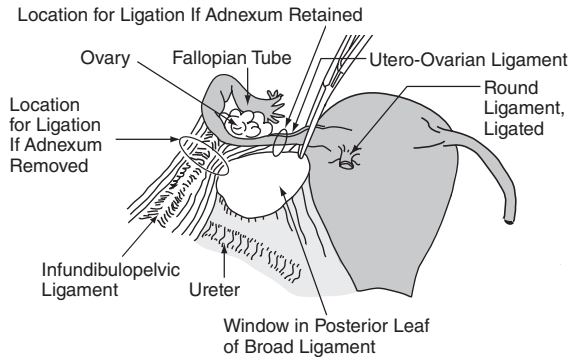
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\*In case of dense adhesions between the cervix and bladder or rectum in an emergent setting, or ongoing hemorrhage with poor visualization, supracervical hysterectomy can be performed. After mobilizing the bladder and rectum from the uterus and ligating uterine arteries, the uterine fundus is transected from the cervix with a knife. The cervix is then oversewn with a baseball stitch, staying medial to the ligated uterine arteries.

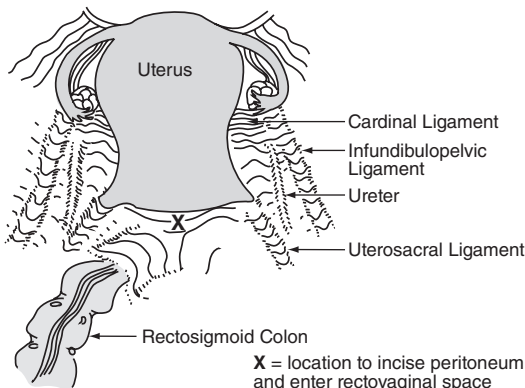


X = location to incise peritoneum and enter vesicocervical uterine space

**Fig. 19-1.** Abdominal hysterectomy—anterior view.



**Fig. 19-2.** Abdominal hysterectomy—adnexal view.



X = location to incise peritoneum and enter rectovaginal space

**Fig. 19-3.** Abdominal hysterectomy—posterior view.

## **Adnexa**

### ● **Fallopian tubes.**

- Damage to the wall of the fallopian tube by ruptured ectopic pregnancy or penetrating abdominal trauma should be treated by salpingectomy, if there is significant damage to the tube, due to the risk of subsequent or recurrent ectopic pregnancy if left in situ. If the damage is equivalent to a linear salpingotomy, achieve hemostasis, then allow healing by secondary intention.
- The mesosalpinx is ligated or cauterized, then the tube is ligated and cut at its connection with the uterine fundus.
- Unruptured ampullary/isthmic ectopic pregnancy can be treated by linear salpingotomy, with extraction of the ectopic gestation. The tubal incision is left open to heal by secondary intention.
- An unruptured or ruptured cornual/interstitial ectopic pregnancy requires wedge resection of the uterine cornu with salpingectomy.
- An ectopic pregnancy spontaneously aborted into the abdominal cavity through the end of the tube should be removed, but the tube may be left in situ if hemostasis is attained.

### ● **Ovaries**

- A **ruptured ovarian cyst** should be treated via cystectomy by shelling the cyst wall out of the ovary, then cauterizing or ligating any bleeding vessels, usually at the base of the cyst.
- **Torsion of an ovarian mass** is first treated by assessing the ovary. Untwist the ovary and/or fallopian tube. If it appears healthy, with some continuing blood supply, it can be left in situ. If the ovary contains a large (>4 cm), simple-appearing cyst, the cyst can be drained and the cyst wall removed. Interrupted sutures using a fine monofilament or electrocautery can be used to obtain hemostasis. If the ovary appears dark and dusky after untwisting and observation, perform a salpingo-oophorectomy by ligating the infundibulopelvic ligament first (after identifying the ureter), then the utero-ovarian ligament and fallopian tube.

- Hemorrhage from an infundibulopelvic ligament, as a result of penetrating abdominal trauma, is best treated by ligation with salpingo-oophorectomy.

### **Retroperitoneal Hematoma**

- **Laceration of an arterial branch of the hypogastric artery can cause a retroperitoneal hematoma.**
- A large amount of blood may collect in the broad ligament with few symptoms. Dissection of the hematoma can extend up to the level of the renal vessels. The hematoma may be discovered during emergency surgery for trauma or during reoperation or post-pelvic surgery, or suspected by signs of shock suggesting internal bleeding.
- Retroperitoneal hematoma can be treated by hypogastric artery ligation on the affected side. **Bilateral hypogastric artery ligation may be necessary for hemostasis.** The uterus, tubes, and ovaries may be left in situ if viable and without other indication for removal.

### **Gynecological/Obstetrical Emergencies**

- **Acute vaginal hemorrhage unrelated to trauma.**
  - **Bright red vaginal bleeding filling more than one large perineal pad per hour is considered vaginal hemorrhage.** Obstetric hemorrhage is quantified by an estimated blood loss (EBL) of 1,000 mL or when the patient demonstrates signs or symptoms of hypovolemia regardless of EBL volume. A pregnancy test and pelvic exam direct initial therapy.
    - ◆ **If the patient is not pregnant, a hemorrhaging mass in the vagina is most likely cervical cancer.** The vagina should be packed to tamponade the bleeding after placing a urethral catheter. Placing sutures is generally futile and may make the bleeding worse.
    - ◆ **If a premenopausal non-pregnant female** has a normal vaginal/pelvic exam, hormonal management with 25 mg IV conjugated estrogen (Premarin) or 50 mg estrogen-containing oral birth control pills should be given every 6 hours. Anovulation is one of the most common causes of bleeding in this population.

- ◇ If bleeding responds to hormonal management, oral birth control pills should be continued 4 times per day for 5–7 days, while more definitive diagnosis and management plans are made.
- ◇ If bleeding has not decreased significantly within 24 hours or the patient becomes unstable secondary to profuse or prolonged bleeding, proceeding with dilatation and curettage is reasonable. Imaging studies and possibly coagulation studies will be needed to help direct further therapy.
- ◆ **In the pregnant patient**, heavy bleeding from the cervix with uterine size <20 weeks (fundus at or below the level of patient's umbilicus) suggests spontaneous abortion. Dilatation and suction curettage should be performed.
  - ◇ Ectopic pregnancy uncommonly presents with acute hemorrhage, but should be considered if the patient has an acute abdomen or if scant tissue is obtained on curettage.
- ◆ **In the pregnant patient** with uterine size consistent with a third trimester gestation (>4 cm above the umbilicus in a singleton pregnancy), vaginal hemorrhage is usually an indication of placental abruption or placenta previa.
  - ◇ Emergent cesarean section will be necessary if the uterine hemorrhage does not spontaneously resolve within several minutes.
  - ◇ After delivery of the fetus and placenta, persistent hemorrhage unresponsive to more conservative measures may require hysterectomy (see Emergency Cesarean Section and Uterine Atony).
  - ◇ Pregnant patients with acute vaginal hemorrhage who have Rh– blood type, or if their Rh status is unknown, should be given RhoGAM 300 mg IM. Additional doses may be needed if there is a positive Keihauer-Betke (KB; fetal bleed screen) test or concern for significant feto-maternal hemorrhage.

## Precipitous Vaginal Delivery

### ● Preparation.

- Supplies needed for the delivery include povidone-iodine sponges, a 10-mL syringe, lidocaine, two Kelly clamps, ring forceps, dry towels, a bulb syringe, and scissors.
- The mother should be placed on her left side for labor.
- The fetal heart rate should be determined every 15 minutes prior to pushing and following each contraction during the pushing phase using a vascular Doppler. **Normal fetal heart rate is between 110 and 160 beats per minute.** The heart rate often drops with the contraction, but should recover to normal prior to the next contraction.

**If the fetal heart rate drops below 100 and stays low for more than 2 minutes, a cesarean section should be considered.**

- When the patient presents, the cervix should be examined to determine dilation and fetal position. Before the woman begins pushing, the cervix should be completely dilated (10 cm), and no cervix should be felt on either side of the fetal head. If the baby's head is not presenting (ie, foot or fetal buttocks palpated), move to cesarean section immediately. If there is any question, and ultrasound is available, it should be used to determine the presentation.
- ### ● Delivery.
- Once the patient begins pushing, flex the hips to optimally open the pelvis. The patient may be on her back or tilted slightly to the left. Assistants should support the legs during pushing and relax them between contractions.
  - Clean the perineum with sterile Betadine solution. If this is the patient's first delivery, the perineum may be anesthetized with lidocaine in case an episiotomy is needed. There is no evidence to support prophylactic episiotomy.
  - The fetal head delivers by extension. Pushing upward on the fetal chin through the perineum can assist this process. Additionally, it is extremely important to control the rate of delivery of the head with the opposite hand.

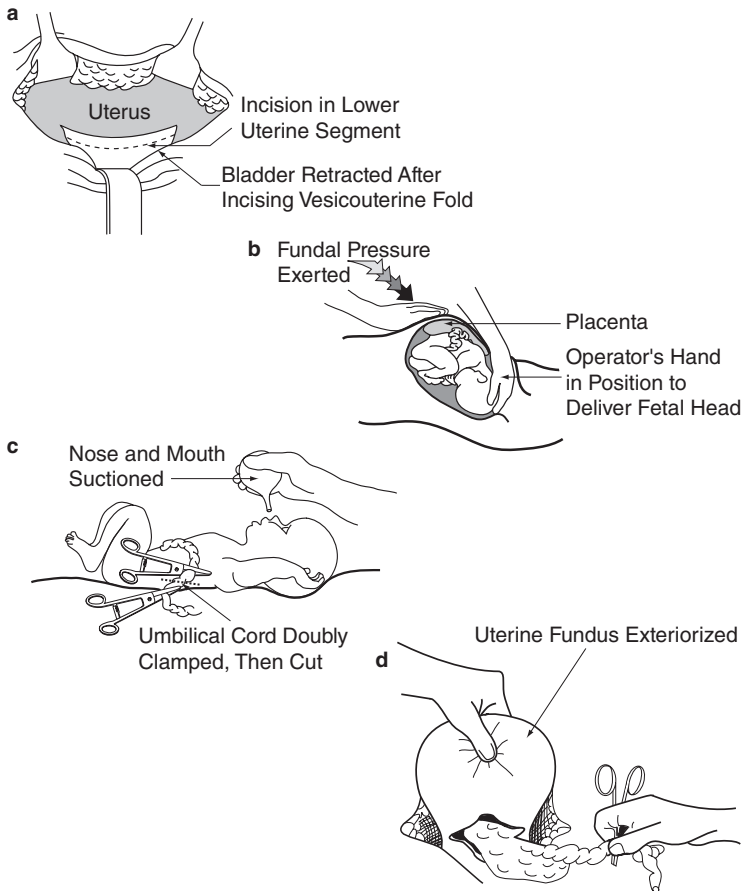
- If an episiotomy is needed (in the event of a difficult delivery such as a shoulder dystocia), the incision begins at the posterior midline at the vaginal opening and extends half the length of the perineum and about 2–3 cm into the vagina. A mediolateral episiotomy may be considered in lieu of a midline incision to reduce the risk of anal sphincter and rectal injury. The mediolateral episiotomy is directed approximately 45–60 degrees away from the midline toward the ischial tuberosity.
- After delivery of the head, the mouth and nose may be suctioned and the neck palpated for evidence of a nuchal cord. If present, the cord can be reduced by looping it over the fetal head or by clamping twice and cutting between the clamps.
- Next, the operator's hands are placed along the parietal bones, and the patient is asked to push again to allow delivery of the anterior shoulder. Gentle downward traction should allow the anterior shoulder to clear the pubis, and the fetus should be directed anteriorly to allow delivery of the posterior shoulder. The remainder of the body will normally follow rapidly.
- Wrap infant in dry towels.
- Once the fetus delivers, the cord should be doubly clamped and cut. The placenta usually delivers within 15 minutes of delivery, but may take up to 60 minutes. Delivery of the placenta is heralded by uterine fundal elevation, lengthening of the cord, and a gush of blood. While waiting, gentle traction may be placed on the cord; however, vigorous uterine massage and excessive traction can lead to complications including cord avulsion which can require manual extraction of the placenta.
- Following delivery of the placenta, the patient should be started on an infusion of lactated Ringer solution with 20 units of oxytocin (Pitocin). Oxytocin can also be given 10 units IM if there is no IV access. If no oxytocin is available, alternatives include administering misoprostol (Cytotec) 800–1000 µg PR or 400 µg sublingual (can also be given orally, but there are more side effects with PO administration); methylergonovine maleate (Methergine)

0.2 mg IM; or allowing the patient to breastfeed the infant. Methergine should be avoided in mothers with hypertension > 140/90.

- **The placenta should be inspected for evidence of fragmentation that can indicate retained products of conception.**
- **If the placenta does not deliver spontaneously within 20-30 minutes, it should be manually removed.** Manual extraction is best accomplished by using one hand on the abdomen to push the uterine fundus down, and inserting the second hand into the uterus to grasp the placenta and extract it. It may be necessary to create a plane between the placenta and the uterine wall to aid the separation.
- **Inspection and repair.**
  - Following delivery of the placenta, the vagina and cervix should be inspected for lacerations. Downward digital pressure on the posterior vagina and fundal pressure (by an assistant, if available) will facilitate visualization of the cervix. A ring forceps is then used to grasp and visualize the entire cervix.
  - The vagina should be inspected, with special attention to the posterior fornix. The perineum and periurethral areas should also be inspected. Vaginal and cervical lacerations may be repaired with 3-0 Vicryl or an equivalent suture in running or interrupted layers.
  - If the anal sphincter is lacerated, it should be reapproximated with 0 to 2-0 absorbable interrupted single or figure-of-eight sutures.
  - If the tear involves the rectum, the rectal-vaginal septum should be repaired with interrupted sutures of 3-0 Vicryl. A second layer imbricating the underlying tissue will decrease the risk of breakdown. Care should be taken to preserve aseptic technique. If a large tear is noted, a saddle block or spinal anesthetic may be necessary and repair performed in the operating room to facilitate exposure.
  - Patients with a periurethral tear may require urethral catheterization. In addition to lacerations, hematoma in the vulva, vagina, or retroperitoneum may occur. See *Gynecological Trauma* for management.

## Emergency Cesarean Section

- Indications.
  - Fetal heart rate drops below 100 and stays down for more than 2 minutes.
  - Acute uterine hemorrhage persisting for more than a few minutes (suggestive of placental abruption or previa).
  - Breech (complete or incomplete) or transverse fetal lie.
- The patient should be placed in the left tilt position with an IV bag or towel displacing the uterus to the left. She should undergo a quick prep from just below the breasts to the midhigh. A major abdominal equipment set should have most of the instruments you will need.
- **Basic steps to performing an emergency C-section** (Fig. 19-4).
  - Direct the anesthetist to administer 2 g cefazolin (Ancef).
  - Enter the abdomen through the lower midline vertical or transverse pfannenstiel incision.
  - Identify the bladder and retract out of the field with a bladder blade. An optional maneuver to create a bladder flap is performed by incising the peritoneal reflection of the bladder transversely and creating a bladder flap to retract the bladder out of the field.
  - Using a scalpel, carefully incise the uterus transversely across the lower uterine segment (where the uterine wall thins above the bladder reflection or bladder flap).
  - Once the amniotic membranes are visible or opened, extend the incision laterally, either bluntly by pulling, or by **carefully** using bandage scissors. **Avoid the uterine vessels laterally.** If necessary, the incision can be extended at one or both of its lateral margins in a J-fashion by vertical incision.
  - Elevate the presenting fetal part into the incision, with an assistant providing fundal pressure.
  - Upon delivery of the fetus, suction the nose and mouth and clamp and cut the cord. Hand the infant off for care.
  - Allow the placenta to deliver by providing gentle traction on the cord and performing uterine massage.
  - Begin oxytocin, if available, as previously described.
  - Using a sponge, clean the inside of the uterus.
  - Vigorously massage the fundus to help the uterus contract.



**Fig. 19-4.** Emergency C-section. (a) Uterine incision. (b) Delivery of fetus. (c) Delivered infant on abdomen. (d) Uterine fundus exteriorized.

- Quickly close the incision with 0 VICRYL. A single layer (running, locking) is adequate, if hemostatic, for transverse incisions. Take care to avoid the lateral vessels. If the incision has a vertical extension, close it in two or three layers. A second layer can be used if hemostasis is not adequate with one layer.
- Once hemostasis is ensured, close the fascia and abdomen in the usual fashion.

- In the rare case of continued uterine hemorrhage, evaluate and treat as outlined in Uterine Atony.

### **Postpartum Hemorrhage – Uterine Atony**

- The majority of postpartum hemorrhage is secondary to uterine atony (failure of uterine contracture).

**When the uterus fails to contract following delivery of the placenta, bleeding may be torrential and fatal.**

- Initial management should include manual uterine exploration for retained placenta. Without anesthesia, this procedure is painful. An opened sponge is placed around the examiner's fingers. Place the opposite hand on the patient's uterine fundus and apply downward pressure. Gently guide your fingers through the open cervix and palpate for retained placenta. The inside of the uterus should feel smooth, and the retained placenta will feel like a soft mass of tissue. This may be removed manually or by using a large banjo curette if available.
- If no tissue is encountered, use both hands to apply vigorous uterine massage/compression to improve the uterine tone.
- Medications should also be used if available. Oxytocin may be given by IV bolus using 20–40 units in 1,000 mL, or up to 10 units IM, but never by IV push. Although unlikely to be available, other medications that can be considered are methylergonovine maleate (Methergine), dinoprostone (Prostin), and misoprostol (Cytotec).
- Tranexamic acid (TXA) may also be used for the treatment of postpartum hemorrhage, and is likely more readily available in an operational setting. Additionally, TXA will treat all causes of postpartum bleeding regardless of the source (eg, atony, laceration, or retained placenta). The dosing is TXA 1 vial consisting of 1,000 mg/10 mL, which is added to 100 mL normal saline and then administered IV over 10 minutes (pump set to 600 mL/h); it may also be administered via slow IV push over 10 minutes. A second repeat dose of TXA can be repeated in 30 minutes if bleeding has not resolved, or if the bleeding stops but restarts within 24 hours of delivery. The only major contraindication to TXA use is presence of venous thromboembolism (PE or DVT).

- If no medication is available, the patient should be encouraged to breastfeed the infant or to perform nipple stimulation to increase endogenous oxytocin release.
- A uterine tamponade device called the Bakri balloon is available commercially but less likely found in an operational setting. Uterine packing and other uterine tamponade options (compression) may be considered to reduce bleeding but should not delay proceeding to laparotomy in the event of an unresolved class 2 (1,000 mL EBL) or class 3 hemorrhage (1,500 mL EBL).
- Massive transfusion protocol should be initiated for an obstetrical patient when estimated blood loss reaches 1,500 mL or if the patient displays signs or symptoms of hypovolemia.

**If conservative measures fail to arrest the postpartum hemorrhage, laparotomy (if the hemorrhage is occurring postvaginal delivery) should be performed.**

- While initiating laparotomy, direct the anesthesia provider to infuse 2 g Cefazolin (Ancef) for infection prophylaxis.
- Once abdominal entry is completed, intraoperative massage of the uterine fundus may be attempted. Intramyometrial injection of Methergine can be considered (0.20 mg IM).
- **If the massage fails to improve uterine tone, the uterine arteries should be ligated in a stepwise fashion (O'Leary sutures).** Begin with the ascending branch at the junction of the upper and lower uterine segment. Using 0 or no. 1 chromic, place a stitch through the myometrium medial to the artery from front to back. The stitch is then brought out through the adjacent broad ligament and tied. If bilateral ligation of the ascending branch does not control bleeding, the descending branch should be ligated at the level of the uterosacral ligament.
- **Uterine tourniquets** using penrose drains or urinary catheters may be placed around the lower uterine segment, which can help reduce acute blood loss as a temporizing measure.
- Consider **uterine compression sutures** such as **B-Lynch sutures** or **Hayman uterine compression sutures** (Figs. 19-5 and 19-6). Compression sutures are performed using a large Mayo needle with no. 1 or 2 chromic catgut/absorbable suture.

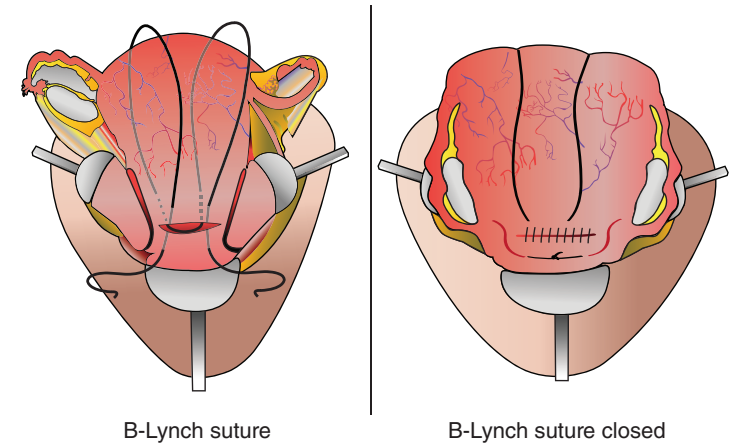


Fig. 19-5. B-Lynch compression sutures.

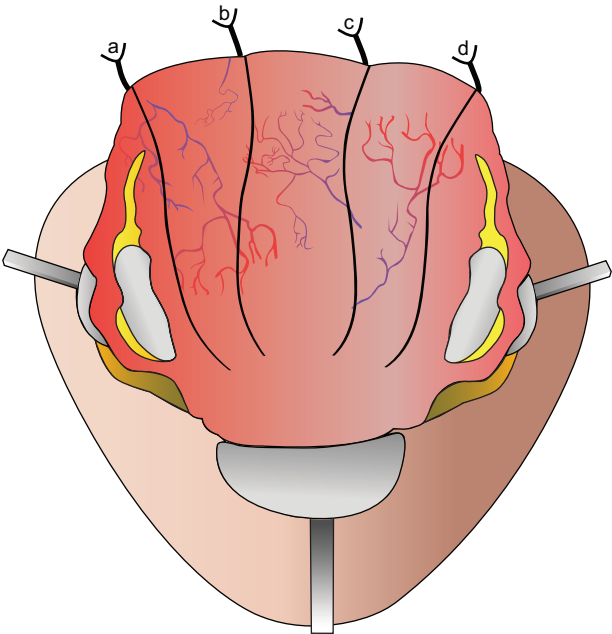


Fig. 19-6. Hayman compression sutures.

- **Bilateral hypogastric artery ligation** should be considered only by surgeons experienced with this procedure. An enlarged, gravid uterus makes visualization and access challenging. **Consider proceeding to hysterectomy** as outlined in the gynecological portion of this chapter.
- **Manual aortic compression** can be considered for temporary control during the threat of severe hemorrhage and is performed via compression of the aorta against the vertebrae several centimeters superior to the sacral promontory or below the renal arteries. However, evidence of safe use of intraaortic balloon catheters in this population is limited to a few case reports.
- **The Pressure Pelvic Pack** (Fig. 19-7) can be used post-hysterectomy in the rare case of continued bleeding despite hysterectomy. A sterile bag (eg, an x-ray cassette bag) is

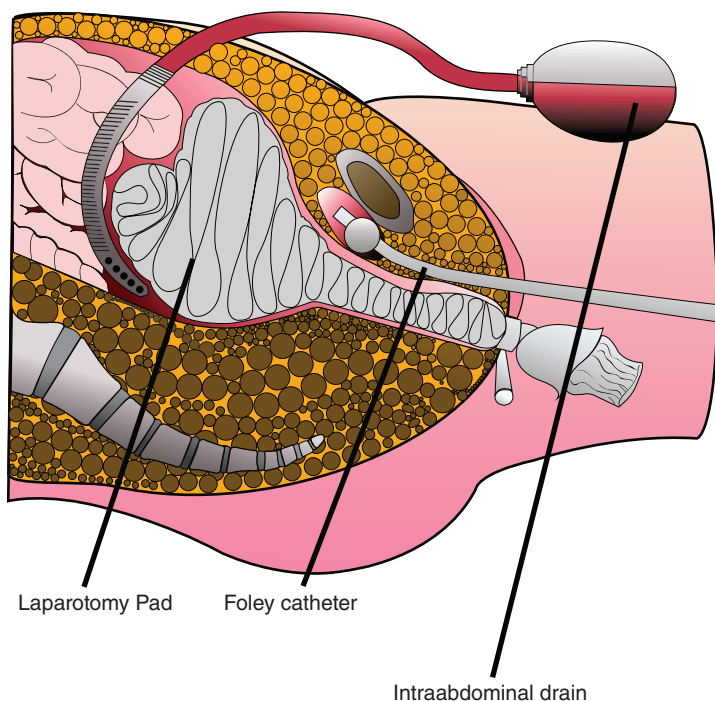


Fig. 19-7. Pressure pack for severe pelvic hemorrhage.

filled with an appropriate amount of gauze. The neck of bag is passed through the vagina from the abdomen. IV tubing connected to 1 L of IV fluids is tied to the neck of the bag and suspended to apply traction and pressure to tamponade bleeding.

### **Other Sources of Bleeding**

- After ruling out uterine atony, other sources of bleeding include retained placenta, genital lacerations, and thrombophilia.
- Examination of the placenta post-delivery can help determine the risk of retained tissue. Manual sweeping of the uterus should be performed if retained placental fragments or membranes are suspected. Additional anesthesia (IV sedation or nitrous oxide) may be required to facilitate manual extraction of the placenta (consider transfer to the OR if patient does not tolerate manual attempt at the bedside). If palpated fragments cannot be extracted manually, sharp curettage with a large banjo curette may be required in the OR which can be facilitated by ultrasound guidance.
- Actively bleeding lacerations on the cervix, vagina, or vulva should be repaired under direct visualization to control hemorrhage.

### **Neonatal Resuscitation**

- **Immediately following delivery, every infant should be assessed for need for resuscitation.** Equipment that may be needed includes warm towels, bulb syringe, stethoscope, flow-inflating or self-inflating bag with oxygen source (with oxygen blender preferred but it may not be available in an operational setting), neonatal cardiac heart rate monitor (if available), laryngoscope and blade, suction catheter, and endotracheal tube. Epinephrine 1:10,000 may be required during neonatal resuscitation.

**If the baby is <36 weeks, or if there is meconium in the fluid at delivery, the baby will need to be observed more closely.**

- Nearly 90% of term babies are delivered without risk factors and with clear fluid, requiring only that they be dried, stimulated, suctioned (if needed), and observed.

- In the first 30 seconds after delivery, dry and stimulate the baby, position it to open the airway, and clear secretions if needed.
- Non-vigorous newborns with meconium-stained fluid do not require routine intubation and tracheal suctioning; however, meconium-stained amniotic fluid is a perinatal risk factor that requires presence of one resuscitation team member with full resuscitation skills including endotracheal intubation.
- Current evidence suggests that cord clamping should be delayed for at least 30 to 60 seconds for most vigorous term and preterm newborns. If placental circulation is not intact, such as after a placental abruption, bleeding placenta previa, bleeding vasa previa, or cord avulsion, the cord should be clamped immediately after birth. There is insufficient evidence to recommend an approach to cord clamping for newborns who require resuscitation at birth.
- **Oxygen Use (if oxygen blender available)**
  - Resuscitation of newborns  $\geq 35$  weeks' gestation begins with 21% oxygen (room air). Resuscitation of newborns  $< 35$  weeks' gestation begins with 21%–30% oxygen.
  - If a baby is breathing but oxygen saturation ( $\text{SpO}_2$ ) is not within target range, free-flow oxygen administration may begin at 30%. Adjust the flowmeter to 10 L/min. Using the oxygen blender, adjust oxygen concentration as needed to achieve the  $\text{SpO}_2$  target.
  - Free-flow oxygen cannot be given through the mask of a self-inflating bag; however, it may be given through the tail of an open reservoir.
- If the newborn has labored breathing or  $\text{SpO}_2$  cannot be maintained within target range despite 100% free-flow oxygen, consider a trial of continuous positive airway pressure (CPAP).
- **Positive-Pressure Ventilation (PPV)**
  - After completing the initial steps, PPV is indicated if a newborn is apneic or gasping or the heart rate is  $< 100$  beats/min. A trial of PPV may be considered if the baby is breathing and the heart rate is  $> 100$  beats/min but  $\text{SpO}_2$  cannot be maintained within target range despite free-flow oxygen or CPAP.
  - For PPV, adjust the flowmeter to 10 L/min.

- Initial ventilation pressure is 20–25 cm H<sub>2</sub>O. When positive end-expiratory pressure (PEEP) is used, the recommended initial setting is 5 cm H<sub>2</sub>O.
- If PPV is required for resuscitation of a preterm newborn, it is preferable to use a device that can provide PEEP. Using PEEP (5 cm H<sub>2</sub>O) helps the baby's lungs remain inflated between positive pressure breaths.
- When PPV is begun, consider using an electronic cardiac monitor for accurate assessment of heart rate.
- The most important indicator of successful PPV is a rising heart rate. If the heart rate does not increase, PPV that inflates the lungs is evidenced by chest movement with ventilation. After intubation or laryngeal mask placement, inflation of the lungs is assessed by chest movement *and* bilateral breath sounds with ventilation.
- When PPV begins, the assistant listens for increasing heart rate for the first 15 seconds of PPV.
- If you are attempting PPV but the baby is not improving and the chest is not moving despite performing each of the ventilation corrective steps ("MR. SOPA," below), including intubation, the trachea may be obstructed by thick secretions. Suction the trachea using a suction catheter inserted through the endotracheal tube or directly suction the trachea with a meconium aspirator.

### Ventilation Corrective Actions

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- M Adjust **MASK** to ensure good seal on the face.
  - R **REPOSITION** airway by adjusting head to "sniffing position."
  - S **SUCTION** nose and mouth for secretions, if present.
  - O **OPEN** mouth slightly and move jaw forward.
  - P Increase **PRESSURE** to achieve chest rise.
  - A Consider **AIRWAY ALTERNATIVE** (endotracheal intubation or laryngeal mask airway).
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- If the heart rate increases to at least 100 bpm with PPV, continue PPV until there is spontaneous respiratory effort.
- If the heart rate is < 60 bpm despite corrective steps and 30 seconds of effective PPV, insert an alternate airway, switch

to 100% oxygen, and initiate **chest compressions** using the 2-thumb technique at 90 compressions/min, compressing one-third the anterior-posterior diameter.

- **Epinephrine** is indicated if the newborn's heart rate remains < 60 beats/min after at least 30 seconds of PPV that inflates the lungs (moves the chest), preferably through a properly inserted **endotracheal tube or laryngeal mask**, *and* another 60 seconds of chest compressions coordinated with PPV using 100% oxygen. Epinephrine is *not* indicated before you have established ventilation that effectively inflates the lungs.
- One endotracheal dose of epinephrine may be considered while vascular access is being established. If the first dose is given by the endotracheal route and the response is not satisfactory, a repeat dose should be given as soon as emergency umbilical venous catheter (UVC) or intraosseous access is obtained (do not wait 3-5 minutes after the endotracheal dose).
- The recommended solution for acutely treating hypovolemia is 0.9% NaCl (normal saline) or type-O Rh-negative blood. Ringer lactate solution is no longer recommended for treating neonatal hypovolemia.
- The UVC is the preferred method of obtaining emergency vascular access in the delivery room, but the intraosseous needle is a reasonable alternative. All medications and fluids can be infused into an intraosseous needle in term and preterm newborns.
- Sodium bicarbonate should not be routinely given to babies with metabolic acidosis. There is currently no evidence to support this routine practice.
- There is insufficient evidence to evaluate safety and efficacy of administering naloxone to newborns with respiratory depression due to maternal opiate exposure. Animal studies and case reports cite complications from naloxone, including pulmonary edema, cardiac arrest, and seizures.

Refer to the American Academy of Pediatrics Algorithm for the Neonatal Resuscitation Algorithm at: <https://www.aap.org/en-us/continuing-medical-education/life-support/NRP/Pages/NRP.aspx>.

**For Clinical Practice Guidelines, go to  
[http://jts.amedd.army.mil/index.cfm/PI\\_CPGs/cpgs](http://jts.amedd.army.mil/index.cfm/PI_CPGs/cpgs)**