Chapter 35A
Surgical Management of Obstetric Complications

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DEFINITIONS

B-Lynch stitch—A uterine body compression suture used to control postpartum hemorrhage resulting from uterine atony. A deep suture is placed vertically on the side of the uterus from 3 cm below the end of the uterine incision to 3 cm above the incision. The suture is then taken over the fundus, and a horizontal bite is taken on the posterior wall of the uterus below the level of the uterine vessels entering the myometrium on the same side as the anterior stitch. The suture is again passed over the fundus on the opposite side, and a deep suture is placed starting 3 cm above the other end of the anterior uterine incision and exiting 3 cm below the incision. This large four-corner mattress suture is then tightly tied down, compressing the fundus.

Cervical insufficiency—Premature, painless dilation of the cervix leading to midtrimester delivery if not treated. The etiology of the condition is poorly understood and may be due to prior cervical trauma and/or an inherent cervical defect.

Cerclage—A purse-string suture placed around the cervix to treat or prevent premature cervical dilation without labor.

Late postpartum hemorrhage—Hemorrhage occurring more than 24 hours following delivery.

McDonald suture—Surgical treatment for cervical insufficiency. A purse-string suture of heavy caliber is placed around the cervix at the level of the internal os.

Placenta accreta—Abnormal invasion of the placenta into the decidual layer lining of the endometrial cavity with no plane of separation.

Placenta increta—The placenta penetrates into the myometrium.

Placenta percreta—The placenta penetrates through the whole thickness of the myometrium up to the serosal surfaces or beyond to surrounding organs.

Postpartum hemorrhage—Blood loss is difficult to estimate accurately; the American Congress of Obstetricians and Gynecologists has arbitrarily defined postpartum hemorrhage as blood loss of greater than 500 mL with a vaginal delivery or greater than 1,000 mL with a cesarean section. Other definitions describe a 10% drop in the hematocrit or the need for blood transfusion (as defined by CA Combs in 1991).

Shirodkar suture—A thick suture or mesh band is placed submucosally around the cervix to treat cervical insufficiency.

Surgery in the pregnant patient presents several unique challenges. There is, of course, the added complexity of caring for two patients simultaneously. Illness and surgery both affect the fetus and the mother, and every decision to recommend surgery and when that surgery should be done requires weighing the risks and benefits to both patients. In many cases, there may be some urgency required to prevent or reduce maternal or fetal morbidity or mortality. In addition, the physiologic and anatomic changes of pregnancy may complicate diagnosis and alter the surgeon's normal operative field. The size of the uterus and increased vascularity of the pelvis may make it significantly more difficult to perform routine gynecologic procedures during pregnancy.

PHYSIOLOGIC CHANGES OF PREGNANCY

Profound physiologic changes of the cardiovascular, respiratory, renal, and coagulation systems occur during pregnancy. It is important for the surgeon to understand these changes in order to understand normal from abnormal findings because they can affect laboratory interpretation, blood product replacement, and surgical approach.

Cardiovascular System

During pregnancy, maternal blood volume increases by 45% to 50% above nonpregnant volumes. Placental hormone production stimulates maternal erythropoiesis, increasing red cell mass by approximately 20%. Because plasma volume increases disproportionately to the increase in red blood cell mass, physiologic hemodilution occurs, manifested as a physiologic anemia. Pregnancy should be considered a hypervolemic state. A mild increase in maternal heart rate begins early in pregnancy and continues until term. In late pregnancy, maternal heart rate is increased by approximately 20% over antepartum values, often resulting in mild tachycardia.

Systemic vascular resistance decreases by 20%, but gradually increases near term. This results in a decrease in systolic and diastolic blood pressure during pregnancy, with a gradual recovery to nonpregnant values by term. As there is increased pressure in the venous system, there is decreased return from the lower extremities, resulting in dependent edema.

Respiratory System

In pregnancy, minute volume is increased, while functional residual volume is decreased. This is primarily the result of upward displacement of the diaphragm. It seems intuitive that lung volume would be decreased during pregnancy, but an increase in minute volume in association with an expansion of the anterior and posterior diameter of the chest results in increased tidal volume, thereby also increasing minute ventilation. These changes result in a compensated respiratory alkalosis. Normal Pco_2 in pregnancy ranges from 28 to 35 mm Hg. Po_2 is usually greater than or equal to 100 mm Hg. Oxygen consumption and basal metabolic rate are also increased during pregnancy by approximately 20%.

These physiologic changes result in less pulmonary reserve for the acutely ill pregnant patient; therefore, this reduces the time interval from respiratory distress to respiratory failure. Because of this, early recognition and intervention in patients with respiratory challenge is mandatory.

Gastrointestinal Tract

During pregnancy, there is a decrease in gastrointestinal motility. This is caused by mechanical changes in the abdomen with the enlarging uterus and smooth muscle relaxation induced by high production of progesterone in pregnancy. Gastric emptying may be delayed for up to 8 hours; therefore, pregnant women should be considered to have a functionally full stomach at all times. In addition, a decrease in large intestine motility may result in constipation severe enough to cause significant abdominal pain.

Coagulation Changes

Pregnancy is a hypercoagulable state. Fibrinogen is increased approximately 30% over baseline values. The hypercoagulable

state of pregnancy is associated with increased risk of deep venous thrombosis and pulmonary embolus. This is particularly compounded when bed rest or immobilization occurs during the gestational period.

Renal Changes

Pregnancy increases blood flow to the renal pelvis approximately 60% to 80%. This results in an increased

glomerular filtration rate accompanied by frequent urination. Serum creatinine is approximately 40% less than in a nonpregnant state. Therefore, a creatinine of 1 mg/dL during gestation should be considered to be at the upper limits of normal.

Ureteral diameter increases in pregnancy secondary to compression and smooth muscle relaxation. Peristalsis is delayed, and reflux occurs freely from the bladder into the lower ureteral segment. This results in an increased incidence of pyelonephritis during pregnancy, making treatment of significant asymptomatic bacteriuria mandatory.

IMAGING TECHNIQUES

The most common imaging technique used during pregnancy is *ultrasonography.* Ultrasound is considered safe and primarily is used for fetal assessment. In patients with abdominal pain, an ultrasound should be considered the first-line diagnostic imaging test. During ultrasound, the presence of an intrauterine pregnancy should be documented and the size and other pertinent parameters of fetal well-being should be recorded. Evaluation of the cul-de-sac for fluid, the ureter for dilatation or stones, the gallbladder for the presence of gallstones, and the placenta for abnormalities should also be noted in the report.

Magnetic resonance imaging can be safely used during pregnancy. There are no data to suggest any increased fetal risk from this modality. Magnetic resonance imaging is now used to diagnose fetal abnormalities, especially abnormalities of the central nervous system. It may be particularly important for the diagnosis of appendicitis in pregnancy.

Although there are theoretical risks associated with ionizing radiation, fortunately, most *diagnostic x-ray procedures* are associated with minimal or no risk to the fetus. While unnecessary, multiple, or recurrent x-ray exposure should be avoided, existing evidence suggests that there is no increased risk of fetal congenital malformations, growth restriction, or abortion from x-ray procedures that expose the fetus to doses of 5 rads or less. The American Congress of Obstetricians and Gynecologists has published guidelines regarding diagnostic imaging during pregnancy. Women should be reassured that concern about radiation exposure should not prevent medically indicated diagnostic procedures. It cannot be stressed enough that maternal well-being is of the utmost importance, and appropriate diagnostic procedures should be obtained to facilitate a rapid diagnosis.

POSTPARTUM HEMORRHAGE

Postpartum hemorrhage is poorly defined by estimation of blood loss; therefore, it is difficult to accurately determine actual or percentage of blood loss at the time of delivery. Additionally, blood volume expansion is variable during pregnancy and can be affected by several factors including hypertension, renal disease, maternal body mass index, and the presence of multifetal gestations. The potential effects of blood loss largely depend on the degree of blood volume expansion. For example, blood loss of 1,000 mL during cesarean section is generally well tolerated by healthy pregnant women. A blood loss of 500 to 750 mL, however, may not be tolerated in a woman with minimal volume expansion or one who is hemoconcentrated secondary to severe preeclampsia or eclampsia. The American Congress of Obstetricians and Gynecologists has noted that a number of definitions have been used to define hemorrhage, including a blood loss greater than 500 mL with a vaginal delivery or greater than 1,000 mL during a cesarean section or a drop in hematocrit of 10% regardless of the amount of documented blood loss.

Gilstrap and Ramin have defined clinically significant hemorrhage as that amount of bleeding “that produces signs and symptoms of hemodynamic instability or that is likely to produce such if left unabated.”

Incidence and Etiology

Although the exact incidence of hemorrhage associated with pregnancy is unknown, it remains one of the leading

causes of maternal mortality in this country. Kaunitz and associates reported that 13% of more than 2,000 maternal deaths were secondary to hemorrhage, and one third of these occurred postpartum. Rochat and colleagues reported a similar incidence of 11% of maternal deaths resulting from hemorrhage.

In a randomized trial conducted in the United States, birth weight, labor induction and augmentation, chorioamnionitis, use of magnesium sulfate, and a maternal history of previous obstetrical hemorrhage were associated with increased risk of postpartum hemorrhage. A large population-based study supported these findings, with significant risk factors identified using multivariate analysis. Risk factors associated with an increased risk of postpartum hemorrhage were retained placenta (odds ratio [OR] 3.5; 95% confidence interval [CI]: 2.1 to 5.8), failure to progress during the second stage of labor (OR 3.4; 95% CI: 2.4 to 4.7), placenta accreta (OR 3.3; 95% CI: 1.7 to 6.4), vaginal or perineal lacerations (OR 2.4; 95% CI: 2.0 to 2.8), instrumental delivery (OR 2.3; 95% CI: 1.6 to 3.4), large-for-gestational-age newborn (OR 1.9; 95% CI: 1.6 to 2.4), hypertensive disorders (OR 1.7; 95% CI: 1.2 to 2.1), induction of labor (OR 1.4; 95% CI: 1.1 to 1.7), and augmentation of labor with oxytocin (OR 1.4; 95% CI: 1.2 to 1.7).

Diagnosis and Medical Management

The most important aspects in the management of postpartum hemorrhage are prompt recognition and treatment of the condition. Recognition of external bleeding is straightforward and almost always can be controlled with medical or minor surgical means. Tachycardia, decreased urine output, and, finally, hypotension without obvious external blood loss are important signs of potential internal bleeding, and many such instances will require surgical intervention to arrest the hemorrhage. If the etiology of the hemorrhage is not determined quickly, coagulopathy may complicate the clinical presentation, thereby making diagnosis and treatment more difficult.

Uterine atony is readily recognizable by palpation of the uterus. If atony it not present, the cervix and vagina should be carefully inspected for lacerations. The placenta also should be inspected for missing fragments, and careful manual palpation of the uterine cavity should be performed. If the source of bleeding still is not obvious or if bleeding is seen around venipuncture or catheter sites, then the patient should be evaluated for coagulopathy. A thrombin clot (clot retraction test) tube will reveal gross disruption in coagulation within minutes. Useful laboratory tests include prothrombin time, partial thromboplastin time, platelet count, fibrinogen, and fibrin degradation product levels. The clinician should note that d-dimer levels may be abnormal during pregnancy even in patients without coagulopathy. Before surgical intervention, an ultrasound

examination of the uterine cavity may prove useful for the identification of an accessory placental lobe or fragment.

Medical management of postpartum hemorrhage consists of volume replacement and uterotonics, including intravenous oxytocin and parenteral methylergonovine and prostaglandins. Volume can be maintained with crystalloid and blood or blood products. Invasive monitoring, such as with a pulmonary artery catheter, generally is not necessary and may be dangerous in the presence of a coagulopathy. Its use should be reserved for those patients who do not respond to usual and expected therapy. As a general rule, monitoring of urine output, vital signs, and oxygen saturation will be sufficient. Volume replacement generally is adequate when the blood pressure is maintained at 90 to 100 mm Hg systolic, pulse rate is less than 100 beats per minute, and urine output is at least 25 to 30 mL per hour. When a patient has required transfusion of packed red blood cells, it is important to transfuse coagulation factors to replace those lost in the hemorrhage. Calcium also should be replaced in these patients because of risk of complications such as hypotension related to hypocalcemia in patients receiving massive transfusions. Fluid overload generally can be detected with a stethoscope and an oxygen monitor in conjunction with clinical signs and symptoms. Diuretics should only be used to remove excess fluid if the patient becomes hypoxic related to volume overload. A medical management protocol for postpartum

hemorrhage is summarized in **Table 35A.1.**

Surgical Management

Lower genital tract lacerations usually are best managed by suturing. The rare case of uterine rupture also is managed surgically. Other techniques to control hemorrhage include uterine and utero-ovarian artery ligation, hysterectomy, or uterine or hypogastric artery embolization.

Uterine packing, which until recently had been abandoned by most clinicians, may allow adequate time for blood and fluid replacement before surgical intervention. Maier described the use of a packing device called a Torpin packer. The device uses a plunger to place several yards of 4-inch-wide gauze into the uterine cavity and has been used successfully to control postpartum hemorrhage. Uterine packing allows time for volume replacement and slows bleeding enough to allow for surgical techniques short of hysterectomy. In many cases, it may stop the bleeding so that no further treatment is necessary. Other methods of uterine tamponade reported in the literature have included the use of a Foley catheter with a 30- to 50-mL balloon or a Sengstaken-Blakemore tube with the esophageal balloon inflated with 50 mL of normal saline and, more recently, the use of the Bakery balloon. The choice of a specific surgical technique to control bleeding depends on several factors, including the degree of hemorrhage, the hemodynamic status of the patient, parity, and the desire for future childbearing. An undoubtedly important factor in achieving a favorable outcome in control of postpartum hemorrhage is the experience of the surgeon.

TABLE 35A.1 Medical Management Protocol for Postpartum Hemorrhage

General
Large-bore intravenous line Foley catheter
Drugs
Oxytocin, dilute solution of 20 U in 1,000 mL of normal saline or Ringer solution, given as IV infusion Methylergonovine, 0.2 mg IM 15-Methyl $PGF_{2\alpha}$, 0.25 mg IM or intramyometrially every 15-60 min as indicated
Volume Replacement
Crystalloid, 3 mL/mL of estimated blood loss (maintain urine output ≥30 mL/h) Packed red blood cells Fresh frozen plasma, platelets, or cryoprecipitate, as indicated

IM, intramuscularly; IV, intravenously. Reprinted from American College of Obstetricians and Gynecologists. *ACOG Technical Bulletin No. 143: Diagnosis and management of postpartum hemorrhage.* Washington, DC: ACOG, 1990, with permission.

Arterial Embolization

Angiographic arterial embolization has been described for the successful control of obstetric and gynecologic bleeding. Small metal coils, Gelfoam, polyvinyl alcohol dehydrated particles, and other substances have been

used for such embolizations. Pelage and associates, in two separate reports, describe use of arterial embolization in patients with primary or secondary postpartum hemorrhage, defining primary postpartum hemorrhage as that which occurs within 24 hours after delivery. Twenty-seven women were identified, including two who had already undergone hysterectomy in an unsuccessful attempt to control the hemorrhage. Following transcatheter embolization, immediate decrease or cessation of bleeding occurred in all patients. Two patients required repeat embolization the next day with no further complications. Fourteen women were diagnosed with secondary postpartum hemorrhage after the first 24 hours following delivery. All of these patients had complete resolution of bleeding with embolization with no further complications. Arterial embolization can be performed quickly and safely; therefore, it should be strongly considered in patients with postpartum hemorrhage who are stable enough to be managed in the radiology suite. There have been reports of successful pregnancies following embolization, which makes it an especially attractive alternative to hysterectomy in the patient who desires preservation of fertility.

Uterine Artery Ligation

STEPS IN THE PROCEDURE

Uterine Artery and Utero-Ovarian Artery Ligation (O'Leary Stitch)

- First-line treatment to control postpartum hemorrhage at the time of cesarean delivery.
- Advance bladder before placement of sutures is important to avoid bladder injury.
- Absorbable suture no. 0 chromic or polyglycolic acid suture is placed through the lateral aspect of the lower uterine segment, 2 to 3 cm medial to the uterine vessels through the myometrium, and then back through the broad ligament just lateral to the uterine vessels.
- The suture is tied *to compress the vessels.*
- Placement of second ligature at junction of the uteroovarian ligament and uterus.

Uterine artery ligation is a relatively safe procedure that can be performed by most obstetricians. It also allows for future childbearing. The technique consists of ligating the uterine artery and vein at the lower uterine segment 2 to 3 cm below the level of the transverse uterine incision. An

absorbable ligature is placed 2 to 3 cm medial to the uterine vessels through the myometrium (to obliterate any intramyometrial ascending branches) and then lateral to the vessels through the broad ligament. It is imperative that the bladder be advanced before placement of the suture to prevent bladder injury. Because of collateral flow from the ovarian artery, some recommend that a second ligature be placed at the junction of the utero-ovarian ligament and uterus. The technique of uterine artery ligation is shown in **Figures 35A.1** and **35A.2**.

In a review of 90 women who underwent uterine artery ligation (30 were for uterine atony), O'Leary reported that only six (7%) procedures resulted in failure. There were no major complications from the procedure itself. In a follow-up review of 265 women who underwent uterine artery ligation, O'Leary reported a greater-than-95% success rate.

This technique is most useful (and successful) when hemorrhage is of a moderate degree and originates from the lower uterine segment. Such an example is bleeding from a low placental implantation site. Uterine artery ligation also can prove beneficial for lower segment extensions or lacerations, in addition to slowing bleeding for a uterine artery laceration. Philippe and associates reported a vaginal approach to ligation of the uterine arteries in two patients after vaginal delivery, but a larger case series would have to be performed to determine the

feasibility of this approach.

B-Lynch Suture

STEPS IN THE PROCEDURE

B-Lynch Suture Placement

- The B-Lynch suture is an effective method for reducing uterine blood loss related to uterine atony.
- A large Mayo needle with absorbable suture is used to enter and exit the uterine cavity laterally in the lower uterine segment.
- The initial placement is anteriorly at one angle of the uterine incision.
- The suture is passed over the uterine fundus.
- A deep transverse bite is taken in the posterior lower uterine segment.
- The suture is then passed back over the fundus to enter the anterior lower uterine segment opposite and parallel to the initial bite.
- The free ends are pulled tightly and tied down securely to compress the uterus.

B-Lynch and colleagues also described five cases in which hemorrhage was controlled by placing an absorbable suture vertically from 3 cm below the uterine incision to 3 cm above the uterine incision on the right side of the uterus (**Fig. 35A.3**). The stitch is then taken vertically over the fundus and placed horizontally in the posterior uterus at the same level as the anterior suture. The suture is threaded over the left side of the uterus to place another stitch on the left from 3 cm above the uterine incision to 3 cm below the uterine incision. The long suture is tied, compressing the fundus. A large suture, such as no. 1 Prolene on a large needle, is used. The uterine incision is closed in the usual fashion. There are several case series in the literature supporting the efficacy of the B-Lynch stitch for the treatment of uterine atony. In all series, the suture has been reported to be effective. It has been suggested that the B-Lynch be considered in all cases of severe postpartum hemorrhage before resorting to hysterectomy.

Hypogastric Artery Ligation

STEPS IN THE PROCEDURE

Hypogastric Artery Ligation: Ligation Performed Bilaterally

- Open the peritoneum overlying the common iliac artery.
- Identify the ureter and retract medially.
- Longitudinally open the sheath covering the internal iliac (hypogastric) artery.
- A right angle clamp is passed lateral to the medial direction with blunt dissection.
- Two nonabsorbable 2-0 silk sutures are placed 2 cm distal to the bifurcation.
- Hypogastric artery ligation should be performed bilaterally to adequately decrease pressure to the uterus.

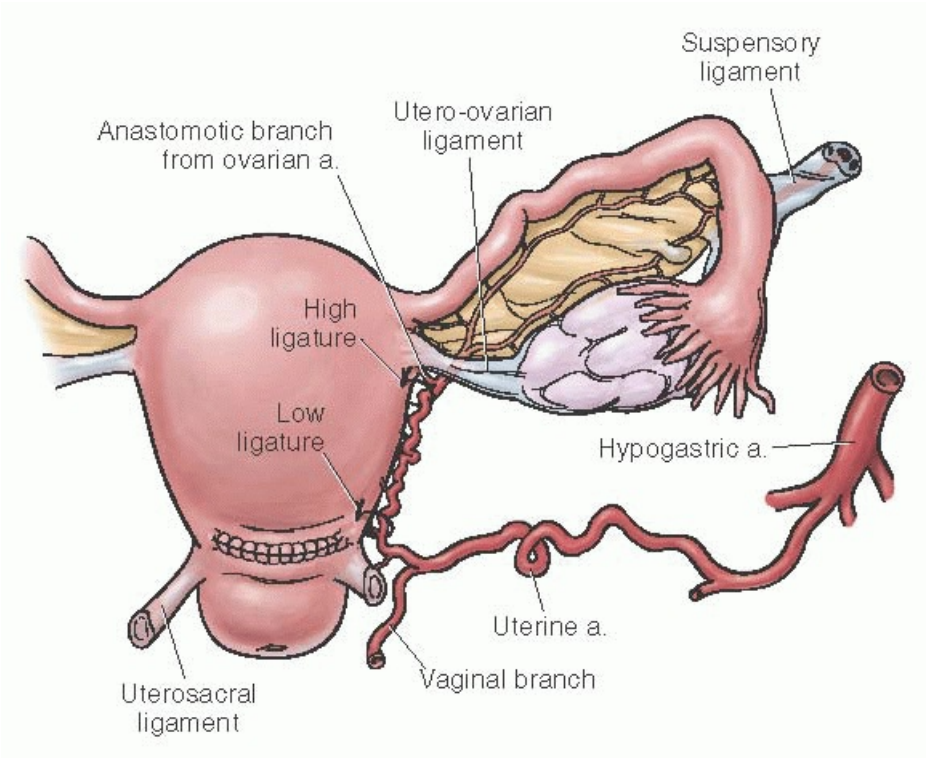

FIGURE 35A.1 Uterine artery ligation.

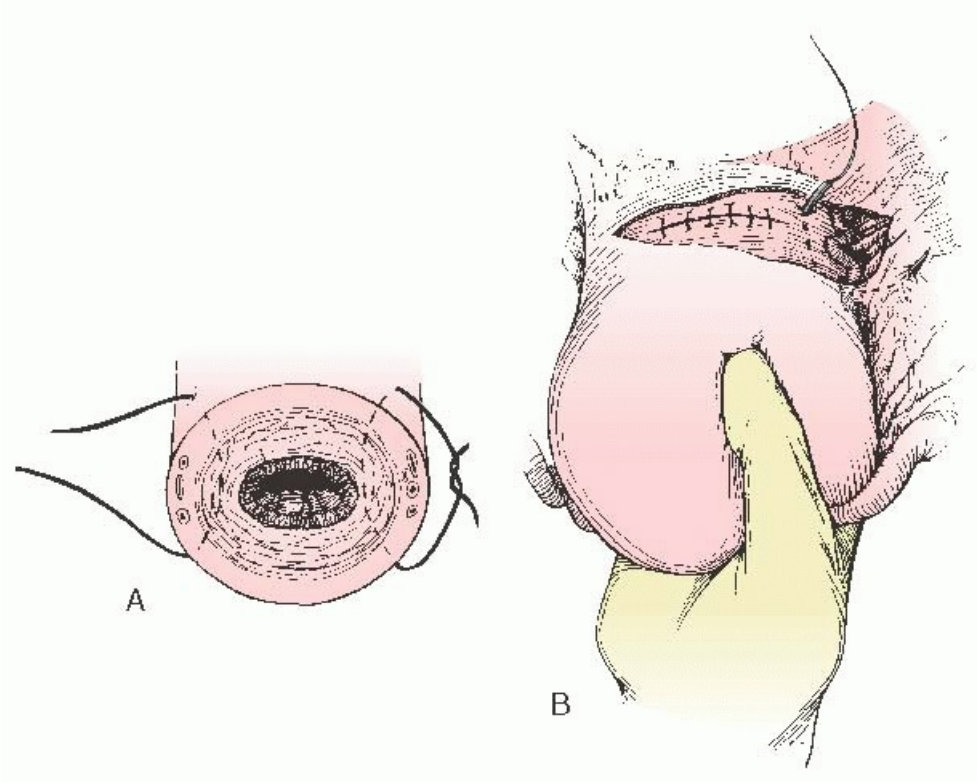

FIGURE 35A.2 Uterine artery ligation. **A:** Lateral view demonstrating ligature placement. **B:** Anatomic relation of ligature to uterine wall and vessels. (Reprinted from Floyd RC, Morrison JC. Postpartum hemorrhage. In: Plauche WC, Morrison JC, O'Sullivan MJ, eds. *Surgical obstetrics.* Philadelphia, PA: WB Saunders, 1992:272, with permission. Copyright © 1992, Elsevier.)

The major blood supply to the uterus and pelvis comes from the internal iliac artery, often called the hypogastric artery. Bilateral ligation of this artery can effectively control significant bleeding and thus prevent the need for hysterectomy and permanent sterilization. Burchell has aptly described the physiology of internal iliac artery

ligation. It appears that ligation of this artery controls bleeding by converting an arterial system into a venous system, which decreases the pulse pressure by as much as 85%. This allows pressure and packing to produce clotting. Hypogastric artery ligation probably interferes little, if at all, with subsequent pregnancies. Mengert and colleagues reported successful pregnancies in five women who had undergone internal iliac artery ligation. This technique also may prove useful for controlling bleeding in patients with large hematomas of the broad ligament or for a lacerated artery that has retracted into the broad ligament. Such vessels or active bleeding sites often are difficult to identify. If the bleeding is from the hypogastric vein, ligation of the hypogastric artery will decrease venous pressure which makes the bleeding easier to control.

The technique of hypogastric artery ligation is illustrated in **Figure 35A.4**. The peritoneum overlying the external iliac artery is divided directly above the artery between the infundibulopelvic ligament and the round ligament of the uterus. The internal iliac (hypogastric) artery is identified as it arises and runs from the common iliac artery posteriorly into the pelvis just beneath the infundibulopelvic ligament. The ligation should be performed about 2 cm distal to the bifurcation to avoid disrupting the posterior division of the hypogastric, which can lead to ischemia and necrosis of the skin and subcutaneous tissue of the gluteus. A right angle clamp is gently passed under the artery in the lateral to medial direction with blunt dissection. Great care must

be taken not to perforate the internal iliac vein, and the clamp is passed lateral to medial to avoid injury to the vein by the tip of the clamp. Two nonabsorbable sutures of 2-0 silk should be used for ligation. It is important that hypogastric artery ligation be performed bilaterally to adequately decrease systolic pressure to the uterus. Clark and associates reported on the successful control of bleeding in 8 (42%) of 19 women who underwent hypogastric artery ligation. In a review of hypogastric artery ligation from three series, Clark reported that this procedure prevented hysterectomy in about half of the patients associated with uterine atony and placenta accreta. Interestingly, in this series, the success of hypogastric artery ligation did not appear to be related directly to the conditions for which it was performed. It must be noted, however, that the number of patients in each category is small.

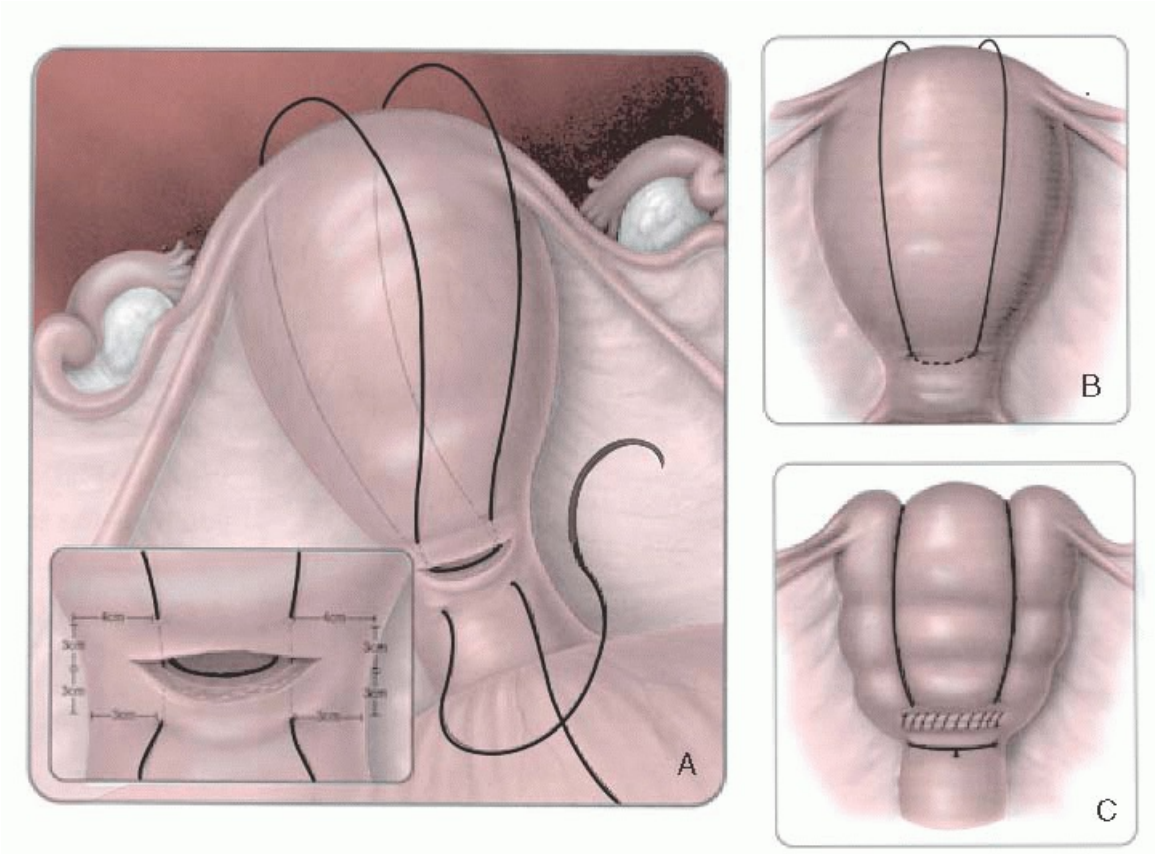

FIGURE 35A.3 Technique of B-Lynch suture placement. A: The initial bite is placed anteriorly at one angle of the

uterine incision (see inset). B: After the anterior B-Lynch suture is placed, the suture is passed over the fundus, a deep transverse bite is taken in the posterior lower uterine segment, and the suture is passed back over the fundus.

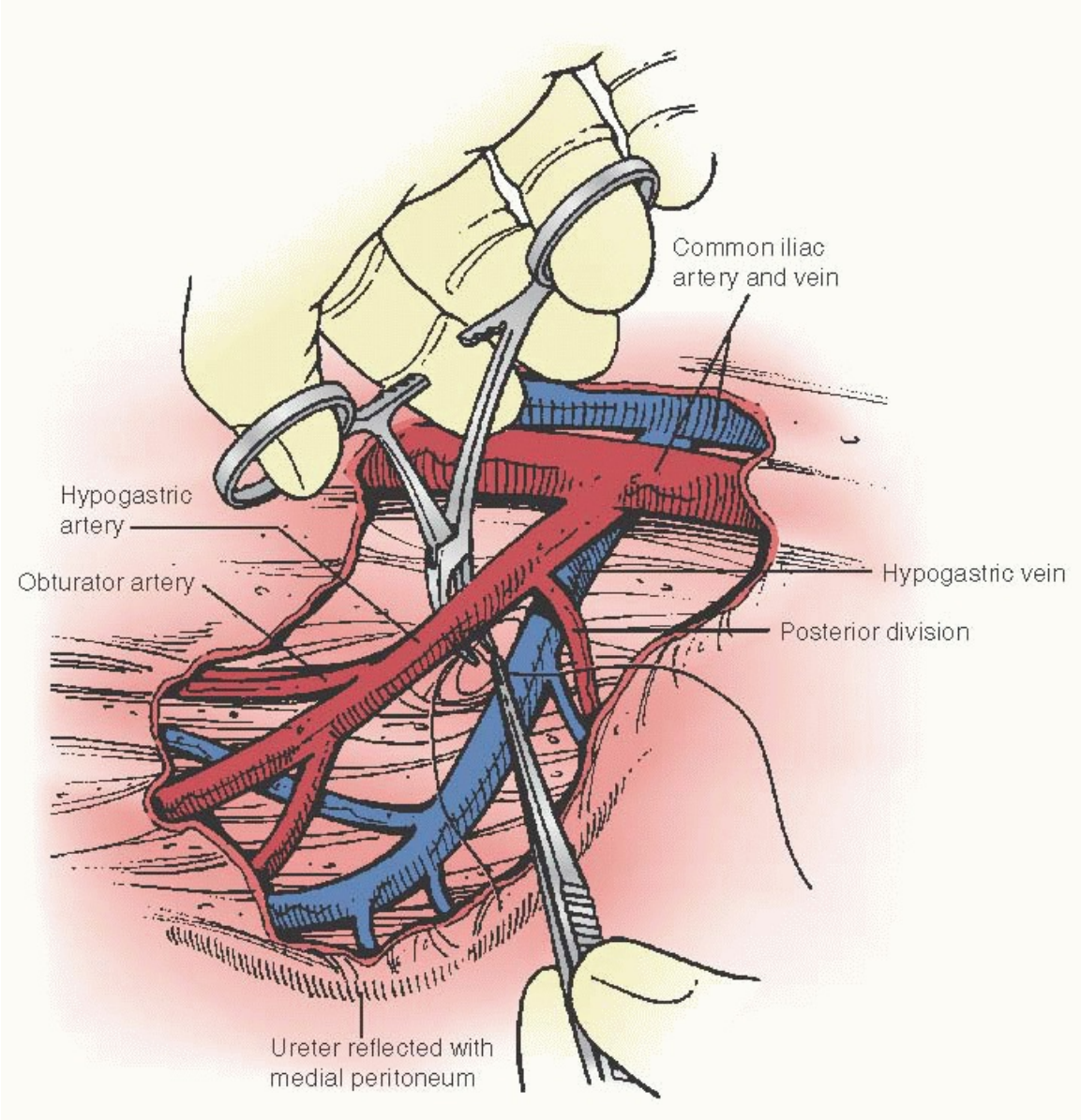

FIGURE 35A.4 Ligation of the right hypogastric artery. The clamp is passed laterally to medial, and the ligature is placed around the anterior division of the hypogastric artery. Note the ureter is attached to the peritoneum, which is reflected medially.

Although this procedure is successful in about 50% of patients and does not interfere with subsequent fertility, it is not technically easy to perform and requires special skill and experience. Many obstetricians have little, if any, experience with this procedure, especially in the presence of a surgical emergency. Moreover, potential complications of hypogastric artery ligation include laceration of the iliac vein, ligation of the external iliac artery, ureteral injury, and death.

Hysterectomy

Because of the lack of experience and skill with the technique of hypogastric artery ligation, many clinicians prefer to do a hysterectomy to control postpartum hemorrhage. Peripartum hysterectomy is extensively discussed later in this chapter. Hysterectomy usually is the safest procedure and also the quickest that can be performed for refractory bleeding. For example, Clark and associates reported that patients undergoing hypogastric artery

ligation who subsequently required hysterectomy had an increased incidence of cardiac arrest secondary to blood loss. The increased morbidity associated with hypogastric artery ligation followed by hysterectomy may be secondary to a delay resulting from attempted conservative management short of hysterectomy. Hypogastric artery ligation was attempted before hysterectomy 64% of the time in nulliparous women, compared with 10% of the time for multiparous patients. Lack of experience with hypogastric artery ligation adds to the overall time required to attempt the procedure and overall blood loss.

In a review of 70 women who underwent emergency hysterectomy for postpartum hemorrhage, Clark and colleagues reported that almost all required blood transfusion, and 50% had postoperative febrile morbidity. The most common indication for hysterectomy in this series was uterine atony, followed by placenta accreta. Of the 70 procedures, 60 were performed after cesarean delivery. Mean operating time was 3.1 hours, and mean blood loss was 3,575 mL.

ABNORMAL PLACENTATION

Placenta accreta occurs when the placenta attaches abnormally to the underlying uterine wall. It is believed to occur due to an abnormal attachment of the chorionic villi to the myometrium due to an absence of decidua basalis and incomplete

development of the fibrinoid layer. Placenta increta occurs when the placenta extends in to the myometrium, and placenta percreta occurs when the placenta invades through the myometrium and serosa with possible involvement of adjacent organs. Because of the abnormal attachment to the myometrium, there is a risk of life-threatening hemorrhage often requiring massive transfusion of blood products and hysterectomy. The maternal mortality rate was reported in 1996 by O'Brien and his group to be as high as 6% to 7%.

Flood and his group reported in 2009 that the incidence of placenta accreta has increased from approximately 0.8 per 1,000 deliveries in the 1980s to 3 per 1,000 in the past decade. The rising incidence of placenta accreta parallels the rising cesarean section rate. Important risk factors include prior history of placenta previa, previous cesarean delivery, increasing parity and maternal age, and prior uterine surgery. Antepartum diagnosis of placenta accreta is best accomplished by ultrasound, with a reported sensitivity of 77%, specificity of 71%, and a positive predictive value of 65%. Sonographic findings that may be associated with accreta include loss of normal hypoechoic retroplacental myometrial zone, thinning of the uterine serosa-bladder interface, and increased vascularity at the interface of the uterus and bladder. Magnetic resonance imaging may be helpful if there is suspicion that the placenta has invaded the parametrium or surrounding organs.

LATE POSTPARTUM HEMORRHAGE

Late postpartum hemorrhage is defined as occurring more than 24 hours after delivery. The etiology of such bleeding includes placental site subinvolution, infection, coagulopathy, and retained products of conception. Initial therapy for this complication is the same as for early hemorrhage. If infection is present, antibiotics should be used. Endometrial curettage may be necessary for retained placental fragments. Angiographic embolization may prove especially useful in the case of late postpartum hemorrhage. Uterine artery ligation, hypogastric artery ligation, and hysterectomy are rarely required for control of late postpartum hemorrhage.

PERIPARTUM HYSTERECTOMY

Horatio Storer performed the first cesarean hysterectomy in 1869. Initially, the procedure was performed only for emergency situations, but in the early 20th century, it became an accepted means of sterilization. In the modern obstetrical age, elective cesarean hysterectomy is rarely performed, except in cases of cervical neoplasia.

Peripartum hysterectomy can be performed in conjunction with a cesarean delivery (e.g., cesarean hysterectomy) or after a vaginal delivery for complications such as postpartum hemorrhage. In a recent review of

a nationwide sample of deliveries from 1998 to 2003, Whiteman and colleagues estimated that the rate of peripartum hysterectomy in the United States is 0.77 per 1,000 deliveries.

Although there is little controversy regarding peripartum hysterectomy for emergency conditions, there is significant debate in modern obstetrics regarding an elective hysterectomy performed at the time of cesarean delivery. There has been legitimate concern about increased morbidity related to peripartum hysterectomy—including damage to the ureters, bladder, and rectum—and an increased rate of reoperation. However, Plauche has pointed out that morbidity often is associated with the conditions leading to the hysterectomy and not necessarily the procedure itself. Lower morbidities have been reported for elective cesarean hysterectomies when compared with emergency hysterectomies. However, there is inherent bias in these retrospective reviews. Emergent surgery for lifesaving maternal indications would be expected to have higher morbidities, such as blood loss and injury to surrounding structures. In a retrospective study, Castaneda and colleagues observed that over the years the indications for peripartum hysterectomy have changed from predominately elective to almost exclusively emergent indications. In their series, the average blood loss was 3,009 mL in emergent cases and 1,262 mL in nonemergent cases. They concluded that, at the present time, peripartum hysterectomy is almost always emergent in nature and associated with a significant blood loss. As might be expected, there are no randomized prospective studies of elective cesarean hysterectomy, and it is unlikely that such a study could ever be done given the ethical dilemma involved.

Emergency Peripartum Hysterectomy

Obstetric hemorrhage secondary to a variety of etiologies is a common indication reported for peripartum emergency hysterectomy. The three most common reasons are uterine rupture, abnormal placentation, and uterine atony. Although the exact incidence of emergency peripartum hysterectomy is not known, several authors have reported widely varying rates of 0.004 to 1.5 per 1,000 deliveries.

Clark and associates reviewed 70 cases of emergency hysterectomy for obstetric hemorrhage and found that 60 (86%) of these procedures were performed after cesarean delivery and 10 (14%) were performed after vaginal delivery. Uterine atony and placenta accreta accounted for almost three fourths of the cases. Other indications were uterine rupture, extension of the uterine incision, and fibroids precluding closure of the uterine incision.

It is clear from the literature that *abnormal adherent placentation or placenta accreta (with or without hemorrhage) is emerging as the most common condition leading to an emergency hysterectomy.* In three studies from 1993 to the present, 156 (56%) of the 279 emergent peripartum hysterectomies were performed for placenta accreta. These studies are outlined in **Table 35A.2**. *The increase in placenta accreta is related to the high rate of cesarean deliveries,* which has risen in the United States from 5% in the early 1960s to 30% at the present time. A recent study of more than 60,000 deliveries at the University of Chicago by Wu et al. found that the rate of placenta accreta had increased to 3 per 1,000 deliveries in 2003. They observed that this was directly associated with the increase in cesarean section rate. Clarke and colleagues found that in the presence of a placenta previa, the risk of having placenta accreta increased from 24% in women with one prior cesarean delivery to 67% in women with 3 or more prior cesareans.

Cesarean Hysterectomy

STEPS IN THE PROCEDURE

Cesarean Hysterectomy

- Midline skin incision.
- Cesarean delivery with dissection of bladder flap.
- Placenta removal unless placental invasion exists.
- If accreta is suspected, clamp cord and leave placenta in situ.
- Close the uterine incision with a no. 1 suture placed in a running locking fashion.
- Ligate the round ligament close to the uterus using 0 Vicryl.
- Open the peritoneum superiorly.
- Identify the ureters crossing the iliac artery at the level of the bifurcation in the medial leaf of the broad ligament.
- Identify the utero-ovarian ligaments, then clamp, cut, and ligate bilaterally.
- With upward traction on the uterus, identify and clamp the uterine vessels bilaterally (using a Heaney or Zeppelin clamp); vascular pedicles are double ligated.
- Using a straight or slightly curved clamp, clamp, cut, and tie the cardinal and uterosacral ligaments at the level of the cervix.
- Remove the uterus by clamping across the vagina on each side and incising the vaginal mucosa.
- Secure the lateral vaginal fornix to the cardinal and uterosacral ligaments.
- Close the vaginal cuff with interrupted figure-of-eight sutures.
- Inspect all pedicles for bleeding.
- Close the abdominal incision.

TABLE 35A.2 Indications for Emergency Hysterectomy for Obstetric Hemorrhage

INDICATION	CLARK ET AL. (1984) (*n* = 70)	BAKSHI ET AL. (2000) (*n* = 39)	STANCO ET AL. (1993) (*n* = 123)	ZELOP ET AL. (1993) (*n* = 117)
Uterine atony/hemorrhage	30 (43%)	11 (28%)	44 (35.9%)	25 (21.3%)
Placenta accreta/percreta	21 (30%)	20 (51%)	61 (49%)	75 (64.1%)
Uterine rupture	9 (13%)	5 (15%)	14 (11.5%)	—
Extension of uterine incision	7 (10%)	—	—	—
Leiomyomata	3 (4%)	2 (5%)	3 (2.4%)	—
Uterine infection	—	—	—	17 (14.5%)
Other	—	1 (1%)	1 (1.2%)	—

Although a number of conditions have been reported as indications for elective cesarean hysterectomy, currently accepted indications are usually limited to microinvasive or invasive cervical cancer. In retrospective reviews that go back to the 1950s and 1960s, sterilization, menstrual abnormalities, and uterine fibroids are listed as

indications; however, most practitioners would not consider these appropriate indications for such an invasive surgical procedure in the 21st century.

Morbidity and Mortality of Hysterectomy

The conditions leading to emergency hysterectomy also are responsible for much of the morbidity reported with the procedure. Two other important factors associated with morbidity, both of which are difficult to quantify, are training and experience (or surgical skill) of the surgeon. Chestnut and associates reported statistically significant reductions in operative time, estimated blood loss, intraoperative and total blood replacement, and length of hospital stay if the patient was in the care of an experienced surgeon. It seems reasonable, however, to conclude that morbidity and complications are also higher in women undergoing emergency versus elective procedures despite the skill of the surgeon.

Zelop and associates reported 102 (87%) of the patients in their series required transfusion of blood products. Complications of three series, totaling 279 cases of emergency peripartum hysterectomy, are summarized in **Table 35A.3.** Maternal mortality rates in these studies varied between 0% and 4.5%. As with morbidity, mortality is better correlated with the specific complication than with the hysterectomy per se.

In a review of 80 women undergoing elective cesarean hysterectomy, McNulty reported that only 5 (6%) experienced febrile morbidity and 15 (19%) received blood transfusion. Four (5%) women sustained bladder injuries, and 4 (5%) women developed broad ligament hematomas. Yancey and colleagues compared the outcomes in 43 women undergoing scheduled cesarean hysterectomy with those of 86 women who underwent cesarean delivery and subsequent scheduled delayed postpartum hysterectomy. Although women in the cesarean hysterectomy group were more likely to need a blood transfusion than were women in the subsequent hysterectomy group (OR 3.4; 95% CI: 1.4 to 8.4), they were less likely to have other complications, such as infection (OR 0.34; 95% CI: 0.25 to 0.45). The overall postoperative complication rate was the same in both groups (51%). Thus, it appears from the older literature that *elective* cesarean hysterectomy is not associated with an increased risk of complications or morbidity compared with a cesarean delivery followed by an elective hysterectomy at a later time. However, in a healthy population, one must weigh the risk of blood transfusion versus the benefit of the combined procedure. As pointed out by Baker and D'Alton, there is little doubt that elective cesarean hysterectomy is associated with increased morbidity when compared with a cesarean delivery and a tubal ligation.

Emergency versus Elective Hysterectomy

In two studies comparing emergency with elective peripartum hysterectomy, morbidity was greater with the emergency procedure. Estimated blood loss, number of women transfused, and operating time were all higher in the emergency group.

It is important to remember that many of the patients who undergo emergent delivery have already had significant blood loss and hemorrhage before the decision is made to proceed with hysterectomy.

TABLE 35A.3 Complications of 279 Cases of Emergency Peripartum Hysterectomy

	COMPLICATION INCIDENCE (%)			
	CLARK ET AL. (*n* = 70)	**BAKSHI ET AL. (*n* = 39)**	**STANCO ET AL. (*n* = 123)**	**ZELOP ET AL. (*n* = 117)**

Infection	50	20.5	9	50
Wound infection	12	—	9	3.4
Blood transfusion	96	80	82	87
Coagulopathy	6	2.5	5.7	27
Urologic injury	4	7.7	13	10.2
Death	1	0	0	0

Cesarean Hysterectomy Technique

Elective cesarean hysterectomy can be accomplished through either a midline or low transverse (Pfannenstiel) skin incision. Often, it is more prudent to use a midline skin incision, which affords better surgical exposure.

After the cesarean delivery, the placenta is quickly removed unless there is a contraindication to do so. *No attempt is made to remove the placenta in cases of placenta accreta because significant life-threatening hemorrhage can ensue.* In cases of placenta percreta involving the posterior wall of the bladder, a partial cystectomy may be required. In these cases, the bladder trigone and ureteral orifices must be carefully identified, and urologic consultation may be needed. In cases of anterior placenta previa and suspected placenta accreta, it is prudent to arrange for urologic support preoperatively. In cases of suspected accreta, some interventional radiologists may place bilateral hypogastric artery balloons preoperatively. When inflated, these balloons have significantly decreased operative blood loss in our experience.

The uterine incision can be closed with a running no. 1 suture in a locking fashion. The bladder flap should be dissected well down before the start of the hysterectomy. This is best accomplished at the time of the cesarean delivery. The bladder should be dissected off the anterior, lower uterine segment with sharp dissection if firm adhesions are encountered. Firm adhesions often are present in patients who have undergone multiple cesarean deliveries. If bleeding is a problem, further dissection of the bladder from the lower uterine segment can be accomplished after ligation of the uterine artery. If significant difficulty or bleeding is encountered in dissection of the bladder flap, a supracervical hysterectomy should be considered. Bleeding many also be diminished after the uterine arteries have been ligated bilaterally, so another attempt to dissect the bladder off of the anterior cervix may be considered at this time.

The actual hysterectomy is begun by ligating the round ligament close to the uterus and ligating the distal stump with a 0 Vicryl suture ligature. The vesicouterine serosa, where the bladder was attached before its dissection, then is extended laterally to the severed round ligaments.

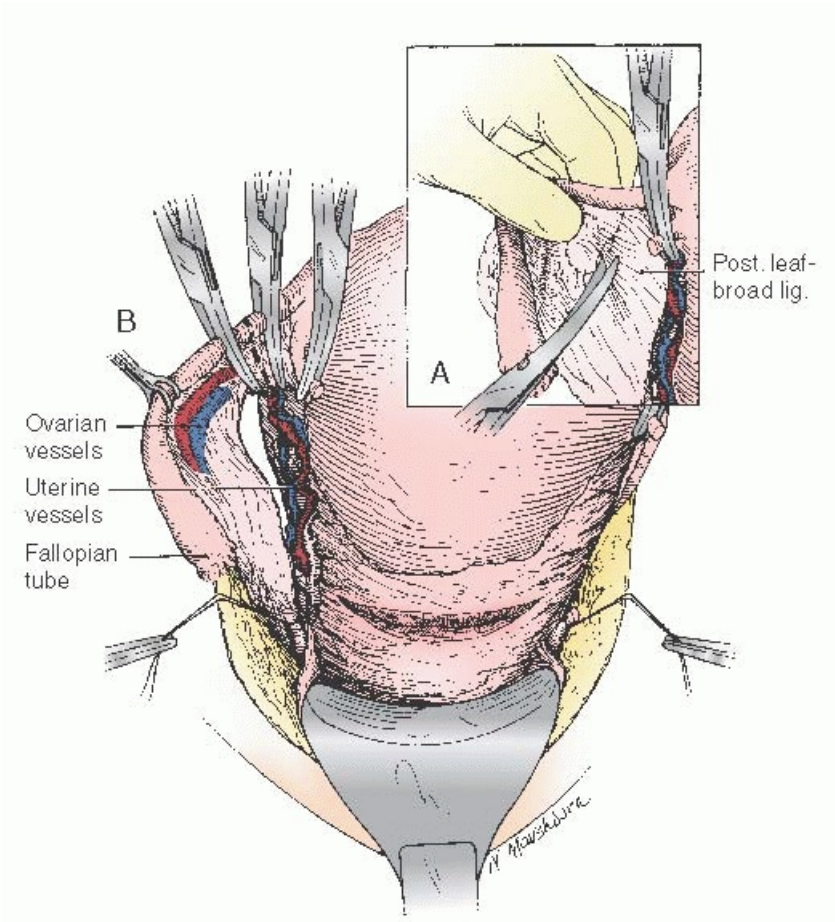

FIGURE 35A.5 A: The posterior leaf of the broad ligament adjacent to the uterus is perforated just beneath the fallopian tube, utero-ovarian ligaments, and ovarian vessels. B: These are then doubly clamped close to the uterus and severed. (From Cunningham FG, MacDonald PC, Gant NF, et al. Caesarean section and caesarean hysterectomy. In: *Williams obstetrics,* 19th ed. Norwalk, CT: Appleton & Lange, 1993:591, with permission from The McGraw-Hill Companies, Inc.)

The peritoneal incision should be extended superiorly. Because the ureters are dilated in pregnancy, they should be identified quickly to avoid injury. The ureter can be seen crossing the iliac artery at the level of the bifurcation in the medial leaf of the broad ligament and is most easily identified at this location. The utero-ovarian ligaments can be secured by first making a “window” through the posterior leaf of the broad ligament and then doubly clamping, cutting, and ligating the utero-ovarian ligament bilaterally (**Fig. 35A.5**). This step is easy and uncomplicated in the nonpregnant patient, but the dilated vasculature of pregnancy requires the surgeon to carefully select a clear window and handle the tissues gently to avoid troublesome bleeding from easily torn veins. The uterine vessels are skeletonized as in the nonpuerperal

hysterectomy. These vessels are large and easy to identify. Dissection is made easier with continuous upward traction of the uterus. If possible, the uterine vessels are clamped bilaterally (usually with a Heaney or Zeppelin clamp) before the vessels are cut. If there is room, we prefer to place three large clamps on each side and divide the pedicle between the first and second clamp (**Fig. 35A.6**). This provides two clamps on the active vessels for security and one back clamp to prevent back bleeding from the enlarged, blood-engorged uterus. The vascular pedicles are doubly ligated with 0 synthetic absorbable sutures, and we generally prefer to suture ligate the back bleeders also, so that the back camps can be removed from the field. This provides better exposure and reduces the risk of tearing the uterine tissues by excessive traction on these clamps. Once the uterine vessels are secured bilaterally, bleeding should be decreased and the situation should be reevaluated. Taking into account the indication for the hysterectomy in the first place, the stability of the patient, the blood loss to this point and an

estimation of additional blood loss, and the pelvic anatomy, the surgeon may elect to complete the total hysterectomy or decide that, if the bleeding is now well controlled but the patient is unstable or further pelvic dissection risks urinary tract injury or hemorrhage, a supracervical hysterectomy may be advisable. As with all hysterectomies, care must be exercised in identifying and avoiding the ureter.

The next pedicles encountered should be the broad ligament, the base of which is the cardinal ligament. A slightly curved or a straight clamp, whichever fits the anatomy best, can be used for these ligaments. It is better to take several small pedicles instead of one large bite, because an excessively large pedicle can slide out of a clamp or suture. This is especially true with the edematous tissues associated with pregnancy. Once the cardinal and uterosacral ligaments have been clamped, cut, and tied at the level of the cervix, the specimen can be removed by clamping across the vagina on each side and incising the vaginal mucosa (**Fig. 35A.7**). It may be difficult to identify the lower extent of the cervix, especially if the cervix is effaced. The cervix can be grasped with a thumb anteriorly and the hand wrapping around the cervix with the fingers posteriorly. The cervix is then pinched between the thumb and middle finger as the hand slowly slides down the cervix toward the vagina. Usually, it is possible to feel the lower end of the cervix in this way. If there is any doubt, it may also be helpful to make an incision into what is believed to be the anterior vagina just below the cervix using the electrosurgical blade. A finger can be inserted into the vagina, and the cervix palpated directly to confirm its location. Once the specimen has been removed, the cervix should be inspected to ensure that it has been removed completely.

After removal of the uterus and cervix, each of the angles of the lateral vaginal fornix is secured to the cardinal and uterosacral ligaments with a figure-of-eight 0 delayed absorbable suture. There is no unanimity of opinion regarding whether the vaginal cuff should be run and left open or closed. The vaginal cuff can be closed with interrupted figure-of-eight sutures. If there is continued oozing, as with a coagulopathy or in the presence of purulent amniotic fluid, then the vaginal cuff is left open to allow for adequate drainage. Hemostatic agents such as Gelfoam, with or without topical thrombin, or Surgicel can be considered. Reperitonization of the pelvis is not necessary in most cases. All pedicles should be closely inspected for bleeding before the abdominal incision is closed.

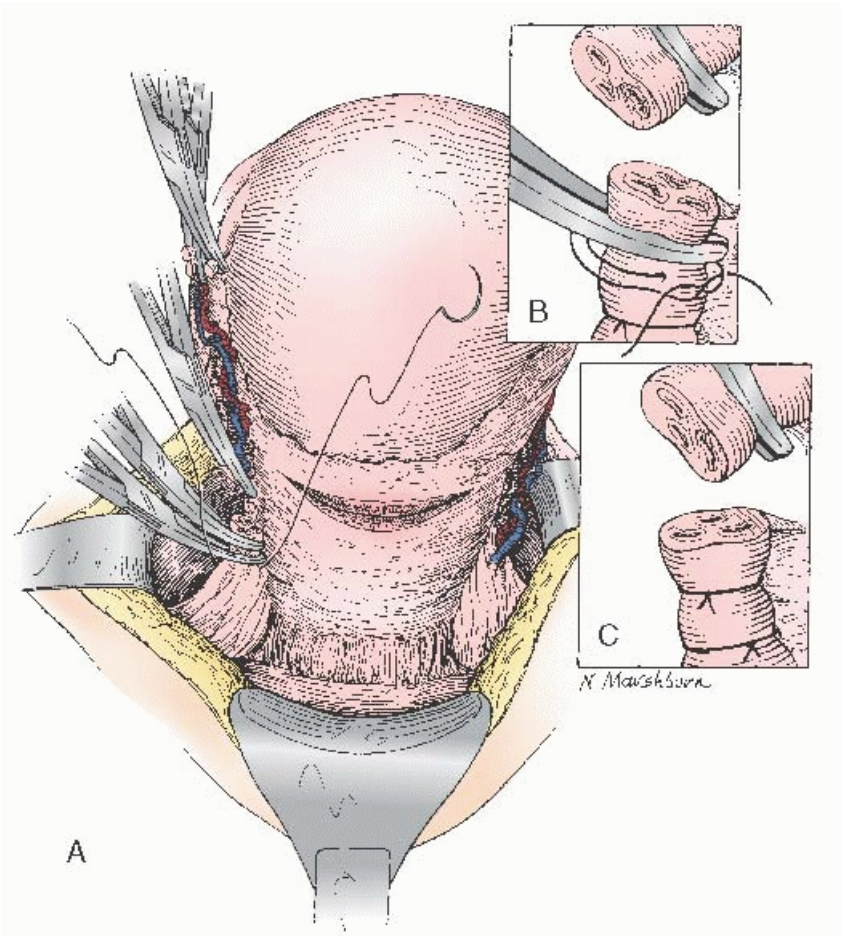

FIGURE 35A.6 A: The uterine artery and veins on either side are doubly clamped immediately adjacent to the uterus and divided. **B, C:** The vascular pedicle is doubly suture ligated. (From Cunningham FG, MacDonald PC, Gant NF, et al. Caesarean section and caesarean hysterectomy. In: *Williams obstetrics,* 19th ed. Norwalk, CT: Appleton & Lange, 1993:591, with permission from The McGraw-Hill Companies, Inc.)

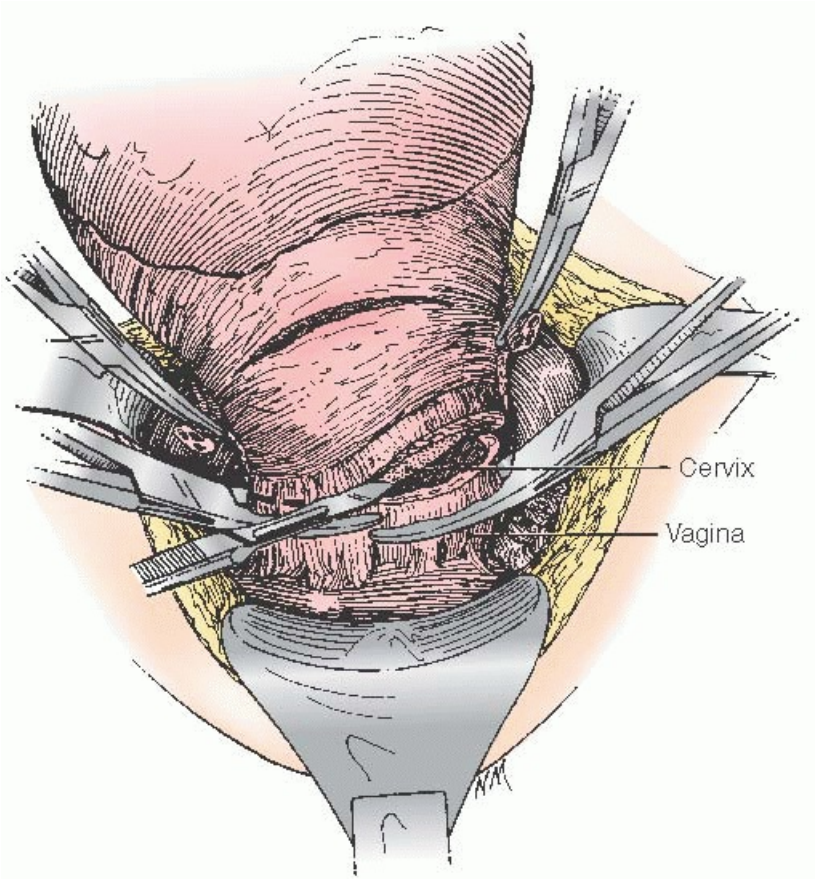

FIGURE 35A.7 A curved clamp is swung in across the lateral vaginal fornix below the level of the cervix, and the tissue is incised medially to the point of the clamp. (Reprinted from Cunningham FG, MacDonald PC, Gant NF, et al. Caesarean section and caesarean hysterectomy. In: *Williams obstetrics,* 19th ed. Norwalk, CT: Appleton & Lange, 1993:591, with permission from The McGraw-Hill Companies, Inc.)

Subtotal versus Total Hysterectomy

Some clinicians have a tendency to perform a subtotal or supracervical hysterectomy in most cases of emergency peripartum hysterectomy. There is a general belief that both operating time and blood loss are significantly lower with the subtotal technique. In addition, the risk of bladder or ureteral injury may be decreased. There is no question that in the select patient who has been or is hemodynamically unstable, it may be prudent to perform a supracervical hysterectomy, especially if all bleeding has been controlled to that point. However, it is necessary to remove the cervix in cases of placenta previa or placenta accreta involving the lower uterine segment.

Despite the reputed advantages of a supracervical hysterectomy, there is evidence that performance of a complete hysterectomy with removal of the cervix adds little to either operating time or blood loss. Clark and associates reported no significant differences in mean values for blood loss and operating time in obstetric patients undergoing emergency total hysterectomy versus supracervical hysterectomy. Mean hospital stay also was not significantly different. However, the women in this study were not randomized to supracervical versus total hysterectomy. In 1998, Zorlu and associates also reported no significant difference between total and supracervical hysterectomy in operative time, blood transfusion, and mean hospital stay. It is important to separate emergency cesarean hysterectomy for hemorrhage, and so on, from elective peripartum hysterectomy for indications such as microinvasive cervical cancer because the blood loss and other morbidity are generally significantly greater for the emergency procedure. It is important for the surgeon to appreciate his or her experience; the stability of the patient; the operative team, including the anesthesiologists and the availability of operative consultation such as other gynecologic surgeons or urologists; and the postoperative support of a good intensive care unit and possible interventional radiology. A combination of good surgical judgment as well as surgical skill is required to achieve the best result.

EPISIOTOMY

An episiotomy is a surgical incision into the perineal body for the purpose of either aiding the actual delivery process or preventing tears and lacerations.

Indications

The routine use of episiotomy with vaginal delivery has been strongly challenged. A recent Practice Bulletin from the American Congress of Obstetricians and Gynecologists stated that the previously held ideas that episiotomy facilitated vaginal delivery, especially difficult or operative vaginal delivery, or improved neonatal outcome when expeditious delivery was indicated are *not* supported by current evidence. Studies by Myles and Santolaya and Bodner-Adler and colleagues failed to show any reduction in anal sphincter damage, rectal mucosal tears, or improved neonatal outcomes in women who underwent episiotomy.

In the past, it was thought that episiotomy prevented vaginal and perineal damage that led to subsequent pelvic relaxation. However, there is little evidence to support the premise that “prophylactic” episiotomy prevents cystocele, rectocele, enterocele, uterine prolapse, vaginal prolapse, or stress urinary incontinence. Röckner and associates evaluated pelvic floor muscle strength using vaginal cones and found that women with episiotomies had less strength than those with spontaneous vaginal deliveries. Neural testing of the

perineal musculature in other studies showed that the amount of denervation was associated with weight of the baby and the length of the second stage of labor and was unrelated to episiotomy. Sleep and Grant looked at deliveries in those who restricted use of episiotomy and those who reported liberal use of episiotomy. Over 3 years of follow-up, there was little difference between the two groups in severity of incontinence or the reported incidence of incontinence. These studies indicate that episiotomy does not appear to prevent the physical/anatomic or symptomatic changes of pelvic relaxation.

In addition, there are no good data to support prophylactic episiotomy for the prevention of "trauma" to the fetus, especially the preterm fetus. Although there is no evidence that the risk of shoulder dystocia can be decreased by the use of an episiotomy, many experts feel that a generous episiotomy may help in the management of a shoulder dystocia when it presents.

In summary, current opinion does not support the routine use of episiotomy for vaginal delivery. Previous ideas that suggested episiotomy decreased the risk of perineal injury, reduced trauma of operative delivery, or improved neonatal outcome have not been supported by recent studies. An episiotomy undoubtedly provides more room for a difficult vaginal delivery. Such deliveries are inherently associated with an increased risk of fetal distress and maternal trauma. The obstetrician must individualize each patient and weigh the potential advantages of an episiotomy against the known risks of episiotomy or vaginal delivery without an episiotomy or even cesarean delivery.

Midline versus Mediolateral Episiotomy

There is little question that the midline perineal incision is easier to perform and repair and is associated with less postoperative pain than is the mediolateral episiotomy. In general, it is also associated with less blood loss and better anatomic results. Midline perineal incisions are used more frequently in the United States, whereas mediolateral episiotomy is used more commonly in Europe. The major disadvantage of midline episiotomy is an increased risk of third- and fourthdegree lacerations. Owen and Hauth report that 20% of primiparous women with a midline episiotomy had a third- or fourth-degree laceration, compared with 9% of women with a mediolateral incision and only 1% when no episiotomy was performed. Of interest, multiparous women with a midline episiotomy had fewer third- and fourth-degree lacerations than those with a mediolateral episiotomy. Although these data appear to favor performing either a mediolateral episiotomy or no episiotomy at all, caution must be exercised when interpreting the data because this was not a randomized, prospective study, and it does not control for possible confounding factors. For example, patients who underwent episiotomy may well have had larger babies, a higher incidence of forceps assistance, or other characteristics resulting in an increased risk of laceration.

Although the mediolateral episiotomy may be associated with fewer third- and fourth-degree lacerations (at least in the primiparous patient) (**Table 35A.4),** there are several disadvantages to this technique. Blood loss is greater, and mediolateral episiotomies are more difficult to repair. Postoperative pain also is more common and can be very troublesome.

In the absence of good, prospective, randomized trials, the decision to perform a mediolateral or midline episiotomy must be based on clinical judgment and experience. A mediolateral episiotomy may provide more room for a difficult delivery

with a lower risk of third- and fourth-degree laceration, but it also results in more blood loss and a greater risk of long-term dyspareunia.

TABLE 35A.4 Relation of Lacerations to Type of Episiotomy in 7,675 Primiparous Women

	TYPE OF EPISIOTOMY		
LACERATION TYPE	**MIDLINE (*n* = 4,822)**	**MEDIOLATERAL (*n* = 79)**	**NONE (*n* = 2,774)**
Second degree	1,425 (30%)	26 (33%)	375 (14%)
Third or fourth degree	968 (20%)	7 (9%)	52 (1%)
Other	295 (6%)	7 (9%)	274 (10%)
Totals	2,688 (56%)	40 (51%)	701 (25%)

Reprinted from Owen J, Hauth JC. Episiotomy infection and dehiscence. In: Gilstrap LC III, Faro S, eds. *Infections in pregnancy.* New York, NY: Alan R. Liss, 1990:61, with permission. Copyright © 1997, John Wiley and Sons.

Episiotomy Repair

STEPS IN THE PROCEDURE

Episiotomy Repair

- Closure of the vaginal mucosa and submucosa with a continuous running locking 2-0 absorbable suture.
- Closure of the fascia and muscle of the perineal body with interrupted sutures using absorbable suture material.
- Closure of the skin of the perineum can be closed with a continuous subcuticular stitch using 3-0 or 4-0 suture. An alternate method to close skin is to use interrupted sutures of 3-0 or 4-0 absorbable suture.
- For sphincter repair, carefully approximate with several interrupted 2-0 sutures through the muscle and fibrous capsule.
- For repair of the rectum, approximate the edges of the rectal mucosa with a running submucosal 3-0 or 4-0 delayed absorbable suture, followed by a second reinforcement layer of the rectovaginal septal tissue.

An episiotomy can be repaired in numerous ways. One popular method is to close the vaginal mucosa and submucosa with a continuous locking suture of 2-0 synthetic delayed absorbable suture, followed by closure of the fascia and muscle of the perineal body with three or four interrupted sutures of similar suture material. The skin of the perineum can then be closed with a continuous subcuticular stitch or by interrupted sutures of 3-0 or 4-0 synthetic absorbable or chromic suture through the subcutaneous tissue and skin. In cases of fourth-degree lacerations, it is important to approximate the edges of the rectal mucosa with a running submucosal 3-0 or 4-0 delayed absorbable or chromic suture, followed by a second reinforcing layer of the rectovaginal septal tissue. If the external anal sphincter is severed, it should be carefully reapproximated with several interrupted 2-0 sutures

through the muscle and fibrous capsule. The technique for primary episiotomy closure is illustrated later in this chapter and is also discussed in Chapter 40.

Complications of Episiotomy

Extensions and Fistula Formation

The major complications of episiotomy include infection, hematoma, breakdown, and fistula formation. Probably the single most common complication is extension (i.e., third- or fourthdegree laceration). Extensions in turn can lead to incontinence of flatus and stool, rectovaginal fistula, and infection. The association of extensions with the type of episiotomy has been discussed already. In the report by Harris, 11.6% of the more than 7,000 women with midline episiotomies had a third- or fourthdegree laceration. In the women with these lacerations, 2% subsequently had poor sphincter tone, and 0.1% developed a rectovaginal fistula. Signorello and colleagues performed a retrospective cohort study to evaluate the relationship between midline episiotomy and anal incontinence postpartum. Women with episiotomies had a higher risk of fecal incontinence 3 months and 6 months postpartum. Episiotomy tripled the risk of fecal incontinence at 3 months and 6 months postpartum and doubled the risk of flatus incontinence compared with women with spontaneous lacerations. In a prospective evaluation of 16,583 deliveries, Walsh and colleagues found that 0.56% of deliveries were complicated by third-degree lacerations. Lacerations were not prevented by episiotomy but were associated with forceps delivery. Of the 81 patients followed, 30 had abnormal anorectal examination, 7% were incontinent of stool, and 12% were incontinent of flatus.

Fistula is fortunately an uncommon complication of episiotomy. Causes include unrecognized lacerations in the rectovaginal septum at the time of episiotomy repair or infected hematoma. Risk factors for fistula formation include obesity, poor hygiene, malnutrition, anemia, history of inflammatory bowel disease, connective tissue disease, or prior exposure to radiation therapy. Half of these fistulae spontaneously heal, but repair should be considered if the patient is bothered by symptoms.

Dehiscence

The exact incidence of episiotomy dehiscence is unknown, but it appears to occur infrequently. In a review of 390 women with fourth-degree perineal lacerations, 18 (4.6%) experienced a dehiscence, and 11 of these were associated with infection.

Several predisposing factors have been reported to be associated with episiotomy dehiscence, including infection, human papillomavirus, cigarette smoking, hematoma, or trauma. Infection is probably the most common factor. In the study by Ramin and associates, 86% of patients with midline episiotomy dehiscence and 69% of patients with mediolateral episiotomy dehiscence had evidence of infection that was based on the presence of fever or purulent discharge. Infection with human papillomavirus also has been reported by some to be associated with dehiscence. Although inadequate or “faulty” repair has been reported to be associated with dehiscence, this is a rare cause.

Early Repair of Dehiscence In the past, it had been taught that repair of episiotomy dehiscence should be delayed for several months to allow for revascularization and healing. However, current surgical opinion supported by recent data strongly favors early repair. Delayed repair is an inconvenience for the woman and may be associated with fecal incontinence and loss of sexual function. Delay also can increase the hospital stay and cost, and increase risk of litigation.

There are many advantages to early repair of episiotomy dehiscence. Hauth and colleagues reported on the efficacy and safety of early repair in eight women who had a dehiscence of a fourth-degree midline episiotomy. Early repair was successful in seven of the eight women. One woman developed a pinpoint rectovaginal fistula 4

days after early repair. This was fixed with a 1-cm rectal flap 4 months later.

Monberg and Hammen reported on the successful resuturing of episiotomy breakdown in 20 women with infection, dehiscence, or both. Although four of the women had superficial reseparation, all subsequently healed spontaneously.

Hankins and associates updated the initial report by Hauth and colleagues to include 22 women with dehiscence of an initial fourth-degree repair, 4 with dehiscence of a third-degree repair, and 5 with breakdown of a mediolateral repair. Initial success of early repair was achieved in 29 (94%) of 31 women. Two women with a pinpoint rectovaginal fistula were subsequently repaired with a rectal flap procedure. Of the 27 women with a follow-up of 1 year or greater, all were continent and had resumption of normal coital activity. The follow-up of the 22 women with early repair of episiotomy dehiscence revealed no complications in 18 patients. Occasional incontinence of flatus and stool, dyspareunia, dyschezia, and numbness occurred in the remaining patients. All of the symptoms resolved by 9 months, except for 2 patients who had persistent dyspareunia.

Ramin and coworkers reported on the early repair of 34 women with episiotomy dehiscence, most of whom were infected (**Table 35A.5).** These women received care from a large urban hospital serving primarily an indigent population. The timing of repair for dehiscence ranged from 3 to 13 days. Two women with initial third-degree episiotomy dehiscence had unsuccessful repairs. Thus, successful repairs were accomplished in 32 (94%) of the women. The average time from delivery to subsequent discharge after repair of the dehiscence was 15.5 days. This is similar to the time reported by Hankins and colleagues. This time probably can be shortened significantly with outpatient management of the wound and repair in ambulatory care units.

Secondary Repair Technique Before attempting a closure, it is important to prepare the wound for repair. The first step is cleaning and debridement of the episiotomy site. This can be accomplished either on the ward with intravenous sedation or local anesthesia or in the operating room under regional anesthesia. All necrotic tissue and suture fragments should be removed and the wound irrigated with a diluted povidone-iodine solution or half-strength Dakin solution. Broad-spectrum antibiotics are indicated for overt infection or significant cellulitis. After initial debridement, the wound should be scrubbed and cleaned at least twice daily. Scrub brushes impregnated with povidone-iodine or gauze dressing pads can be used. A 1 % lidocaine jelly is applied to the wound several minutes before cleansing, and analgesics should be used as necessary. The liberal use of sitz baths helps keep the wound clean.

TABLE 35A.5 Characteristics of 34 Patients with Episiotomy Dehiscence and Subsequent Early Repair

CHARACTERISTIC	MIDLINE	MEDIOLATERAL
Total number of patients	21	13
Type of delivery		
Spontaneous	11	0
Outlet forceps	3	3
Low forceps	7	10

Extension		
None	1	5
Third degree	9	6
Fourth degree	11	2
Evidence of infection	18 (86%)	9 (69%)
Early repair failures	1	1

Reprinted from Ramin SM, Ramus RM, Little BB, et al. Early repair of episiotomy dehiscence associated with infection. *Am J Obstet Gynecol* 1992;167:1104, with permission. Copyright © 1992, Elsevier.

Secondary repair of the episiotomy is not attempted until the wound is free of exudate and covered by granulation tissue. A mechanical bowel preparation with an oral electrolyte solution should be administered the evening before surgery for fourth-degree breakdowns. Prophylactic antibiotics are recommended for all repairs. One to three doses of a first-generation cephalosporin generally proves satisfactory.

The first step in the surgical repair of dehiscence is debridement of granulation tissue and dissection to ensure good tissue mobility. If the anal sphincter muscle has been severed, extensive retraction usually has occurred. It is important to identify the fibrous capsule and mobilize the muscle and capsule for successful reapproximation. If the rectal mucosa has been lacerated, it should be reapproximated as described in this chapter. In a prospective, randomized trial, Fitzpatrick and colleagues compared 55 women who underwent a sphincter overlap procedure with 57 women who underwent staple approximation repair of third-degree lacerations. In this study, there were no significant differences in anal manometry or endoanal ultrasound in the two groups. Therefore, either approach is acceptable. The rest of the closure is the same as for a secondary episiotomy repair. The secondary repair of a fourth-degree episiotomy breakdown is shown in **Figures 35A.8** to **35A.11.**

Postoperatively, women can be placed on a regular diet if the rectal mucosa is not involved. If the rectal mucosa is involved, a low-residue diet should be used for several days and advanced to a regular diet. Stool softeners are recommended, but diarrhea should be avoided because of the increased likelihood of infection. Postoperative care should also include sitz baths and a heat lamp.

The care and repair of a mediolateral episiotomy dehiscence are the same as for a midline repair. More extensive tissue mobilization may be required with the repair of a mediolateral episiotomy dehiscence.

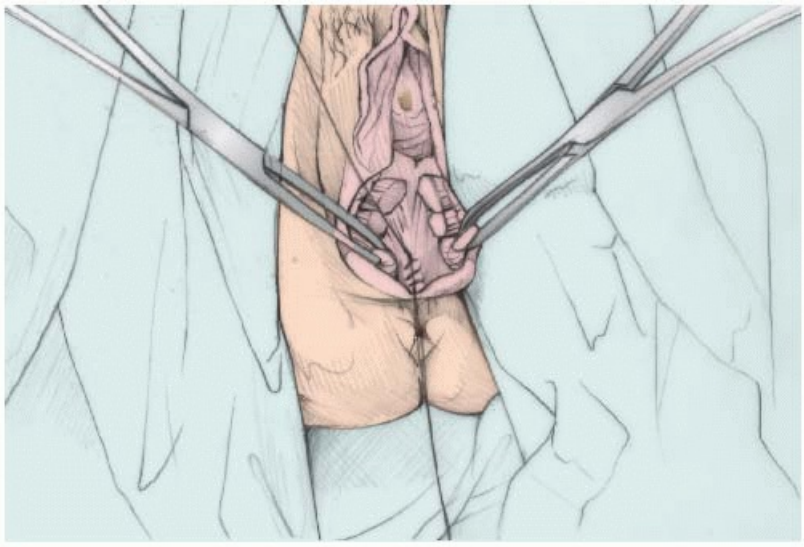

FIGURE 35A.8 Secondary closure of fourth-degree episiotomy breakdown. The rectal mucosa has been closed with 4-0 running chromic submucosal suture and reinforced with a second layer of 3-0 chromic suture through the rectovaginal septum.

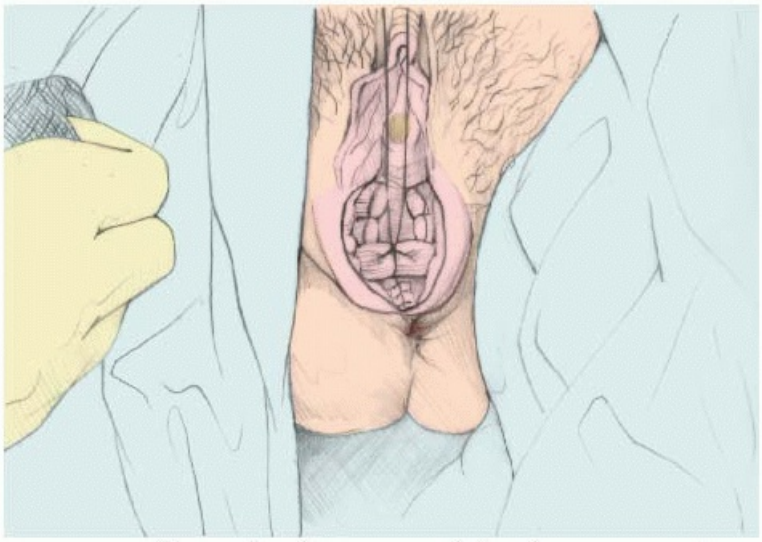

FIGURE 35A.9 The anal sphincter muscle has been reapproximated end to end with several interrupted 2-0 chromic sutures through the muscle and capsule.

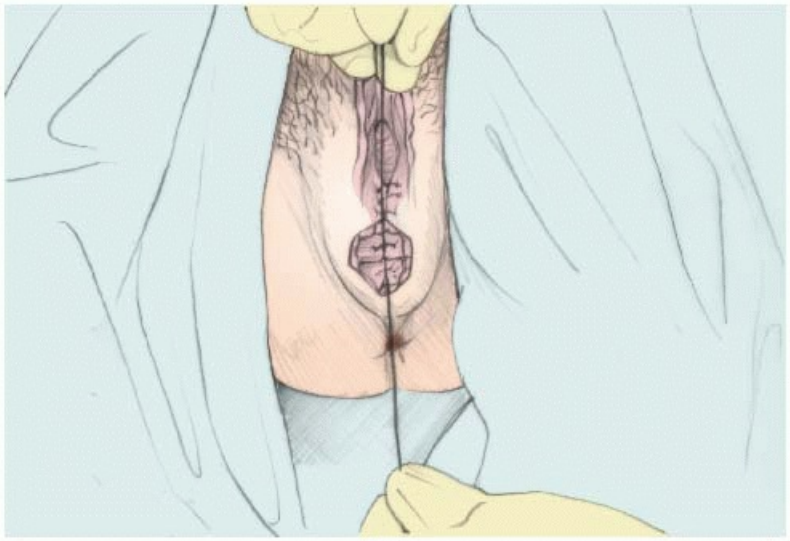

FIGURE 35A.10 The vaginal mucosa and bulbocavernosus muscle have been closed with 2-0 chromic suture.

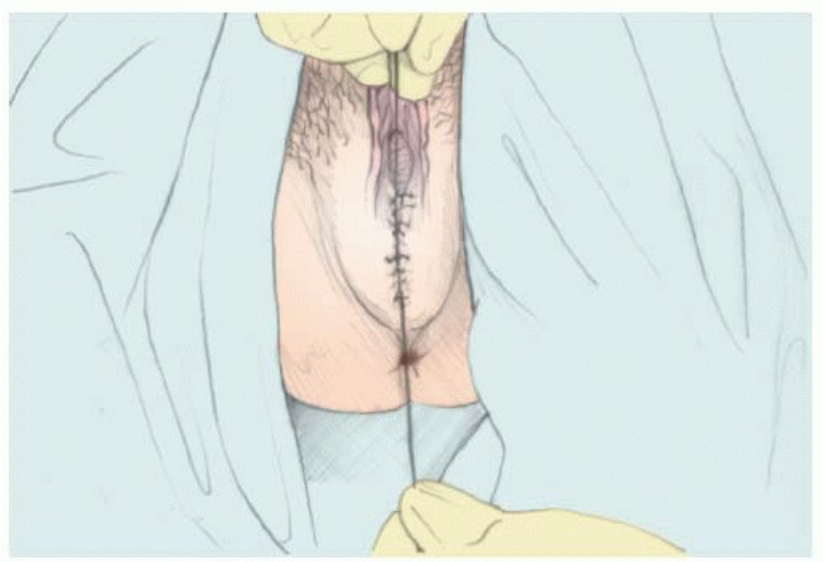

FIGURE 35A.11 Secondary repair of fourth-degree episiotomy dehiscence is completed. (Courtesy of Susan Ramin, University of Texas, Dallas.)

CERVICAL CERCLAGE

Premature dilation of the uterine cervix is a major cause of loss or delivery in midpregnancy. Although the pathophysiology of *cervical insufficiency* is poorly understood and the diagnosis challenging, concepts continue to evolve regarding this complex situation. The concept of cervical insufficiency, its diagnosis, and its management have been well reviewed in a Practice Bulletin issued by the American Congress of Obstetricians and Gynecologists. Although a variety of diagnostic criteria—including prior midtrimester losses and history of cervical surgery (including loop electrode excision procedure or cone biopsy) and painless dilatation of the cervix—have been used in the past and serve as useful clinical risk factors, today *ultrasound monitoring of cervical length and funneling are usually used to make a diagnosis of cervical insufficiency.*

Shirodkar first described cerclage placement in 1955 as a new method to prevent habitual abortion in the second trimester. McDonald, in 1957, reported a simplified technique. The technique for the abdominal approach for cerclage was described by Benson and Durfee in 1965. Data regarding the efficacy of cerclage placement has been conflicting. The Cervical Incompetence Prevention Randomized Cerclage Trial (CIPRACT) concluded that serial ultrasounds for evaluation of cervical insufficiency with secondary intervention are a safe alternative to traditional prophylactic cerclage. Studies have supported the uses of cerclage for pregnancy prolongation in singleton gestations; however, there are conflicting data about its utility in multiple gestations. Cerclage is rarely performed after 24.5 weeks gestation because the risks of surgery are outweighed by the benefits of bed rest for a few weeks to achieve improved fetal survival.

Zaveri and colleagues noted that transabdominal cerclage may be associated with a lower risk of perinatal death, but has a higher risk of intraoperative complications. Data suggest that an abdominal cerclage may be preferable in patients in whom a transvaginal cerclage has failed. The abdominal approach is also indicated in patients whose cervix has been shortened significantly by cone biopsy or other surgery. Laparoscopic transabdominal suture insertion during and before pregnancy has recently been described. Recent case reports suggest that placement of the abdominal cerclage by a laparoscopic approach is safe and may reduce maternal recovery time; however, its efficacy over the additional abdominal approach has not been examined.

Technique

STEPS IN THE PROCEDURE

Cervical Cerclage: Transvaginal

• Modified Shirodkar

- Make a transverse incision in the vaginal mucosa of the anterior cervix to allow for displacement of the bladder upward.
- A posterior incision is made in a similar fashion to avoid entry into the rectum.
- The lateral angles of the anterior and posterior incisions are then expanded with blunt dissection of the lateral cervix.
- A 5-mm woven Mersilene tape on a large needle is then passed through the submucosal tunnel from anterior to posterior on both sides of the cervix, then tied posteriorly.

• McDonald approach

- Placement of a suture of 5-mm Mersilene or other type of heavy monofilament suture (Prolene) around the cervix in a purse-string fashion and securely tied anteriorly

STEPS IN THE PROCEDURE

Cervical Cerclage: Abdominal

- Low, transverse abdominal incision (Pfannenstiel technique)
- Transverse incision of the vesicouterine peritoneum to allow for bladder retraction
- Placement of 5-mm Mersilene suture through the broad ligament close to the cervical stroma and tied securely
- Delivery by cesarean section

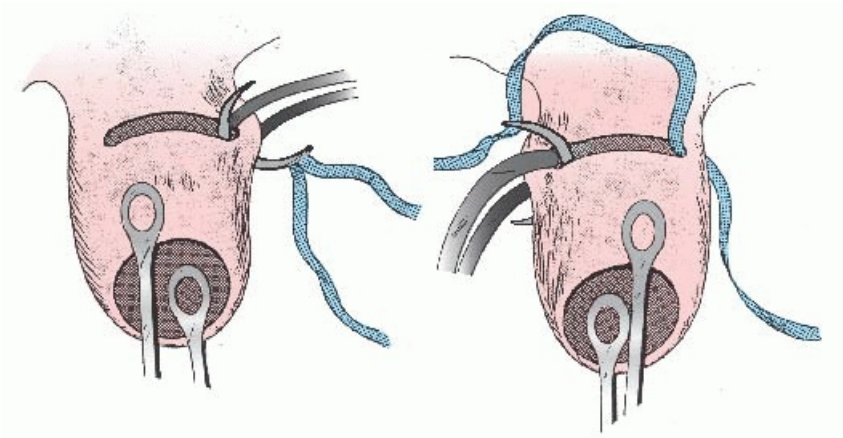

FIGURE 35A.12 Modified Shirodkar cerclage. An incision in the mucosa is made anteriorly and posteriorly to advance the bladder and rectum. A 5-mm Mersilene suture on a large needle is placed in a submucosal tunnel around the cervix and tied posteriorly.

The modified Shirodkar and the McDonald procedure are performed using the transvaginal approach. In the *modified Shirodkar approach,* a transverse incision is made in the vaginal mucosa of the anterior cervix to allow for upward displacement of the bladder to avoid injury. A posterior incision is made in similar fashion to avoid entry into the rectum. The lateral angles of the anterior and posterior incisions are then expanded with blunt fingertip dissection of the lateral cervix (**Fig. 35A.12**). A 5-mm woven Mersilene tape on a large needle (Ethicon, USA) is then passed through the submucosal tunnel from anterior to posterior on both sides of the cervix. It is preferable to avoid entering the cervical canal because the tape may irritate the fetal membranes; this can be done by placing an index finger in the cervical canal as the needle is passed through the lateral cervix. The lateral cervical mucosa at 3 and 9 o'clock can also be grasped with an Allis clamp or ring forceps as shown in **Figure 35A.12** to facilitate placement of the sutures. After the suture is placed on both sides of the cervix, the knot is tied in the posterior defect. The defects are then closed with 3-0 Vicryl in figure-of-eight fashion. We usually leave a whisker of the Mersilene band extending through the closure so that it can be grasped and the suture exposed and cut when the patient goes into labor.

The *McDonald* approach requires no dissection into the cervical tissues. A suture of braided Mersilene or a heavy monofilament suture (Prolene) may be placed around the cervix in purse-string fashion and tied securely (**Fig. 35A.13**).

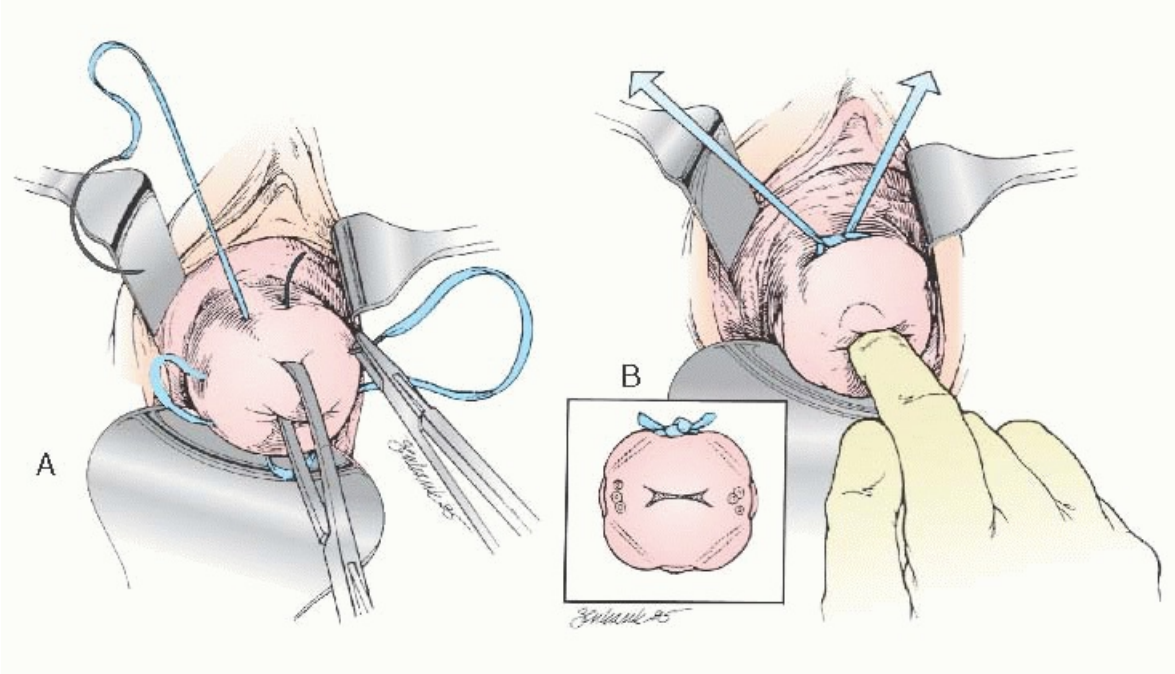

FIGURE 35A.13 Placement of suture for McDonald cervical cerclage. **A:** We use a double-headed Mersilene band with four “bites” in the cervix, avoiding the vessels. **B:** The suture is placed high upon the cervix close to the cervical-vaginal junction, approximately the level of the internal os.

Proponents of the modified Shirodkar feel that cervical dissection assists in placing a higher cerclage, but Rozenburg and associates noted that the anterior colpotomy associated with the modified Shirodkar cerclage only increased the distance from the external os by 2.7 mm. Rust and colleagues noted that the length of the cervix below the level of the cerclage does not affect the rate of preterm delivery.

Placement of the *abdominal cerclage* traditionally has required a low transverse abdominal incision, usually

performed by Pfannenstiel technique. The vesicouterine peritoneum is incised in transverse fashion to allow for retraction of the bladder inferiorly. A suture of 5-mm Mersilene is placed through the broad ligament close to the cervical stroma with care taken to avoid the uterine vessels. The suture is then tied securely. Unlike the transvaginal cerclage, the suture cannot be removed vaginally; thus, the patient requires a cesarean delivery. This suture may be left in place until childbearing is complete.

BEST SURGICAL PRACTICES

- The anatomic and physiologic changes of pregnancy may make diagnosis and surgical management more complex. Ultrasound and magnetic resonance imaging are safe and useful diagnostic imaging techniques that can be used in the pregnant patient.
- Postpartum hemorrhage may be a life-threatening emergency. It may be due to an obstetric laceration, retained products of conception, uterine atony, or coagulation defects. Aggressive fluid replacement and oxytocic agents are indicated while a diagnostic evaluation is undertaken. Uterine packing has recently been rediscovered as an effective way to treat hemorrhage from uterine atony.
- Transcatheter arterial embolization may be very effective to control postpartum hemorrhage. Bilateral uterine artery or hypogastric artery embolization is recommended. This technique is highly effective, preserves the uterus, and does not preclude future pregnancies.
- Surgical techniques for the management of peripartum hemorrhage include uterine artery ligation, hypogastric artery ligation, B-Lynch compression sutures, and hysterectomy. Emergency hysterectomy for hemorrhage is associated with a significantly increased risk of complications, including urinary tract injury and infection. It is not clear whether elective hysterectomy performed at the time of a scheduled cesarean delivery is associated with increased morbidity, but blood loss and risk of transfusion are increased, and delivery followed by hysterectomy 3 to 6 months later may be considered as an alternative.
- The use of episiotomy has declined significantly in recent years. Recently, studies have not shown any benefit of episiotomy in reducing the risk of third- and fourth-degree lacerations, reducing the risk of long-term pelvic support defects, or improving neonatal outcome. Episiotomy should not be used routinely. Median episiotomy is associated with a higher risk of anal sphincter and rectal injury. Mediolateral episiotomy is associated with increased blood loss and perhaps an increase in postpartum pain and longterm dyspareunia. Repair of episiotomy, especially if there is rectal or sphincter injury, should be done meticulously, using good surgical technique with adequate anesthesia and sterile technique.
- Surgical treatment of cervical insufficiency is complicated by a poor understanding of the pathophysiology of the condition. Painless dilatation and effacement of the cervix in the second trimester, usually documented by ultrasound, is an indication for treatment. Both the McDonald and Shirodkar techniques have been used successfully. An abdominal cerclage may be considered if the cervix has been shortened or damaged by surgery or trauma.

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