

Management of Unintended and Abnormal Pregnancy

Comprehensive Abortion Care

Edited by

Maureen Paul, MD, MPH

E. Steve Lichtenberg, MD, MPH

Lynn Borgatta, MD, MPH

David A. Grimes, MD

Phillip G. Stubblefield, MD

Mitchell D. Creinin, MD

Illustrator: Lisa Peñalver, BA, AMI

 **WILEY-BLACKWELL**
A John Wiley & Sons, Ltd., Publication

This edition first published 2009. © 2009 by Blackwell Publishing Ltd

Blackwell Publishing was acquired by John Wiley & Sons in February 2007. Blackwell's publishing program has been merged with Wiley's global Scientific, Technical and Medical business to form Wiley-Blackwell.

Registered office: John Wiley & Sons Ltd, The Atrium, Southern Gate, Chichester, West Sussex, PO19 8SQ, UK

Editorial offices: 9600 Garsington Road, Oxford, OX4 2DQ, UK
The Atrium, Southern Gate, Chichester, West Sussex, PO19 8SQ, UK
111 River Street, Hoboken, NJ 07030-5774, USA

For details of our global editorial offices, for customer services and for information about how to apply for permission to reuse the copyright material in this book, please see our website at www.wiley.com/wiley-blackwell.

The right of the author to be identified as the author of this work has been asserted in accordance with the Copyright, Designs and Patents Act 1988.

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system, or transmitted, in any form or by any means, electronic, mechanical, photocopying, recording or otherwise, except as permitted by the UK Copyright, Designs and Patents Act 1988, without the prior permission of the publisher.

Wiley also publishes its books in a variety of electronic formats. Some content that appears in print may not be available in electronic books.

Designations used by companies to distinguish their products are often claimed as trademarks. All brand names and product names used in this book are trade names, service marks, trademarks or registered trademarks of their respective owners. The publisher is not associated with any product or vendor mentioned in this book. This publication is designed to provide accurate and authoritative information in regard to the subject matter covered. It is sold on the understanding that the publisher is not engaged in rendering professional services. If professional advice or other expert assistance is required, the services of a competent professional should be sought.

The contents of this work are intended to further general scientific research, understanding, and discussion only and are not intended and should not be relied upon as recommending or promoting a specific method, diagnosis, or treatment by physicians for any particular patient. The publisher and the author make no representations or warranties with respect to the accuracy or completeness of the contents of this work and specifically disclaim all warranties, including without limitation any implied warranties of fitness for a particular purpose. In view of ongoing research, equipment modifications, changes in governmental regulations, and the constant flow of information relating to the use of medicines, equipment, and devices, the reader is urged to review and evaluate the information provided in the package insert or instructions for each medicine, equipment, or device for, among other things, any changes in the instructions or indication of usage and for added warnings and precautions. Readers should consult with a specialist where appropriate. The fact that an organization or Website is referred to in this work as a citation and/or a potential source of further information does not mean that the author or the publisher endorses the information the organization or Website may provide or recommendations it may make. Further, readers should be aware that Internet Websites listed in this work may have changed or disappeared between when this work was written and when it is read. No warranty may be created or extended by any promotional statements for this work. Neither the publisher nor the author shall be liable for any damages arising herefrom.

ISBN: 978-1-4051-7696-5

A catalogue record for this book is available from the British Library.

Set in 9/12pt Meridien by Aptara® Inc., New Delhi, India
Printed and bound in the UK by TJ International

1 2009

This is an excerpt, pp.227-246, from 2009 edition of abortion textbook, without pages with tables. The tables were excluded because they show a low rate of complications per abortion site, which is possibly inaccurate. What is shown is the number of procedures performed and the number of complications, but not the number of patients who returned for follow-up visit. By their own admission, p.20, 1999 edition, "the largest database of abortion complications in the United States is maintained by the National Abortion Federation (NAF)." "In the United States only about one-third of abortion patients return for follow-up care, so delayed complications are not always known to the abortion provider." Medical and nursing reference books continue to repeat the assumption that "abortion is safer than childbirth," yet there is absolutely no data to support that claim. There is no national, mandatory, methodical system for reporting abortion deaths and injuries.

E. Lynn Smith, R.N.

Misestimation and failure in induced abortion

Underestimation of gestational age

Underestimation of gestational age can result in preventable complications, particularly when the gestational age lies beyond the surgical skills of the provider or when cervical priming is omitted in a patient with a noncompliant cervix. Facilities providing abortion without ultrasonographic confirmation of gestational age should advise patients about this possibility during the informed consent process. Clinical dating using the patient's history and pelvic examination can sometimes be inaccurate, irrespective of clinician experience (Chapter 6). Patient anxiety, obesity, and uterine retroversion make gestational age assessment particularly challenging. As a result, providers typically obtain ultrasound confirmation when uterine size is uncertain or exceeds 12 weeks.

In a series of 15 cases of uterine perforation during D&E, the authors found underestimation of gestational age by 2 weeks or more in six patients [29]. Seven patients had not undergone preoperative ultrasonography. In three cases the surgeon unwisely proceeded with the abortion despite an assessment that cervical dilation was inadequate.

Telltale signs of underestimation during D&E include more amniotic fluid than anticipated and larger-than-expected fetal parts or umbilical cord diameter. When underestimation is suspected, the provider should stop the procedure and use ultrasonography to estimate gestational age. In the case of an early- or mid-second-trimester pregnancy with a compliant cervix, an experienced surgeon may be able to dilate the cervix safely using mechanical dilation. Usually, however, the safer strategy is to stop and prepare the cervix with osmotic dilators or prostaglandins before completing surgical evacuation. An alternative is to switch the procedure to a labor-induction abortion. Amended consents and prophylactic antibiotics are advisable in these circumstances.

Failed attempted abortion

Failed surgical abortion is rare. In a large prospective study conducted from 1975 to 1978, the proportion of failed first-trimester surgical abortions was 2.3 per 1,000 procedures [30]. According to voluntary self-reports by NAF member clinics, the frequency following first-trimester surgical abortion has remained constant during the last decade at about 0.5 per 1,000 cases; some underreporting is likely, however. Several factors increase the risk for this complication. Uterine anomalies, whether congenital (e.g., bicornuate or septate uterus) or acquired (e.g., fibroids, synechiae), are associated with a high risk of failed attempted abortion. In a study of 33,000 first-trimester abortions, the relative risk of failed abortion in women with uterine anomalies was 90 times that of women with normal anatomy; multiple prior pregnancies, early gestational age, and operator inexperience also conferred increased risk [30]. In another series, involving 25 failed vacuum abortions, four patients had septate uteri, three had rudimentary horns, and eight had tubal ectopics [31].

Recent reports have addressed the risk of failure with early surgical abortion. Using a protocol involving sensitive human chorionic gonadotropin (hCG) testing, intraoperative ultrasonography, and manual vacuum aspiration, a physician performed surgical abortions on 2,399 patients with gestations of less than 6 weeks. Only three (0.13%) required reaspirations for continuing pregnancies, which were discovered expeditiously. Three additional reaspirations were performed for hematometra [32]. Among 1,132 patients having vacuum abortions at less than 6 weeks' gestation by several experienced physicians at a large Planned Parenthood affiliate, the risk of failed abortion was 2% after rigorous follow-up [33].

Failed attempted abortion is usually recognized by immediate gross tissue examination with backlighting or the use of magnification when necessary. Clinic staff members can be trained to become proficient examiners of tissue specimens. Routine screening of tissue aspirates may on occasion uncover important ancillary findings including suspicion of hydatidiform mole, multiple gestation, or fetal

deformity, disclosure of which may prove useful in genetic counseling [34].

Postoperative ultrasonography is usually diagnostic of failed attempted abortion, but formal ultrasound consultation is sometimes necessary. Collapsed sacs and small intact gestational sacs in bicornuate, septate, or large fibroid uteri, as well as cornual/interstitial implantations, can be challenging to visualize. A useful first-trimester evacuation technique with uterine duplication anomalies is to direct a malleable sound into the pregnant cavity under ultrasound guidance (Chapter 13).

In some instances, failed abortion is not recognized immediately. Patients who report persistent pregnancy symptoms after a week warrant evaluation for continuing pregnancy. However, not every woman with a failed abortion experiences or acknowledges pregnancy symptoms. Although current data do not support the need for a routine postabortion visit for all patients [35], scheduling follow-up for those with risk factors for failed abortion is prudent unless the provider unequivocally confirmed successful abortion at the time of the procedure. Low-sensitivity urine hCG assays offer a simple and inexpensive means of screening patients after surgical abortion. A positive latex-agglutination hCG slide test (sensitivity of about 1,500 to 2,000 mIU/ml) 2 weeks after surgical abortion warrants assessment for retained placenta, ongoing pregnancy, or gestational trophoblastic disease. When failed abortion is diagnosed, most patients choose to undergo repeat uterine evacuation, as did all patients in the aforementioned series by Kaunitz [30] and Valle [31].

Failed attempted abortion may or may not adversely affect obstetrical outcomes in women who continue their pregnancies. Data are limited to small case series. A recent US single-institution report described 18 failed attempted vacuum abortions, 11 (60%) of which occurred at 7 weeks' gestation or less. By 6 weeks after the procedure, only 12 failures (67%) had been discovered. Seven patients elected to continue their pregnancies, and another four exceeded the upper-gestational-age limit for an abortion. Among these 11 continuing pregnancies, seven (77%) had complications: growth restriction occurred in two; preterm labor in two, and premature membrane rupture in three. In all, eight of 11 newborns survived. Two mothers had postpartum depression and seven expressed guilt, underscoring the potential emotional burden of experiencing traumatic obstetrical outcomes after a reversal of the initial decision to abort [36].

Retained tissue

Incomplete abortion

Retained products of conception is one of the more common complications of surgical abortion. Worldwide, the frequency of reaspiration after first-trimester surgical abortion varies from 0.29 to 1.96% and in the second trimester, from 0.40 to 2.70% (Table 15.2).

Women with retained products commonly present with lower abdominal pain and bleeding. Although symptoms usually arise within the first week, patients with subtle symptoms may not seek immediate attention. Infection occurs infrequently provided the operators are well trained, use sterile technique, and the uterus has not been injured. The uterus may feel enlarged and soft, and ultrasonography reveals a heterogeneous echo complex in the cavity. However, gray-scale ultrasonography and bimanual uterine examination cannot distinguish between retained products of conception and hematometra unless placental tissue protrudes from the cervical os or fetal bone is seen on ultrasonography [37]. Also, intrauterine collections of varying echogenicity represent normal ultrasound findings after surgical abortion and do not usually warrant intervention in asymptomatic women [38,39].

The pathology report after reaspiration may also be unhelpful or misleading. In a pilot study with a convenience sample of 200 women undergoing first- and second-trimester surgical abortions by a single experienced operator, a pathologist identified scattered villi microscopically in 32% of specimens obtained by repeat vacuum curettage for 30 seconds immediately after clinically complete evacuation (Christensen D, 1995, unpublished observations). Thus, the presence of villi on pathology slides after successful surgical abortion is an expected finding and is not diagnostic of retained tissue.

After surgical abortion, small amounts of retained products may pass spontaneously, avoiding the need for further intervention. If large amounts of tissue are left, the patient is at risk for bleeding and infection. Endometritis following untreated incomplete abortion can evolve into salpingitis and, occasionally, sepsis [53]. Therefore, prompt vacuum reaspiration or prostaglandin therapy (e.g., misoprostol 800 µg vaginally) is the treatment in symptomatic cases; sharp metal curettage should not be used as the primary means of evacuation. Aspiration is preferred over expectant or medical management if signs of infection, hemorrhage, severe pain, or serious anemia are present. Antibiotic treatment after reevacuation is optional unless the provider suspects infection.

Thoroughness is the key in reducing the risk of retained products after surgical abortion. Proper surgical technique includes positioning the vacuum cannula well into the endometrial cavity and suctioning until tissue is no longer forthcoming; a gritty sensation is often detectable as the cannula moves against the emptied uterine cavity (Chapter 10). Intraoperative ultrasonography may be helpful in difficult cases. Although some clinicians perform a sharp curette check at the end of the procedure, no data exist concerning the advisability of this practice and it may carry some risk.

Hematometra

Hematometra refers to accumulation of blood in the uterine cavity. This gynecological term is preferable to obsolete

descriptions such as "postabortal syndrome," "redo syndrome," "postabortal pain syndrome," and retained clot. The frequency of this complication after suction curettage is about 2 per 1,000 [5,54]. In one study of 170,000 vacuum abortions, 88% of patients requiring remote aspiration ($n = 285$) had hematometra rather than retained products of conception [5]. Studies comparing general anesthesia with local anesthesia have not shown differences in the frequency of hematometra [5].

The volume of liquid and clotted blood varies, as does the timing of presentation. For example, accumulation of 250 to 1500 ml of blood causes low midline pelvic pressure and cramping within 15 minutes and up to several hours after the procedure. When large volumes of blood are sequestered in the uterus, hypotension may occur. Alternatively, patients may have vasovagal reactions from the pain of uterine distension. Accumulations of less than 100 ml are more common and can remain asymptomatic, even for a few weeks. Patients may have sudden expulsion of clots, pelvic pressure, and mild fever. Typically, pelvic examination reveals an enlarged, firm, and tender uterus; ultrasonography shows an intrauterine heterogeneous echo complex (Fig. 15.1). The process is often self-limiting and responds immediately to repeat suctioning. Reaspiration can be accomplished with an electric suction machine, manual vacuum aspirator, or even wall suction in an emergency department. Mild temperature elevations are usually not indicative of infection; these usually resolve rapidly with reevacuation, regardless of antibiotic coverage.

Prophylactic uterotonic agents may reduce the risk of postabortal hematometra, although data are sparse. Approaches include oral ergot derivatives, such as ergonovine 0.1 mg intramuscularly or intracervically, or low-dose locally administered vasopressin [55,56]. Small intrauterine accumulations of blood visible on ultrasonography after surgical abortion are normal, may take several days to dissolve or expel, and should be regarded as a natural physiologic event that seldom requires intervention [38,39,57].

Hemorrhage

Uterine hemorrhage associated with abortion can result from cervical laceration, perforation, retained tissue, uterine atony or rupture, uterine scar-related problems, arteriovenous malformations, placental abnormalities (accreta, increta and percreta), or coagulopathy. Because of the poor validity of estimates of blood loss and varying definitions of hemorrhage, sound comparisons of incidence are elusive. Over time, however, incidence rates in North America have trended downward, possibly reflecting greater surgical experience and more skill in the use of uterotonic agents (Table 15.3). The rare frequency of blood transfusion provides a better measure of serious blood loss.

Surgical inexperience and gestations beyond 10 weeks are associated with increased risk of uterine hemorrhage. Other

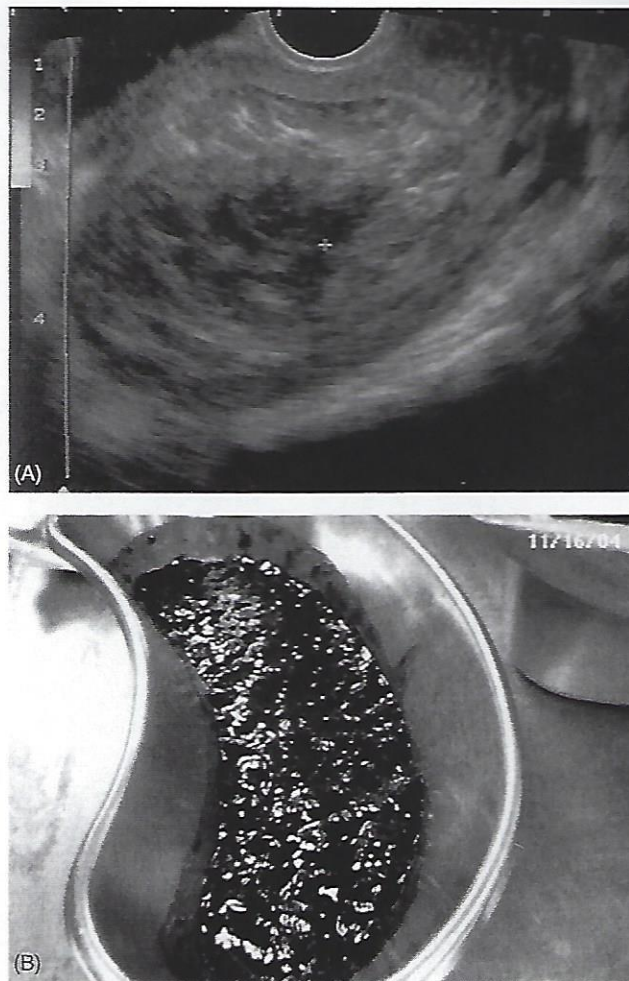


Figure 15.1 (A) Transvaginal ultrasound image showing intracavitary heterogeneous echoes in a patient with hematometra diagnosed 4 days after aspiration abortion at 12 weeks' gestation. (B) Uterine reaspiration yielded approximately 150 cc of blood clots and serum only.

risk factors include advanced maternal age and parity [62], prior cesarean delivery, number of uterine scars, uterine fibroids, and history of excessive postabortal or postpartum bleeding. By reducing uterine tone, halogenated anesthetic gases may also increase the risk of blood loss.

Several measures may reduce blood loss with abortion. Administration of vasopressin 4 units with paracervical anesthesia reduces bleeding with second-trimester D&E, and the effect increases with gestational age [63]. Peterson et al reported a decrease in the incidence of blood loss exceeding 500 ml from 9 per 1,000 D&Es to 2 per 1,000 in a large ($n = 12,000$) single-institution series after 1 ml of vasopressin was added to the local cervical anesthetic [41]. Pridmore and Chambers found similar improvement when 5 μ g/ml of epinephrine was added to the intracervical block ($n = 5,700$ patients) [51]. Another study reported that local vasopressin produced a 50% reduction in blood loss at all gestations before 13 weeks [64].

Uterine atony

Uterine atony is a potentially serious complication of induced abortion. Clinicians should consider it whenever excessive blood loss occurs during or after an abortion.

Depending on the severity of bleeding, treatment may proceed sequentially or concomitantly. Treatment options include manual uterine massage, dilute intravenous oxytocin, intramuscular ergot derivatives, and low-dose cervical vasopressin injections (e.g., 4 to 6 pressor units injected in the paracervical tissue as part of cervical anesthesia). Intraoperative use of the four classes of uterotonic agents (oxytocin, ergot, vasopressin, and prostaglandins) reduces surgical blood loss in abortion, particularly after the first trimester. Elaborated at separate gene sites, they probably work synergistically to control bleeding.

For treating atony, rectal misoprostol has largely replaced intramuscular carboprost (250 µg, repeated every 15 minutes up to eight doses) in many centers as the initial high-intensity option. Five tablets per rectum (1000 µg) usually stop bleeding within a few minutes [65] and this regimen is both less expensive and potentially less noxious (vomiting, diarrhea, transient fever) than carboprost. Higher-dose vasopressin (10 units) in 20 ml of crystalloid, administered transcervically into the myometrium at multiple sites, produces rapid vasoconstriction that may last for up to 45 minutes.

Intrauterine tamponade with plain gauze [66] or with vasopressin- or thrombin-soaked [67] gauze packing can be an effective temporizing or therapeutic measure; so can balloon catheters [68]. Foley catheters with 30- to 75-ml balloons are standard equipment in many operative settings and have been inflated safely beyond their stated capacity in emergencies [68,69] with good clinical outcomes. For uterine cavities capable of greater distension, a larger intrauterine catheter [70] can inflate to volumes of 250 ml.

Surgical measures include encircling sutures around the uterus, hypogastric [71] or uterine artery ligation [72], and hysterectomy. B-Lynch [73] described a single suture surrounding the uterine wall. Of the simplified versions published since then [74,75], the modification by Pereira [76] is the only one that avoids entry into the uterus. A single-institution series of 28 postpartum cases using primarily the B-Lynch technique reported success in 82%. Among seven of these patients who underwent subsequent repeat cesareans, grooves or mild adhesions of the uterine serosa were observed in four cases [77]. Data are too limited to evaluate any effect on future fertility. Effective use of a Bakri balloon (Appendix, Fig. A-14) together with a B-Lynch compression suture has been reported [78].

Angiographic embolization is another treatment option for refractory atony [79,80]. Borgatta summarized 11 unpublished and seven published cases of embolization use in women undergoing spontaneous or induced abortions; three cases had atony as a contributing diagnosis. Seventeen of 18 women had successful treatment, including all 11 women

with pregnancies beyond 14 weeks' gestation [79]. Angiographic embolization has clinical limitations; it takes about 1 hour to set up after the radiology team is assembled. It may be inadequate to treat multiple vessel injuries accompanying a large uterine laceration, and its success with placenta accreta/increta/percreta is mixed [79,80]. Occasionally, cases refractory to occlusion of the uterine artery alone will then respond when the utero-ovarian vessels are supplementally injected with occlusive agents [79]. On occasion, radiopaque dye alone may occlude a single damaged arteriole responsible for uncontrolled hemorrhage after D&E abortion [81].

Placental abnormalities

In ultrasonography studies, the reported prevalence of second-trimester placenta previa ranges from 2 to 6%; rates are higher if low-lying placentas are included [82]. Placenta previa itself (without placenta accreta) does not complicate abortion, including D&E [83,84]. Likewise, vasa previa has not been associated with abortion-related complications [85]. In terms of the pathophysiology of benign previas, serial ultrasonography of the progressing pregnancy illustrates an upward migration of the placenta toward the fundus as the placenta seeks the more fulsome blood supply available in the fundus, resulting in the relative atrophy of the portion overlying the less well-perfused lower segment and cervix [85]. As a result, unless placenta previa actually overlies a uterine scar (usually entailing a complete or wraparound previa), risk of abnormal placental adherence is low. Laminaria insertion is safe in the presence of benign placenta previa [86]. Even when an accreta is present, insertion of osmotic dilators does not usually trigger uncontrollable bleeding, but their removal may. Hence, the provider must be equipped to deal immediately with life-threatening hemorrhage at the start of any procedure in which placenta accreta is known or suspected. In a case-control study, Johnson et al [87] found that repeated sharp curettage procedures (OR 2.9, 95% CI 1.0, 8.5 for ≥ 3 abortions), but not multiple vacuum aspirations (OR 1.4, 95% CI 0.6, 3.1 for ≥ 3 abortions), were associated with risk of subsequent placenta previa. This finding carries stark implications for regions where sharp curettage is still commonly practiced for induced abortion or management of spontaneous abortion.

Placenta accreta carries the risk of torrential bleeding during uterine evacuation, and its frequency may be increasing as cesarean delivery becomes more common [88]. In a large series of D&E abortions, the estimated prevalence of placenta accreta was about 0.4 per 1,000 operations. All seven patients had at least one prior cesarean delivery, and all required hysterectomy for management of hemorrhage [89]. The most recent information on the relationship between cesarean delivery and placenta accreta comes from the Maternal-Fetal Medicine Units Network [90,91]. In these obstetrical populations the risk of placenta accreta,

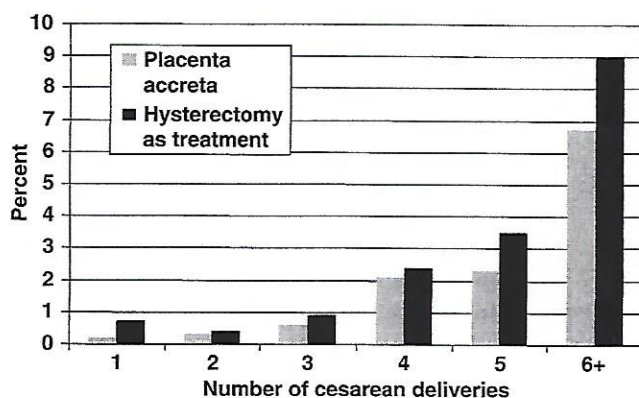


Figure 15.2 The relationship between number of cesarean deliveries and the risk of placenta accreta and hysterectomy for treatment (Data from Silver et al [90].)

and hysterectomy as its treatment, increased exponentially with the number of previous cesarean deliveries women had (Fig. 15.2).

Placenta accreta is rare in first-trimester abortion [92–94]. Second-trimester abortion patients with complete placenta previa and a history of cesarean delivery are at serious risk for placenta accreta. Placental localization for second-trimester patients with prior uterine incision may be helpful, with referral of suspicious cases to a skilled ultrasonographer. Color Doppler ultrasonography, computer-assisted tomography (CT) scanning, or magnetic resonance imaging (MRI) have varying diagnostic accuracy [95,96] (Fig. 15.3). The combination of initial color Doppler scanning (sensitivity 0.77, specificity 0.96) plus confirmatory MRI for equivocal cases (sensitivity 0.88, specificity 1.0) has been effective [97].

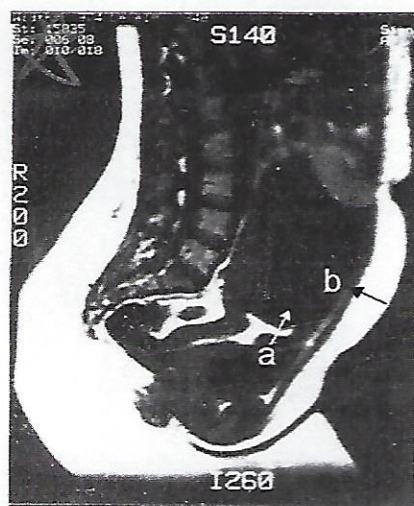


Figure 15.3 Magnetic resonance imaging (MRI) ruled out placenta accreta in a woman 23 weeks pregnant with placenta previa and a history of three prior cesarean deliveries. Sagittal T2-weighted image through the placenta previa. Normal placenta (a) remains dark and does not invade the anterior scar tissue (b), which remains lucid throughout.

Angiographic embolization has been used with mixed results to treat unremitting hemorrhage from placenta accreta following D&E. Borgatta [79] reported four successful preoperative embolizations among eight patients with high radiological suspicion of placenta accreta. These women underwent surgical abortion at or after 12 weeks' gestation. Steinauer and colleagues [80] reported successful uterine artery embolization in 38 of 42 patients. The four treatment failures had histologic confirmation of placenta accreta (incretta or percreta) after hysterectomy. Eight women with cervical lacerations or perforations had successful embolizations.

When placenta accreta is suspected, performing the D&E in a hospital with full blood-bank capabilities is prudent. Second-trimester labor induction is contraindicated. The preoperative treatment plan should include extensive family counseling and mobilization of staff and supplies necessary to perform emergency hysterectomy with massive blood and clotting-factor replacement. Preoperative placement of an angiographic port is advisable in high-risk cases, especially those that suggest bladder involvement (placenta percreta). Prophylactic stenting of the ureter(s) deserves consideration as well. For select cases, allowing the adherent placenta to remain *in situ* is an option [98], sometimes in conjunction with administration of methotrexate to promote its reabsorption. Because these measures entail some risk of remote bleeding as well as infection [98] and no studies are available to gauge their overall benefit versus risk, expert consultation is advisable when contemplating their use.

Arteriovenous malformation

Uterine arteriovenous malformation (AVM) of the endometrium, a rare but life-threatening condition, can be congenital or acquired. Operations, trauma, infection, or neoplasm (e.g., gestational trophoblastic disease or carcinoma) can lead to abnormal communication between arteries and veins. With color Doppler ultrasound, CT scan, MRI, or angiography, an AVM appears as a loosely arrayed bundle of inchoate vessels resembling the findings seen at the site of a placenta accreta; hence they are sometimes misdiagnosed, one for the other [94].

An AVM can produce massive bleeding unresponsive to standard uterotonic therapy. In other instances, heavy or moderate persistent bleeding can occur hours, days, or months later. Hemorrhage associated with AVM has occurred spontaneously [99] and following spontaneous abortion [100], early medical abortion [101], and surgical abortion in the first [102] and second trimesters [103]. Conservative management has been successful for milder presentations [101], but serious bleeding warrants angiographic embolization, which has often been therapeutic, with anecdotal reports of subsequent successful delivery in five cases [104].

Disseminated intravascular coagulopathy

Disseminated intravascular coagulopathy (DIC) is an infrequent but dangerous complication. First-trimester frequency ranges from 0.0 to 0.08% [48,105] (Lichtenberg ES, 1995, unpublished observations) and in the second trimester, 0.0 to 0.5% [40,49,106]. The risk of DIC increases with advanced gestational age, prolonged fetal death, abruptio placentae, placenta previa or accreta, amniotic fluid embolism, and massive blood loss. DIC can follow an uncomplicated D&E in a patient without preexisting conditions (idiopathic DIC). In dedicated pregnancy termination facilities with experienced surgeons, idiopathic DIC is the most common clinical presentation of this condition. Intravascular infusion of amniotic fluid during the operation has long been hypothesized to trigger the clotting cascade, with the coagulopathy first becoming evident in the recovery room. In reality, fetal cells are invariably present in the maternal circulation beginning in early pregnancy, and no compelling evidence has explained why most pregnancies avoid this complication despite the obvious admixing of maternal and fetal elements in the maternal circulation.

In abortion practice, recognition of DIC is complicated by its infrequency, mimicry, and insidious onset. What begins as normal or absent bleeding may evolve into accumulation of intrauterine clot resembling postabortal hematometra before ultimately manifesting as DIC. The transformation from clotted bleeding to serosanguineous flow may take from 30 minutes to 6 hours or more. Differential diagnoses include uterine atony and operative trauma. Aggressive uterotonic therapy, reaspiration, and thorough digital examination of the uterus help to exclude these other conditions.

A coagulation panel is useful but not essential. Drops in fibrinogen level and platelet count and increased fibrinogen degradation products (fibrin split monomer) or D-dimer (molecules resulting from fibrinolysis of thrombi) are the most sensitive indices. Clinicians can diagnose DIC early in its course with a simple bedside test: failure of 10 cc of whole blood to produce a retracted, stable clot in a plain glass tube within 5 to 10 minutes indicates impaired clotting. Conversely, the presence of a solid clot excludes DIC from the differential diagnosis at that time.

Once the diagnosis of DIC is made, therapy consists of clotting factors and volume replacement and, if needed, red cell transfusions. Rapid treatment may forestall progression of DIC. Therefore, one or two large (16 to 18 gauge) intravenous ports should be established for rapid infusion. True blood loss may substantially exceed measured blood loss, because DIC is a systemic process involving small vessels throughout the body. When administered early in DIC, as little as 2 to 4 units of fresh frozen plasma (FFP) usually restore clotting function; occasionally, 5 to 8 units or more are needed. Each standard unit of FFP (200 to 250 ml) raises fibrinogen levels about 25 mg/dl. Although FFP derived from AB-negative donors is usual, specimens

from AB-positive donors can be utilized safely if the patient receives full dose Rh-immune globulin.

Cryoprecipitate is another important acceptable clotting factor replacement. It is the cold precipitable fraction of FFP suspended in a minimal plasma volume and refrozen. Cryoprecipitate contains only fibrinogen (200–300 mg), factor VIII:C (80–120 units), von Willebrand factor, fibronectin, and factor XIII. Like FFP, cryoprecipitate is type-specific, has a shelf life of 1 year, and can be thawed rapidly by microwave. About 14 units are required to raise fibrinogen 100 mg/dl. The selection and number of units of products can be coordinated with blood bank personnel and guided by the severity of the coagulopathy; it has the advantage of equal effect at lower replacement volume but is more expensive.

Recombinant activated factor VII (rFVIIa) is a powerful, costly (US\$9,000 to \$18,000) synthetic procoagulant therapy [107]. Where available, it can serve as a last resort for unremitting hemorrhage because of tissue injury or coagulopathy [108]. Onset of action typically occurs 10 to 30 minutes after infusion. Thrombosis is a rare complication, mostly among patients extensively immobilized during convalescence.

Transfusion with packed red blood cells deserves consideration when orthostasis, confusion, or oliguria persist after volume replacement with crystalloid or plasma expanders. In a normal adult, blood volume comprises 8% of body weight (5,600 ml in a 70-kg [154-lb] adult). Young, healthy women with continuing acute blood loss below a hematocrit range of 15 to 19% may require transfusion [109,110]. Earlier transfusion may be indicated in women with cardiovascular or respiratory disease. Because the hematocrit does not equilibrate for several hours after acute blood loss, treatment is guided by a combination of blood pressure, pulse, urine output, and clinical judgment, and not solely by serial hematocrit levels. Attentive monitoring is the rule and should include periodic orthostatic vital signs, vaginal pad counts, measurement of urine output (>25–30 ml/hour), inspection for cutaneous bleeding sites, evaluation of patient consciousness, and serial hematocrit determinations and clotting indices. Cessation of vaginal bleeding is often the first sign of successful therapy. Once uncomplicated DIC is reversed, it rarely recurs.

Infection

Endoparametritis

Worldwide, the frequency of infection after first-trimester surgical abortion varies widely from 0.1 to 4.7% (Table 15.4). This disparity reflects differences in method of ascertainment, definition of infection, and inclusion of outpatient cases. In the second trimester, infection rates with both medical and surgical abortion methods have remained within the narrow range of 0.4 to 2% in North America and Great Britain, except during the 1970s when instillation regimens

of induction abortion were still being refined (Table 15.5). Higher rates reported in Scandinavia could in part reflect the larger number of providers, each of whom do a small number of cases annually, as well as more sensitive clinical triggers for invoking the diagnosis.

Typically, signs and symptoms of postabortal endometritis arise within the first few days. Some combination of reported pain, fever, pelvic tenderness, and white count elevation is usually, but not invariably, present. The cervix should be tested for sexually transmitted pathogens; blood or uterine cultures are rarely informative. Because untreated infection can result in chronic pelvic pain, dyspareunia, infertility, and, on occasion, sepsis, a high index of suspicion and expedient treatment are warranted.

Established risk factors for postabortal infection include age less than 20 years; previous pelvic inflammatory disease (PID); and the presence of sexually transmitted pathogens in the cervix at the time of abortion, particularly chlamydia [114–116] or gonorrhea. Studies of prophylactic treatment of bacterial vaginosis are of limited quality and thus inconclusive [117] (Chapter 7). Most postabortal infections occur in women without these risk factors.

Two randomized trials have addressed the efficacy of vaginal cleansing to prevent postabortal infection before surgical abortion. Chlorhexidine digluconate was not found superior to sterile saline washing or no vaginal preparation. Prophylactic antibiotics were not used in either study [118,119].

Administration of prophylactic antibiotics reduces the risk of infection following surgical abortion by about 40% [120]. This protective effect was evident not only in women with antecedent risk factors (history of PID, positive preoperative chlamydia culture, or preoperative bacterial vaginosis), but also in low-risk groups. Two recent US prevalence studies [121,122] showed that carriage rates of chlamydia and gonorrhea are highest among Black women and lowest among White women by a factor of two to four times, with higher rates found among females age 14 to 19 years and highest rates among those with a history of gonorrhea or chlamydia in the previous 12 months. At a large public hospital pregnancy termination clinic in the USA, 11.4 and 2.6% of women tested positive during 2006 for chlamydia and gonorrhea, respectively [123]. Knowing prevalence data in a specific demographic population seeking abortion may influence strategies for postabortal infection prevention (e.g., screen-and-treat versus routine coverage). Routine perioperative antibiotic coverage may prevent up to half of all postabortal infections in the USA and is highly cost-effective.

The optimum drug regimen for routine antibiotic prevention remains unclear. Most studies have used tetracyclines or nitroimidazoles (e.g., metronidazole or tinidazole). Penicillins, erythromycin, and ofloxacin are superior to placebo but were used in only one study each [120]. No randomized trial has compared routine preoperative versus postoperative antibiotic treatment in preventing postabortal in-

fection. In the UK, the Royal College of Obstetricians and Gynaecologists (RCOG) recommends a more aggressive approach: presumptive therapy of chlamydia with doxycycline or azithromycin plus anaerobic bacteria coverage with rectal metronidazole, rather than short-course prophylaxis. However, the RCOG guidance also acknowledges that “other regimens may be equally appropriate” [124].

Ascending genital tract infections are typically polymicrobial, and patients who present with serious postabortal infection should receive a full course of broad-spectrum antibiotic therapy. Retained tissue evident clinically or radiographically warrants prompt reaspiration after an initial loading dose of antibiotics. Oral antibiotic treatment with one or more antibiotics is acceptable in a compliant patient who can tolerate the medications and has a favorable prognosis for cure in that she is not immunocompromised, severely ill, or suspected to have a tubo-ovarian abscess. A US multicenter trial has demonstrated effective outpatient treatment of mild-to-moderate PID in this favorable-prognosis group, including long-term follow-up of fertility preservation, using a single 2-gm injection of cefoxitin plus a single dose of 1 gm of probenecid orally followed by 100 mg of oral doxycycline twice daily for 14 days [125]. If patients fail to improve after 2 to 3 days of oral medication, parenteral therapy is warranted. For the period 1991 to 2001 in California, PID hospitalization rates declined by 62% and those for tubo-ovarian abscess decreased by 33%, possibly representing a shift to more outpatient therapy of PID [126].

Toxic shock syndromes

Toxic shock syndromes, heralded by shortness of breath, malaise, tachycardia, hypotension, and major organ system failure, are serious infections resulting from elaboration of bacterial cytotoxins that systemically attack integral cellular functions affecting vascular permeability, such as mitochondrial homeostasis [127]. These infections usually result in rapid multisystem deterioration and death. Sutkin and colleagues [128] reported acute onset of these symptoms 8 hours after insertion of a second set of laminaria prior to D&E abortion. Broad-spectrum antibiotics successfully treated amnionitis resulting from heavy growth of *Staphylococcus aureus* with staphylococcal enterotoxin C expression, permitting surgery to go forward. Mourton and Rich [129] have reported survival of a patient with classic findings of toxic shock syndrome 12 hours after endometrial biopsy. Her blood cultures grew Group A β -hemolytic *Streptococcus*. After fluid resuscitation and broad-spectrum antibiotics, she underwent total abdominal hysterectomy and bilateral salpingo-oophorectomy. The operative specimen was not tested for the presence of cytotoxins.

In addition to some strains of *Staphylococcus aureus* and group A *Streptococcus*, certain clostridial strains can also elaborate cytotoxins. *Clostridium perfringens* (formerly *welchii*) is the most common clostridial organism; like all clostridial

species, it is a spore-forming, rod-shaped, gram-positive anaerobe found predominantly in soil and contaminated water, and thereby in the intestines of grazing animals and humans. Experts theorize that anal-vaginal contamination results in vaginal carriage and that in some individuals these bacteria ascend the genital tract postpartum and after spontaneous or induced abortion [130]. *Clostridium sordellii* is a rare clostridial species found in about 1% of clostridial cultures. As of April 2008, seven deaths have occurred from clostridial infection in North American women undergoing first-trimester medical abortion. Six women used the evidence-based protocol of 200-mg mifepristone followed in 1 to 3 days by 800 µg of vaginal misoprostol, and one woman used mifepristone with buccal misoprostol. All exhibited a toxic shock-like presentation with absent or low fever, insidious onset, hemoconcentration, multiorgan failure and rapid demise. *Clostridium sordellii* was identified in six of these seven infections by a gene probe specific to this organism; the other case was identified as *Clostridium perfringens*. One case was reported from Quebec Province, Canada [131]; four cases, all from California, were reported by the CDC where bacteriologic subtyping identified each as associated with *Clostridium sordellii* [132]. Comparison by the CDC of the medication lot numbers eliminated pill contamination as a cause of infection [132].

Although reports have identified prolonged asymptomatic vaginal carriage of *C. sordellii* in 0.5 to 10% of healthy women, the precise etiology of this cluster of cases involving primarily an uncommon species of *Clostridium* remains unknown. From the time of its approval by the US Food and Drug Administration in 2000 until mid-2008, more than 840,000 doses of mifepristone have been sold in the USA (it is not commercially available in Canada), making the case-fatality rate from the six reported US deaths less than 1.0 per 100,000. All US *sordellii* mortalities have occurred in coastal states of the Western USA. The fatal *perfringens* case occurred in a noncoastal Western state. This distribution suggests a geographic predilection of clostridial species for certain geologic or climatic regions, and investigators are designing a large prevalence study to test this hypothesis. No reported *C. sordellii* or *perfringens* infections or toxic shock deaths have been reported among 2 million European women users of mifepristone.

Serious and often fatal clostridial infections have been reported during pregnancy unrelated to abortion and in women undergoing gynecologic procedures both in North America and Europe [130,133,134] (Zane SB, 2008, unpublished observations). One patient who had a spontaneous abortion at 18 weeks' gestation was treated after presentation with five antibiotics, dopamine, and fluid resuscitation. She is the sole surviving patient in the world literature among childbearing women infected with *C. sordellii* [130]. CDC laboratory testing confirmed that this strain of *C. sordellii* produced no lethal toxin.

In contrast to these disheartening outcomes, clinicians have achieved success by rapidly treating culture-proven clostridial endometritis following D&E abortion using peri-abortal oral doxycycline or standard broad-spectrum parenteral antibiotics, provided that the offending strain of clostridium does not produce endotoxin [135].

Pelvic abscess

Pelvic abscess is uncommon after second-trimester induced abortion and rarely occurs in the first trimester. Fifty per cent of patients with tubo-ovarian abscesses have a prior history of pelvic infection [136]. Increased susceptibility to abscess also exists in women with compromised immunity, as in those with human immunodeficiency virus/acquired immunodeficiency syndrome (HIV/AIDS) infection and high viral titers, or those debilitated and nutritionally deprived from substance abuse. Especially susceptible are women with poor nutrition and transport whose abortions are performed by untrained personnel. When these women develop infection resulting from natural occurrence, uterine injury, retained tissue, or unhygienic practices, they often experience long delays in obtaining trained medical evaluation and treatment, setting the stage for advanced infectious morbidity and mortality.

Most patients with untreated pelvic abscesses become acutely ill over time with severe abdominal or pelvic discomfort, high fevers, abdominal rebound tenderness, and exquisite adnexal pain on one or both sides. In acute, rapid-developing cases, leukocytosis is dramatic, ranging from 17,500/µl to more than 30,000/µl. Subtler and more slowly evolving cases can occur in patients with mature, walled-off abscesses or extensive adhesions from prior infection. Patients with life-threatening multiorgan involvement may present with mild or absent subjective, clinical, and laboratory findings other than severe malaise and toxic appearance because of failure of their immune system to mount an aggressive defense. Persistent low-grade fever, lack of energy, adnexal tenderness, and imaging studies point the way to diagnosis of this sometimes perplexing condition. In experienced hands, ultrasound has both high sensitivity (93%) and specificity (99%) in identifying abscesses [137].

Of the two widely used broad-spectrum intravenous antibiotic therapies, the beta-lactam-containing combination of doxycycline with cefoxitin or cefotetan has no advantage over the regimen of clindamycin plus an aminoglycoside [138]. Overall, 75% of patients with pelvic abscesses respond to medical therapy. Therapeutic surgical intervention is indicated in patients with progressive clinical deterioration and in those whose fever and pelvic pain remain unabated after 48 to 72 hours of medical therapy. Failure occurs more frequently in patients with recurrent infection; large (more than 8 cm), bilateral, or complex abscesses; compromised immunity; and chronic processes. Drainage of abscesses by ultrasound-guided needle aspiration can be highly effective

in selected cases, avoiding laparotomy. Given the current array of assisted reproductive technologies, preservation of the uterus and at least one ovary is highly desirable in women with pelvic abscesses who desire future childbearing. When unilateral adnexectomy is elected for well-confined disease, risk of recurrent abscess during a woman's fertile years remains high because of residual scarring and, possibly, dormant pathogens.

Patients with sepsis require supportive care with large volumes of intravenous fluids to restore normal perfusion; pressor agents (dopamine and dobutamine) may be needed. Acute respiratory distress syndrome, DIC, and renal failure can develop rapidly. Patients who do not respond to initial measures may require hysterectomy and bilateral salpingectomy as a life-saving measure [53,139].

Postabortal endocarditis

Postabortal endocarditis is rare, difficult to diagnose, and often resistant to aggressive broad-spectrum antibiotic therapy [140]. Up to 75% of patients who develop postsurgical endocarditis have preexisting abnormalities of the heart [141] that are often asymptomatic. Predisposing conditions include prior endocarditis, whether recognized or not (rheumatic fever); existing prosthetic valve or surgical shunts; intravenous exposure through illicit drug use, injection therapy, or recent tattoos; immunocompromise (e.g., HIV/AIDS); and poor dentition with caries or chronic periodontal disease. Few affected patients have reported these conditions owing to their subtle nature or to privacy concerns. Usually a single heart valve is affected with reports of tricuspid, aortic, and pulmonic involvement, but multivalvular vegetation has also been reported [142]. Group B *Streptococcus* is the most common culprit and is uniformly sensitive to penicillin G, but absence of initial symptoms referent to the heart often results in late discovery, when the condition is far advanced. Clinical recovery, ultrasound evidence of shrinking of valvular vegetations, and improved cardiac flow gradients are encouraging signs. Refractory or pernicious cases frequently require valve replacement.

Although providers may differ in their approach to women with high-risk conditions, the American College of Obstetricians and Gynecologists does not recommend endocarditis prophylaxis for dilation and curettage, abortion, sterilization, or insertion or removal of intrauterine devices, irrespective of patient cardiac risk status [141].

Uterine injury

Low cervical tears

Lacerations of the anterior lip of the cervical portio occur most commonly when the tenaculum releases under traction. A less common type of injury can occur when a large fetal part, typically the calvarium, is pulled or expelled through the cervix. This type of tear occasionally extends

several centimeters into the body of the cervix and often requires suturing, but it rarely affects large enough branches of the uterine artery to require extensive dissection.

Using atraumatic tenacula and applying traction steadily can avoid some tears. A number of techniques are available to gain a secure purchase on the cervix. These techniques include grasping a generous bite of cervical tissue; placing a tenaculum on the cervix vertically with one tooth inside the cervical canal; or using tandem tenacula, one at the 3 o'clock and the other at the 9 o'clock position of the cervicovaginal folds. In addition, use of osmotic dilators significantly reduces the risk of cervical injury during abortion [143]. Peterson reported a decrease in serious cervical trauma in early midtrimester D&E (from 0.8 to 0.4%) and later D&E (from 5.2 to 1.5%) when laminaria replaced dilation solely with graduated rigid dilators [41].

Treatment options include observation alone; clamp compression for 5 to 10 minutes; the application of silver nitrate or other styptic solutions, such as ferric subsulfate solution (Monsel's solution), and finally suturing. Surgical repair is best accomplished using absorbable suture in a running, locking stitch. Occasionally the bladder flap requires dissection and retraction to provide exposure for repair of extensive tears of the anterior cervix. Better lighting, lateral retractors, and surgical assistants are often needed to repair severe cervical injuries properly; hence, an operating room may be necessary.

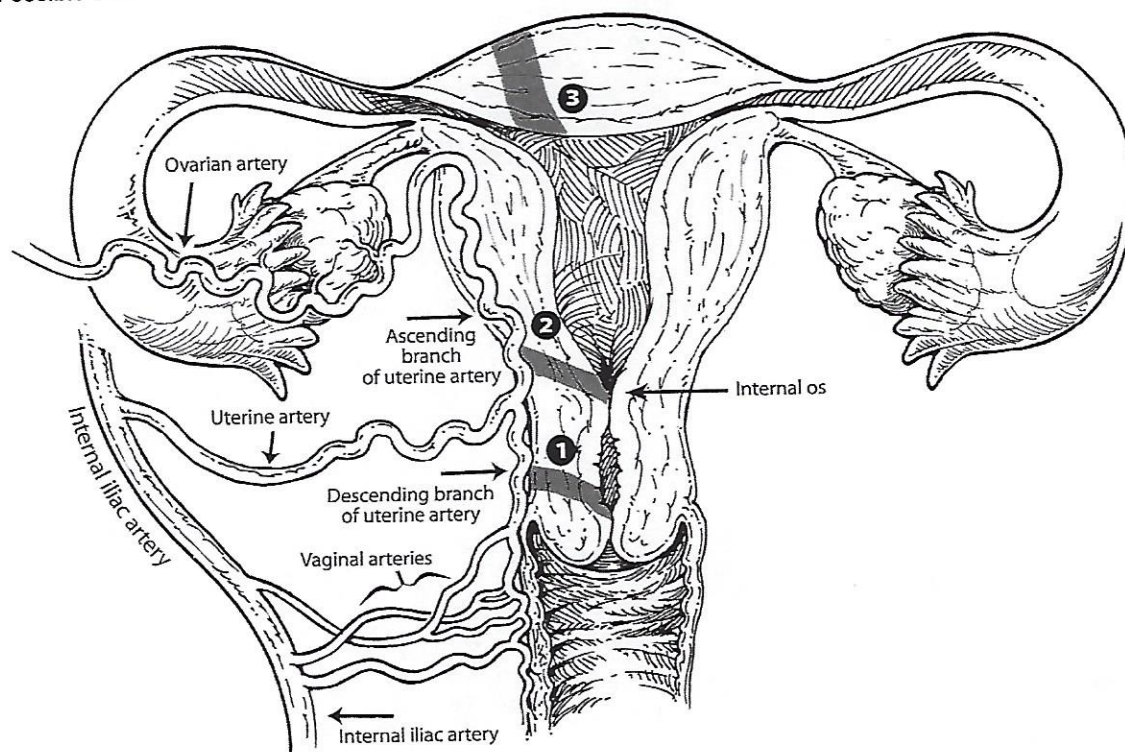
High cervical tears

High cervical tears (cervical fractures) result from stretch-induced injury to the internal cervical os. The injury may be partial- or full-thickness, the latter creating a passage into the paracervical space. These lacerations can occur during labor induction [45] as well as during surgical abortion. Development of cervicovaginal fistulas can occur during labor-induction abortions; the posterior cervix bulges into the vagina, then ruptures, with delivery through the fistula. These injuries were more common with abortions induced with intra-amniotic prostaglandin $F_{2\alpha}$ [144].

Tears of the distal endocervix can traumatize lower cervical branches of the uterine artery and vein, which lie in the retroperitoneum (Fig. 15.4). In these instances, a hematoma may form, and vaginal bleeding is often light. Large hematomas can develop, leading to hypovolemia. Because of tamponade within the retroperitoneum and arteriolar spasm, blood loss may be slowly progressing and laterally sequestered, avoiding the development of rebound tenderness and resulting in delayed diagnosis.

Tears of the proximal portion of the internal os can disrupt upper cervical branches of the uterine artery and vein, which generally lie above the peritoneal reflection (Fig. 15.4). No retroperitoneal envelope is available to provide tamponade in these cases, and life-threatening hemoperitoneum can develop rapidly.

Possible Sites of Uterine Perforation



- 1) Low cervical perforation.
- 2) Perforation at junction of cervix and lower uterine segment.
- 3) Fundal perforation.

Figure 15.4 Possible sites of uterine perforation. (1) Low cervical lacerations can injure descending branches of uterine artery; (2) lacerations at the internal os (often related to overstretching of the sphincteric junction of cervix and lower uterine segment) can injure ascending branches of uterine artery; (3) fundal perforation. Regions lateral to the fundus and corpus are more vascular than in the midline.

The lateral aspects of the cervix are most vulnerable to stretch-induced injury, placing parametrial arterioles at risk. Spasm of these injured vessels results in episodic bleeding and can mislead the clinician in the belief that the injury has resolved spontaneously. Sudden massive internal and external bleeding has occurred with such tears up to 4 weeks after the original trauma.

Clinicians should suspect endocervical injury whenever postoperative bleeding persists despite a well-contracted uterus or when patients exhibit unexplained postoperative orthostatic hypotension unresponsive to fluid resuscitation. As fluid shifts occur and red cells are mobilized by means of demargination, serial hematocrit levels may show little or no drop for several hours, depending on the extent of the bleeding. Digital palpation of the endocervical barrel may reveal the defect. Bleeding from small non-perforating lacerations may stop permanently with application of Monsel's solution. Bleeding that stops temporarily when ring forceps are placed circumferentially at the level of the internal os,

but resumes upon their removal, indicates a need for further therapy. Hysteroscopy can be diagnostic and therapeutic (cautery) when bleeding is light enough to permit endoscopic visualization [145]. Nonpenetrating injuries may respond to balloon tamponade after first-trimester [146] and D&E abortions [68]. Large or full-thickness penetrating lacerations usually require angiographic treatment or surgical repair using a vaginal or abdominal approach. Balloon tamponade or uterine packing (with vasopressin) can at times be curative and nearly always will temporarily slow bleeding enough to allow time for angiographic or surgical treatment.

A slowly developing pelvic hematoma may be insidious, with only mild tenderness, rectal pressure, and modest abnormalities of laboratory tests. Pelvic hematomas may be difficult to palpate if they are lateral or high, and rectal examination can be especially helpful in these circumstances. When palpated, fresh hematomas are uniformly tender. Pelvic ultrasound, CT scan, and MRI are sensitive, but sometimes nonspecific, diagnostic tests for hematomas.

Some hematomas can be managed with observation only. Repetitive hematocrit determinations and serial imaging measurements indicate when the hematoma has stabilized. Broad-spectrum antibiotic therapy may be prudent, given the communication with the vaginal flora. Large hematomas (more than 500–800 ml or 8–10 cm in diameter), failure of the hematoma to stabilize, or the appearance of infection should prompt intervention. Treatment options include ultrasonography- or CT-guided needle aspiration, angiographic embolization, and vaginal or abdominal surgical repair. When a hematoma resolves without intervening infection and without invasive therapy that breaches the peritoneum, adhesion formation within the pelvis is uncommon. Under these circumstances, fertility is not impaired, in contrast with the aftermath of most pelvic abscesses.

High cervical tears cannot entirely be prevented. However, avoiding forceful mechanical dilation and making appropriate use of osmotic dilators or cervical priming agents may lessen somewhat the risk of this complication.

Perforation

Perforation is an uncommon but potentially serious complication. The risk is highest with inexperienced providers and with advanced patient parity or gestational age [147]. Early reports of increased risk of perforation with general anesthesia were not confirmed in a subsequent study by the same investigators [148]. In a more recent large first-trimester study in which 51,000 of 170,000 patients underwent general anesthesia with intravenous methohexital, uterine perforation occurred in only 0.09 per 1,000 cases [5] (Table 15.6). However, some perforations are probably unsuspected and undetected. For example, only two of 14 uterine wall perforations were recognized in a series of 706 patients undergoing concurrent first-trimester vacuum abortion and laparoscopic sterilization [149]. On the other hand, Choudhary et al [28] more recently reported a single-institution series of 288 women undergoing simultaneous vacuum abortion and laparoscopic sterilization in which the one perforation visualized laparoscopically was in fact noted by the vaginal surgeon at the time of the uterine aspiration.

Suspicion of perforation is raised when instruments pass farther than expected, often without discernible resistance; when excessive bleeding occurs; or when contact with the gritty surface of the endometrium is lost during aspiration or curettage. Awake patients may exhibit sudden or unexpected pain, although this finding is nonspecific. Signs can include hypotension and occasionally detection of bowel or omentum in the cannula or cervix. Confirming all major fetal parts during or after D&E is advisable; failure to identify all major pregnancy elements raises suspicion of retained tissue or perforation with tissue in the peritoneal cavity [155]. Delayed recognition of these complications, especially bowel injury, can be life-threatening [156,157]. In general, any

woman with protracted abdominal pain after abortion, especially if lateralized or accompanied by abdominal rebound tenderness, requires evaluation to exclude perforation, rupture, or dehiscence.

The most frequent site of perforation is the relatively avascular anterior or posterior midline surface (Fig. 15.4). In a series of 30 perforations in women undergoing vacuum abortion combined with laparoscopic sterilization [158], 60% occurred in the fundus, 30% in the midline of the corpus, and 10% on the side. Most penetrating injuries in the first trimester resolve without treatment or sequelae. Perforations likely to be more problematic are situated laterally, are larger than 1.2 cm in diameter, occur after the first trimester, result in acute pain or symptomatic blood loss, or involve bowel. Perioperative ultrasound may be useful in documenting whether a perforation has occurred and in monitoring the cul-de-sac for accumulation of blood [159]. Although laparoscopy is more expensive and inconvenient, it is a better diagnostic tool. Culdocentesis is an inexpensive and safe technique to assess blood in the cul-de-sac as well. Blood in the cul-de-sac may result from uterine injury, or from rupture of an ectopic pregnancy or ovarian cyst.

Experienced operators have safely completed first-trimester abortion immediately after known or suspected small midline perforations. Intraoperative ultrasound can guide completion of the procedure in such cases. Alternatively, the abortion can be deferred for a week or more to allow healing in patients with an intact sac who remain stable after an uncomplicated perforation. Preventative antibiotics are advised during the waiting period.

In the absence of heavy vaginal bleeding (i.e., more than 200 ml or suspected injury to abdominal contents), patients with small perforations can be observed closely in an outpatient setting for pain, orthostasis, declining hematocrit, and abdominal rebound tenderness. In most cases, patients who are clinically stable 2 to 4 hours after surgery can be discharged safely with a responsible chaperone. Oral antibiotics are advisable, and patients should receive explicit instructions and warnings, 24-hour emergency phone contact information, and a timely follow-up appointment. This conservative protocol for women with known or suspected low-risk perforations has been advocated by a variety of authors [149–151,153].

Unstable patients and those with other injuries require surgical intervention. Laparoscopy may fail to detect subtle but consequential injury to bowel. Whereas some surgeons can inspect the full length of the bowel with laparoscopy, others feel more comfortable performing this evaluation by laparotomy.

Small bowel is the most common viscera injured with uterine perforation because of its central pelvic location and length [156,160]. In a case series of surgical abortion-related bowel injuries referred to a large academic medical center in India [157], large bowel injuries (often the sigmoid colon)

were often associated with posterior uterine wall perforations, whereas anterior wall or fundal perforations more often resulted in small bowel injury. Reporting a series of small-bore bowel injuries associated with gynecologic laparoscopic procedures, Soderstrom [160] noted that free air was seen in only one-third of injured patients using flat plate radiographs, but most patients became symptomatic (pain, distension, fever, and anorexia) within 72 hours. Large bowel injuries became symptomatic earlier than damaged small bowel because of fecal content [160]. In another series, laparoscopically associated injuries to large bowel led to greater likelihood of developing intra-abdominal abscess and pleural effusion than those to small bowel [161]. During abortion, other adjacent pelvic organs, such as the bladder or ureter [27], can sustain injury as well.

Identifying the cause of the perforation can be difficult. In a Swedish study involving 145 first-trimester perforations, 47% were discovered during aspiration, and 21% were noted during dilation [153]. Many clinicians use a sharp curette or small forceps to confirm that the uterine cavity is empty; 31% of perforations were discovered during this phase, reflecting that this "security check" carries some risk.

Because of the rarity of perforation, randomized controlled trials cannot evaluate the potential benefit of intraoperative ultrasonography. A before-after study from one hospital found that use of intraoperative ultrasound guidance lowered the risk of perforation during D&E and shortened operating time [162]. In a large prospective study of risk factors for uterine perforation in first- and second-trimester abortions, use of osmotic dilators had a protective effect [147]. Use of a sound to measure the depth of the fundus has been associated with perforation during diagnostic dilation and curettage [150], and this practice may entail risk in the abortion setting as well. In a 13-year retrospective review from China of uterine perforations that occurred during first-trimester surgical abortion, the sound was the perforating instrument in 23% of cases [163].

Atraumatic dehiscence (complete separation of myometrium with preservation of overlying abdominal or bladder peritoneum) has been described in D&E abortion [164]. Second-trimester rupture or dehiscence may be slow to develop and initially confused with uterine atony, retained tissue, or pelvic infection.

Asherman syndrome

Asherman syndrome includes scarring either in the endometrial cavity or in the cervical canal [165]. Although they may coexist, the two lesions are usually seen separately. Reported consequences of this condition include amenorrhea, secondary infertility, spontaneous abortion, and preterm delivery, but failed attempted abortion can occur as well [166].

Asherman syndrome after surgical abortion is uncommon and is usually readily correctable. In a large, single-institution report of surgical abortions, the frequency of documented Asherman syndrome was about 16 per 100,000 cases [5]. Most reported cases have involved cervical agglutination without evidence of synechiae in the cavity. In an early case series, nine of 12 cases involved cervical stenosis, while three involved intracavitary adhesions [167]. Chapman and Chapman [168] reported seven cases associated with induced abortion, six of which had cervical agglutination; all were corrected by cervical dilation alone. In a report of the cervical agglutination form of Asherman syndrome attributable to induced abortion, all 10 women achieved normal periods after therapy. Three of the patients had abortions by sharp curettage rather than vacuum aspiration, and the average time to diagnosis for all subjects was 11 months (range: 5–18 months) [169]. No case of Asherman syndrome has been reported after medical abortion using any of the common regimens.

Asherman syndrome typically presents as diminished or no uterine bleeding. Further, the patient may have a history of cyclical cramping if the os is occluded; hematometra is uncommon [165]. Dilating the cervix to a diameter of 7 to 8 mm using paracervical anesthesia can be both diagnostic and therapeutic.

Although still widely used for diagnosis, hysterosalpingography has false-positive rates as high as 30%; three-dimensional (3-D) ultrasound is much more accurate, especially in identifying and categorizing cervical agglutination in the presence or absence of cavitory scarring [170]. Hysteroscopy offers the most precise diagnosis, a vantage for lysis of adhesions under direct vision, and a vehicle for the identification and removal of the conceptus during elective abortion [166]. Milder forms of Asherman syndrome have uniformly optimistic prospects [171]. Although feasible in an office setting, hysteroscopy requires additional expense and skill and is not without complications. In the series cited earlier using 3-D ultrasound as a screening tool [170], two of 18 patients who underwent simultaneous hysteroscopy and laparoscopy experienced uterine perforations. Efficacy of widely practiced nonsurgical therapies such as sequential hormone replacement therapy (e.g., 2 mg oral conjugated estrogen twice daily for 10–14 days), intrauterine stenting (catheter balloons such as the Cook balloon uterine tent or intrauterine contraceptive devices for several weeks), or antibiotics (e.g., oral doxycycline 100 mg twice daily for 10–14 days) is unproven.

The epidemiology of uterine adhesions remains unclear. Sharp curettage appears related to Asherman syndrome [169], providing yet another reason to abandon an archaic tool that dates back to the 1800s. Whether other variations in abortion technique (e.g., preoperative cervical priming with osmotic dilators or prostaglandins, size and type of instrument used as a cervical dilator, use of sharp "check"

curettage, or administration of perioperative antibiotics) influence the risk is unknown.

Thrombosis and embolism

Deep vein thrombosis

Deep vein thrombosis (DVT) is infrequently reported in association with abortion. It leads to pulmonary embolism in approximately 20% of cases. Heritable thrombophilias, such as Factor V Leiden deficiency, are strong risk factors, as are obesity, diabetes, age greater than 40 years, trauma, immobilization, and malignancy [172]. Pain, swelling, point tenderness, and inflammation vary greatly depending on the size and progression of the thrombus. Onset of DVT may be gradual, and the physiologic swelling associated with pregnancy may confound recognition of its symptoms. Noninvasive testing with plethysmography and ultrasound are imperfect screening techniques; venography is the definitive diagnostic tool.

Heparin is the mainstay of treatment; low-molecular-weight heparin (enoxaparin) is now widely used for both prophylaxis and the acute phase of treatment. Patients without risk factors who are undergoing short outpatient operations require no prophylactic measures. Those with risk factors may benefit from pneumatic compression devices, enoxaparin, or subcutaneous unfractionated heparin, particularly if a multiple-day hospitalization is contemplated (e.g., labor-induction abortion).

Pulmonary embolism

Pulmonary embolism is an important cause of abortion mortality [173]. The CDC described 10 cases of fatal pulmonary embolism from 1972 to 1975. These deaths occurred 2 to 50 days after abortion [174]. In addition to pregnancy, most patients had at least one other risk factor, including obesity, hypertension, cancer, family history of embolism, contraindicated recent use of oral contraceptives, or discontinuation of heparin therapy for DVT because of side effects. The authors estimated the overall incidence of fatal and non-fatal pulmonary embolism as 10 to 20 cases per 100,000 induced abortions [174].

Detection of pulmonary embolism is not always straightforward. Symptoms may be nonspecific and of variable severity. Classic signs include rapid or difficult breathing; pleuritic chest pain; and in about half of patients, anxiety, cough, and rales. Arterial hypoxemia occurs in most patients. Only a minority (approximately 5%) of pregnant women suspected of having pulmonary embolism will have the diagnosis radiographically validated after evaluation. Chest radiograph is required to rule out other causes and to interpret ventilation-perfusion scans. More recently, spiral computed tomography has supplanted ventilation-perfusion scans (60% indeterminate) on the grounds of both clinical benefit and cost-effectiveness [175]. Pulmonary angiography is the diagnostic gold standard but is expensive, invasive,

and more risky than alternative tests. Anticoagulation with heparin initially, followed by warfarin therapy, is the mainstay of treatment. Treatment reduces mortality from approximately 15% to less than 1%.

Amniotic fluid embolism

Although rare, occurring in 1:10,000 to 1:80,000 pregnancies [176], amniotic fluid embolism has emerged as an important cause of death associated with second-trimester abortion, with a mortality rate as high as 80% [173]. This catastrophe is usually unforeseeable and often fatal. DIC complicates 40 to 60% of cases that survive beyond the initial insult. The risk of amniotic fluid embolism increases with advancing gestational age, as well as with older labor-induction methods and hysterotomy [177]. The most frequent presentation of amniotic fluid embolism is cardiorespiratory collapse. Sometimes a brief instance of dyspnea or feeling of impending doom precedes cessation of breathing, oxygen desaturation, cardiac electromechanical dissociation, and profound hypotension.

Although its etiology remains unclear, progress in identifying the presence and origin of this condition is ongoing. A number of studies have routinely identified trophoblasts and squamous cells of presumed fetal origin in the circulation of healthy gravidas after the first trimester [178–180]. Large volumes of homologous amniotic fluid are harmless in primate models. Because human maternal exposure to fetal elements is therefore a common occurrence, Clark [181] has posited that uniquely susceptible maternal-fetal pairs are necessary to produce amniotic fluid embolism. In such pairs, disturbance of the pregnancy may inoculate the pregnant woman with fetally derived antigen, which causes an anaphylactoid reaction. Gei and Hankins [182] have speculated that fetal particles in the maternal circulation may cause pulmonary microemboli that trigger release of arachidonic acid metabolites, stimulating an anaphylactoid response. These mediators may exist in the plasma, leukocytes, and fetal gut.

Pathological verification can be arduous and elusive. A diligent search should include central venous blood (for fetal squames, vernix, or eosinophilic leukocytic granules), sputum (for fetal squames), and bronchoalveolar lavage (for stained epithelial cells). Examiners should analyze maternal peripheral blood for the presence of fetally derived cells and debris and also test the blood with an array of highly specialized enzymatic markers (ZnCP-1, monoclonal antibody to TKH-2, and STN) before ruling out the diagnosis.

Treatment is supportive including endotracheal intubation, intracardiac epinephrine, and cardioversion. If the patient survives the primary event in an outpatient setting, she should be transferred promptly to a hospital for intensive care. Management may include replacement of clotting factors for DIC and intravenous dopamine plus prolonged ventilatory assistance for adult respiratory distress syndrome. Survival has been reported with an artificial

membrane lung, and in another case, full-scale cardiopulmonary bypass.

Other conditions

Anaphylaxis

Anaphylaxis requires prior sensitization. It results from IgE-mediated antigen stimulation on the surface of basophils and mast cells, causing release of an array of dermatologic, vasoactive, and bronchospastic proteins. Most manifestations are mild, causing flushing or urticaria. In severe forms, acute bronchospasm, increased alveolar-capillary permeability, and profound hypotension may lead to airway obstruction, hypotensive shock, and extensive bilateral pulmonary edema.

Once the suspected antigen is withdrawn, treatment consists of airway access, ventilation, cardiac support, and fluid maintenance. Initial drug therapy includes epinephrine (0.3–0.5 ml of 1:1,000 solution subcutaneously or 3–5 ml of 1:10,000 intravenously or via endotracheal tube, repeated periodically as needed) and diphenhydramine (0.5–1.0 mg/kg intravenously). Steroids can be added if the patient requires more intensive therapy (hydrocortisone, 250–1000 mg intravenously, or methylprednisolone, 1–2 g intravenously). Inhaled beta-agonists (metaproterenol 0.3 ml or albuterol 0.5 ml in 2.5 ml normal saline) and aminophylline (0.25–0.5 gm intravenously) are used to treat resistant bronchospasm. In an emergency department study of 103 cases, 19% had recurrences at a mean interval of 10 hours (range, 2–38 hours). These recurrences were variably associated with initial symptom onset at least 30 minutes after exposure, inadequate epinephrine dosing, and underuse of steroids [183].

Vasovagal syncope

In abortion practice, a vasovagal reaction can occur in association with paracervical anesthesia, cervical dilation, or venipuncture. Although its etiology is unknown, vasovagal reaction is associated with stressful conditions such as pain, emotional upset, and prolonged standing. Upon standing upright, healthy individuals normally experience a drop in intrathoracic pressure of approximately 15%, a reduction of stroke volume of about 20%, and a corresponding decline in arterial pressure [184]. During a vasovagal reaction, the patient's skin is cold and clammy, and she often reports light-headedness, nausea, or visual changes. Moderate hypotension and bradycardia in the range of 30 to 50 beats per minute are common. Transient seizure-like muscular activity can occur. Brief disorientation may follow momentary unconsciousness, but true postictal states are rare.

Resting in a horizontal position or with the legs elevated is all that most patients require. Most episodes resolve in a few minutes without treatment. Severe or prolonged incidents

can be treated with atropine, 0.4 to 1.0 mg intravenously, antiemetics, hydration and, rarely, airway support.

Asthmatic reactions

Eight per cent of patients seeking abortion report current use of at least intermittent asthma medication. Patients with asthma who merit special concern during presurgical screening are those with (1) symptoms requiring continuous antiinflammatory or steroid therapy; (2) frequent exacerbations or nocturnal dyspnea (more than one to two episodes per week); (3) a recent attack requiring medical therapy; and/or (4) current acute symptoms. In an observational cohort study of pregnant asthmatic women at 16 US health centers for the period 1994 to 1999, obesity (BMI ≥ 30) was significantly associated with asthma exacerbations (cough, dyspnea, or wheezing, OR 1.3, 95% CI 1.1–1.7, $p = 0.01$) after controlling for smoking and race, but not with hospitalizations for asthma, need for steroid treatment, or worsening asthma pattern overall [185].

Although acute asthmatic attacks in well-prepared abortion patients are rare, facilities must be prepared to treat severe asthmatic complications. Mild dyspnea usually responds to two puffs of nebulized beta₂-adrenergic agonist (albuterol, salmeterol) using self-administration or mask. Puffer dosing can be repeated every 20 to 30 minutes for up to three doses. A calm nursing presence is therapeutic. Second-level therapy involves parenteral sympathomimetic agents (subcutaneous epinephrine, 0.3 to 0.5 ml of 1:1,000 solution every 20 minutes up to three doses, or subcutaneous terbutaline, 250 μ g every 15 minutes up to three doses).

A third level of treatment consists of methylxanthine therapy. Aminophylline is the only agent available for parenteral dosing and is highly effective in conjunction with nebulized beta adrenergics, parenteral sympathomimetics, or inspired anesthetic gases. The aminophylline loading dose is 5 mg/kg/30 minutes intravenously, and the maintenance dose is 0.5 to 1.0 mg/kg/hour.

A fourth level of therapy as a final recourse for refractory bronchospasm is the use of inspired halogenated gases such as desflurane or sevoflurane. These agents, where available, are extremely effective in opposing severe bronchoconstriction. Because they act as tocolytic agents upon smooth muscle, however, they carry risk of inciting uterine hemorrhage, possibly requiring intensive uterotonic therapy as a countermeasure.

Hydration is a key feature of treatment in all cases. Pulse oximetry is pivotal in early detection of airway compromise and valuable in gauging therapeutic success. The goal is to maintain oxygen saturation at 95% or better. Failure over time to raise oxygen saturation to 90% calls into question the need for intubation. Prolonged desaturation after intensive outpatient therapy requires hospitalization.

Seizures

Although grand mal, petit mal, toxic drug-induced, and idiopathic seizures can be distinguished clinically, acute treatment of these conditions is the same. This treatment consists of chin thrust (to dislodge the tongue from the oropharynx), mask oxygen, and parenteral anticonvulsants. Most seizures encountered in abortion settings are self-resolving solely with supportive measures and do not recur acutely. Anxiety, *nil per os* (NPO) status, or physical discomfort may contribute to their causation. Repetitive or prolonged seizure episodes warrant referral for expert treatment and evaluation.

Parenteral benzodiazepines (diazepam 5–10 mg or midazolam 2.5–5 mg) usually stop seizures for a period of 30 to 45 minutes, while lorazepam 1 to 2 mg is usually effective for 2 to 3 hours. Short-acting barbiturates represent an alternative first-line therapy. Intravenous thiopental (75–150 mg), propofol (50–100 mg), and methohexital (50–100 mg) are highly effective in temporarily controlling seizure activity. Although these doses do not abolish the gag reflex in most patients, it is prudent to administer these drugs in a setting with an experienced airway manager, pulse oximetry, intubation equipment, and nursing staff assignable to continuous monitoring. Complete loading and daily dosages of anticonvulsive therapy are considerably higher than those used during acute treatment and are best left to clinicians who will undertake the long-term monitoring of the patient.

Conclusion

Legal-induced abortion is one of the safest and most thoroughly studied procedures in medicine. Although surgical abortion complications are not completely avoidable, the following practices can minimize their occurrence:

- Accurate determination of gestational age before abortion;
- Limiting procedures to those in which the surgeon is skilled and experienced;
- Appropriate emergency consultation and hospital referral when necessary;
- Simple regimens of anesthesia and evacuation of the uterus;
- Routine periabortal antibiotics or presumptive treatment of sexually transmitted infections;
- Use of only sterile instruments inside the uterus ("no-touch" technique);
- Judicious use of osmotic dilators or prostaglandins to soften and open the cervix, particularly after 14 gestational weeks;
- Adequate cervical dilation;
- Gentle and thorough uterine evacuation;
- Avoiding sharp curettage;
- Prompt use of uterotonic drugs to treat atony;

- Maintaining a high index of suspicion for occult injury and insidious medical complications;
- Careful tissue examination to confirm successful abortion;
- Assiduous monitoring during and after surgery; and
- 24-hour telephone access to a clinician knowledgeable about postabortal complications.

See the book for References.
Omitted here because to include them would make this PDF too large to transmit.
There are 185 references.

There is no credible scientific basis to support this statement.

1. CDC admits that abortions are under reported.
2. NAF admits that about 2/3 of abortion patients **DO NOT RETURN FOR FOLLOW-UP VISIT.**
3. There is no national, mandatory, methodical system for reporting abortion deaths and injuries.