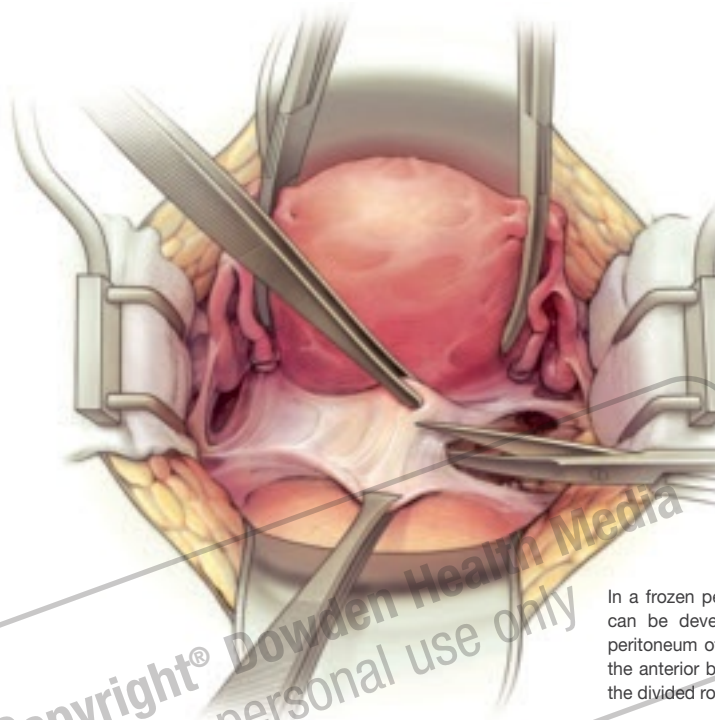


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In a frozen pelvis, the vesical space can be developed by incising the peritoneum of the avascular layer of the anterior broad ligament between the divided round ligaments.

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Surgical strategies to untangle a frozen pelvis

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Few surgeries require the judgment, rigorous experience, and skill necessary to operate on a frozen pelvis

For a surgeon, the “frozen” pelvis can be as hazardous as the icy tundra that its name evokes: The reproductive organs and adjacent structures are distorted by extensive adhesive disease and fibrosis, which obscure the normal anatomic landmarks and surgical planes, making dissection extremely difficult and increasing the risk of damage to vital organs.

Despite these very real challenges, few training programs provide gynecologic residents with sufficient surgical experience to operate safely in this setting. The overall keys to success:

- Solid grounding in pelvic anatomy, with live experience involving vary-

ing degrees of pelvic distortion

- A realistic expectation that the operation will be difficult and fraught with hazards
- Flexibility to change course when a particular pathway proves too risky
- Patience to take things as slowly as necessary.

Most important is a retroperitoneal approach—not to mention complete knowledge of the retroperitoneal spaces, where the structures that nourish and support the uterus and lymphatic system lie, as well as the ureters and rectum (**FIGURE 1, page 64**).

It may not be sufficient to learn the anatomy of the pelvis and the steps of the

Five culprits: Which one is to blame?

Five major causes of extensive pelvic disease lead to a frozen pelvis: infection, surgery, benign growths, malignant growths, and radiation therapy. When evaluating a patient, it is important to determine which of these conditions exist.

Infection. Adhesions and fibrosis secondary to infectious processes such as gonococcal salpingitis, tubo-ovarian abscess, a ruptured diverticulum, infected pelvic hematoma, and ruptured appendix can create anatomic abnormalities.

Surgery. The type of surgery a patient has undergone may provide important clues to potential problems. For example, pelvic distortion that arises from cesarean section and tubal reconstructive surgery differs considerably from that found in women who have undergone abdominal hysterectomy with preservation of one or both ovaries. Removal of a retained left ovary may require extensive dissection of the ureter and bowel.⁴

Benign and malignant growths.

Uterine myomata, endometriosis, and adenomyosis are the most common benign growths that can lead to a frozen pelvis. Malignant growths of the adnexa, such as ovarian carcinoma, can necessitate en bloc resection of portions of the gastrointestinal tract along with the tumor. In contrast, carcinomas of the endometrium and cervix generally do not present with a frozen pelvis, although they occasionally require extensive or radical surgery.

Radiation therapy. When a woman has undergone radiation, pelvic structures are commonly adherent to the uterus and each other, making hysterectomy a challenge. The intestinal and urinary tracts also must be handled with great care. Even a small degree of intraoperative trauma to these structures can lead to postoperative complications including fistula formation.

operation from an atlas of surgical technique; “real-life” findings can vary greatly from those described in a textbook. The surgeon needs ample experience to recognize the appearance and tactile characteristics of disease processes that afflict the female pelvis—and to know how to manage them.

This article describes the challenges posed by the frozen pelvis, so the surgeon can confront the condition with greater confidence and understanding. There is no substitute for hands-on experience, however. Do not begin the operation if you do not think you can complete it. Seek help beforehand, not during the procedure.

Undertake a multipronged diagnostic evaluation

The potential for a frozen pelvis, as well as its causes, can usually be identified by taking a careful history and documenting previous surgeries or pelvic problems (see “Five culprits: Which one is to blame?” above).

The physical examination also can be revealing. Be alert for any anatomic changes apparent at the pelvic examination, which should include a rectovaginal assessment. If a lesion is palpated, attempt to define its size and determine whether it is fixed or mobile. Also ascertain whether the cul-de-sac is free, the uterus can be lifted out of the pelvis, and the disease process is predominantly uterine, adnexal, or involves adjacent organs. Although imaging studies may be useful, a careful pelvic examination may yield more practical information about potential difficulties.

Imaging studies—useful tool

Preoperative imaging can be of inestimable value. Pelvic ultrasonography,¹ computed tomography, or magnetic resonance imaging may be worthwhile, as well as evaluation of the urinary and intestinal tracts. It is particularly important to learn preoperatively whether there is involvement of the ureters, bowel, and pelvic sidewalls.

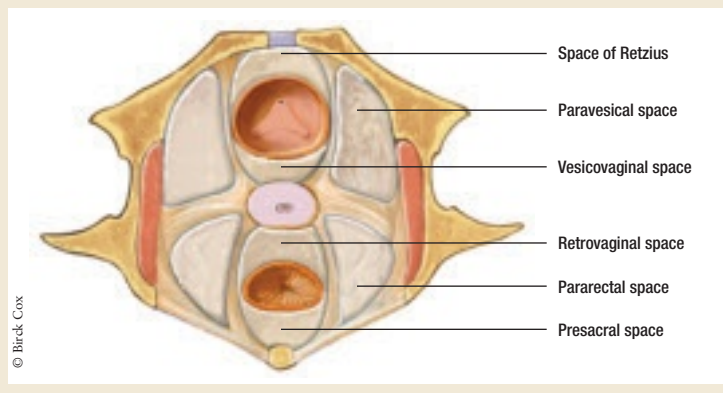
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Malignant growths of the adnexa, such as ovarian carcinoma, can necessitate en bloc resection of portions of the GI tract along with the tumor

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FIGURE 1

Areolar tissue fills the pelvic spaces



The pelvic spaces contain areolar tissue and can be exposed by applying traction and deeply placed retractors.

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All patients should undergo preop bowel preparation because of the possible need for enterolysis or intestinal tract surgery

Diagnostic laparoscopy may aid in planning the definitive surgery

When there is doubt about the extent of pelvic disease, diagnostic laparoscopy is a prudent way to assess the potential difficulties of surgery. The information it provides makes it possible to plan the definitive procedure and determine whether other specialists may be needed.

Other diagnostic steps, such as cystoscopy and sigmoidoscopy, can be performed at the time of diagnostic laparoscopy or postponed until the actual surgery.

**Preparing for surgery
Level with the patient**

Give the patient as much information as possible about potential problems with pelvic structures such as the ureters, bowel, and bladder. Also advise her that other surgeons may be called in to assist or to help repair damage to surrounding structures. In particular, counsel her about the very real possibility that a temporary diverting colostomy or ileostomy will be required. As usual, document details of these discussions in the record.

Bowel prep is imperative

In anticipation of possible enterolysis or intestinal tract surgery, all patients should undergo preoperative bowel preparation.

Consider ureteral catheterization

The possible need for preoperative ureteral catheterization should be discussed with a urologist, particularly if imaging reveals any significant ureteral deviation, fixation, constriction, or dilatation.

The use of catheters also helps the surgeon identify the ureters intraoperatively and may therefore prevent their injury.

Prepare for blood replacement

Advise the patient of the possible need for transfusion of red blood cells or other blood products during surgery. Whether it would be best to store her own blood (or that of a designated donor) or rely on the hospital blood bank depends on the circumstances of her case.

Insert a 3-way catheter

This precaution permits the instillation of retrograde dye intraoperatively to assess the integrity of the bladder.

Prophylactic anticoagulation and antibiotics? Absolutely

Postoperative wound infections and deep venous thrombosis, with the potential for life-threatening pulmonary embolization, are both significantly increased in patients who undergo pelvic surgery.² The prophylactic use of antibiotics and blood thinners has been shown to reduce both complications and is strongly advised.

I prefer subcutaneous heparin because some newer agents, such as low-molecular-weight heparin, have been associated with significant postoperative bleeding.³

Choose an incision that guarantees broad exposure

The extreme care necessary during surgery in a frozen pelvis begins with the incision. If chosen wisely, it can help the surgeon avoid injury to the intestines upon abdominal entry.

In general, I prefer a vertical midline incision because it allows for maximum flexibility and exposure, particularly when used in conjunction with a Book-

Images: Bireck Cox

What to do if you get lost

At one time or another, every surgeon finds it necessary to rethink a planned procedure after the operation begins—a not uncommon scenario during surgery in the frozen pelvis. It can occur at the beginning of a procedure, once the incision is made and the pathology is surveyed, or it can arise when the surgeon is well into an operation, when all the usual landmarks are indistinguishable.

When the problem is clear from the get-go

When confronted with an impossible situation upon opening the abdomen, the surgeon has 2 options:

- close the abdomen and refer the patient
- call for the aid of a surgical colleague who has the necessary experience and skill.

When the operation is under way

This situation may not lend itself to so easy a solution. When the surgeon becomes overwhelmed by an unfamiliar operative field, he or she should stop operating, take stock of what has been accomplished and what remains to be done, check the status of the patient, and reevaluate the case.

Again, 2 options are available:

- change the original goal and terminate the procedure at that point, scheduling reoperation for a later date
- call for help, particularly if arrangements have been made beforehand.

Either way, a compromised patient is too high a price to pay for the sake of the surgeon's vanity, and the dictum of "primum non nocere" should become the guiding principle.

walter retractor. However, if the patient has had a prior paramedian or midline incision, extensive omental and intestinal adhesions are likely and can make entry difficult and increase the risk of intestinal injury. In such a case, an incision in a different location or direction may be wise.

For example, a transverse muscle-dividing incision may make it possible to find an area lateral to the original incision where the peritoneum, omentum, and intestinal tract are not adherent. Then, under direct vision, the incision can be extended and any adherent bowel near the midline incision can be safely dissected.

Once the fascia is incised, grasp it with a Kocher clamp. After entering the peritoneal cavity, include the peritoneum in the clamp. This allows for maximal traction during dissection of the bowel and omentum with scissors.

The most important action to take at the time of incision is to make it large enough to allow for excellent exposure. An adequate incision and the appropriate retractor will minimize operative time and facilitate completion. The old adage that "wounds heal from side to side, not end to end" is particularly applicable.

First steps: Get oriented, assess adhesions

After entering the abdomen, identify pelvic structures and their location in relation to one another. In patients who have undergone previous surgery or had inflammatory disease, the omentum may be adherent to these structures. If the omental adhesions are filmy and easy to reduce, cut them free. However, if the omentum is densely adherent to the parietal peritoneum or other pelvic organs or bowel, it may be helpful to cut across the omentum, leaving a portion attached to the structures to be removed.

Identify landmarks

After omental or intestinal adhesions have been separated, move the small and large intestines up as far as possible from the pelvis and pack them away. Then identify the following pelvic structures: uterine fundus, round ligaments, infundibulopelvic (IP) ligaments, posterior cul-de-sac, anterior cul-de-sac, prevesical peritoneum, and pelvic brim. These structures may be difficult to recognize and to mobilize because of fibrosis and adhesions.

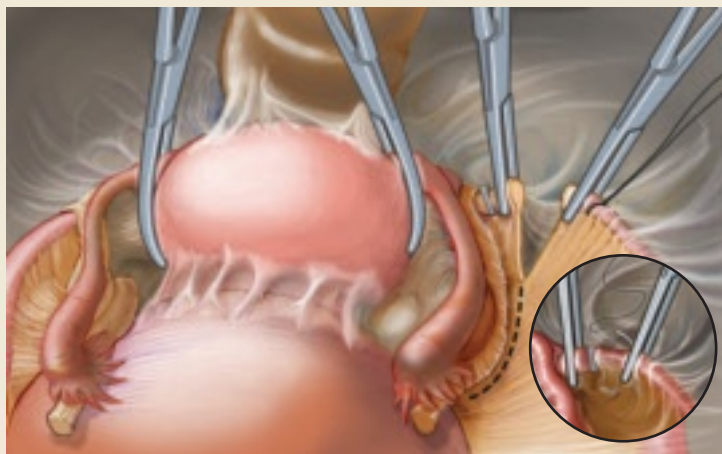
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If the patient has had a paramedian or midline incision, extensive omental and intestinal adhesions are likely and can make entry difficult

FIGURE 2

Transect the round ligaments



To facilitate entry into the retroperitoneum, transect the round ligaments. Then develop the retroperitoneal spaces using blunt dissection.

Choose entry into the retroperitoneum with care

Once you have identified the structures, determine how you will be entering the retroperitoneum. This decision is important because the blood supply to the uterus and adnexa lies in the retroperitoneum, as do the ureters, which must be identified and kept under direct vision during ligation of the IP ligaments and dissection of the peritoneum around the uterus.

Retroperitoneal entry and elaboration of the retroperitoneal spaces are keys to the safe performance of a difficult hysterectomy or removal of retained adnexa in a patient with a frozen pelvis. The retroperitoneal approach makes it possible to reach around structures that are fixed in the pelvis, to identify the blood supply and other vital structures, and to proceed safely.

Several entry sites are possible. In the frozen pelvis, I believe the round ligament is the ideal location. Identify and divide this ligament as it enters the internal ring, and incise the peritoneum cephalad along the course of the IP ligaments (FIGURE 2).

Next, open the pararectal space to visualize the iliac vessels and ureter, which can be identified on the medial leaf of the peritoneum. The IP ligaments can then be visualized and safely divided. Extending

the dissection caudad allows entry into the retrovesical space and into areas of the broad ligament adjacent to the uterus. This approach also makes it possible to produce traction on the peritoneum and facilitate separation of the areolar tissue between the bladder and cervix to enter the vesicovaginal space. Continue dissection of the bladder from the cervix and vagina by operating from one side of the pelvis to the other.

The ureter, a surgeon's nemesis

Never assume you know the position of the ureter without confirming it; a major deviation of its course can occur secondary to pathologic processes in the pelvis. The ureter can be identified by direct visualization, peristalsis, and palpation. If it is rolled between the thumb and forefinger, the ureter produces a snapping sensation.

After entering the retroperitoneum, identify the ureter between the pelvic brim and Wertheim's tunnel. Although it may, at times, be seen through the thin peritoneum as it travels over the common iliac artery down into the pelvis, the ureter is generally not clearly visualized in the frozen pelvis and may become apparent only after the peritoneum has been opened and the retroperitoneal spaces elaborated.

Near the level of the pelvic brim on the left side of the body, the ureter will be closer to the IP ligament than it is on the right side, due to the location of the sigmoid colon and its mesentery on the left side, which elevate the ureter in the ventral direction.

Once the ureter has been identified, leave it attached to the peritoneum as much as possible. When the ureter is adherent to pelvic pathology, lateralize it from the medial leaf of the broad ligament as far down into the pelvis as necessary to allow complete removal of the peritoneum along with the pathology. The extent of dissection necessary will vary with the pathology.

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Never assume you know the position of the ureter without confirming it

Handle the ureter gently

Never handle the ureter excessively or unnecessarily. When it is dissected free, let it lie free rather than retracting it with umbilical tapes or Penrose drains, which can slide up and down, damaging the vasculature that lies in the adventitia of the ureteral wall.

Freeing the bladder can be difficult

A history of surgery in the area of the bladder, such as cesarean section or bladder advancement with uterine suspension, may leave the bladder adherent to or hard to separate from the cervix and vagina. Normally, the vesicouterine peritoneum is flexible, mobile, and easy to free from the cervix and vagina. A history of disease processes such as endometriosis, infection, or tumors makes this dissection difficult, with a real risk of inadvertent cystotomy.

One technique to make this dissection easier and safer is to enter the retroperitoneum laterally near the round ligament. In this location, the bladder may not have been involved in the prior dissection, and the tissue may be more areolar and less dense than it is in the midline. After entering the retroperitoneum, elevate the bladder by incising the vesicouterine peritoneum transversely. By rolling a finger or an instrument cephalad in the anterior leaf of the broad ligament, the bladder can be sharply separated from the cervix.

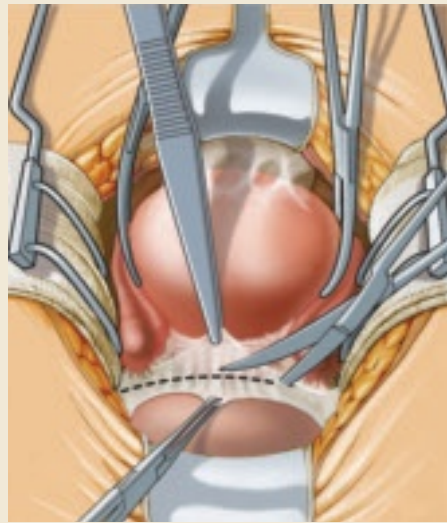
When the bladder is densely adherent, make an incision into its dome away from the cervix to visualize the interior of the bladder. Place the index finger into the bladder to identify its reflection, and cut through the dense adhesions between it and the cervix and vagina (FIGURE 3).

Cul-de-sac of Douglas may be hard to recognize

In a disease-free pelvis, the posterior cul-de-sac is bounded laterally by the utero-

FIGURE 3

Incise the broad-ligament peritoneum



Incise the peritoneum of the avascular layer of the anterior broad ligament bilaterally between the divided round ligaments to develop the vesical space bilaterally. One way to do this is to gently tease away the areolar tissue using a finger, pushing the tissue medially. Then divide the peritoneum between the 2 spaces and sweep the bladder off the cervix using blunt or sharp dissection.

sacral ligaments, posteriorly by the rectum and sacrum, and caudally by the vagina—but these relationships are usually lost in the frozen pelvis. Extensive inflammatory disease, tumors of the tubes and ovaries, extensive pelvic endometriosis, and prior infection due to a diverticular abscess or ruptured appendix can obscure the normal confines of the cul-de-sac. It can also be obliterated by large myomas, which can fill the pelvic cavity and extend upward beyond the sacral promontory into the abdominal cavity, thereby displacing the intestines and creating potential deviation and compression of the ureters.

Freeing the peritoneal attachments both anteriorly and posteriorly, as well as at the sides of the pelvis, may release the pelvic contents and allow elevation of the uterus into the abdominal cavity. Then the ureter, uterine vasculature, and supporting ligaments can be identified. Dissection becomes simpler after this point.

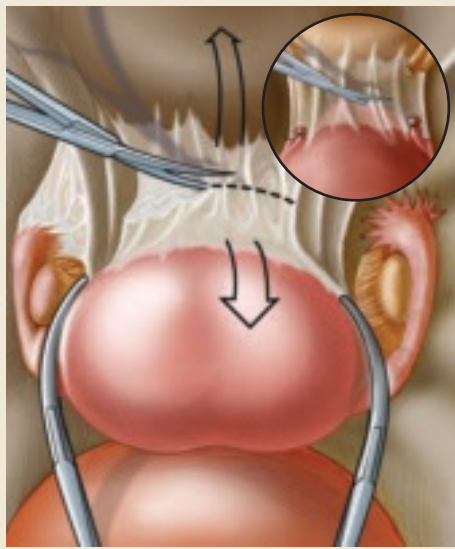
However, when the rectum and ureters are densely adherent, as they often

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A history of surgery in the area of the bladder may leave it adherent or hard to separate from the cervix and vagina

FIGURE 4

Mobilize the uterus



To free the uterus from its posterior visceral attachments and render it mobile, develop the rectovaginal space.

are in the frozen pelvis, dissection can become difficult, with a real danger of rectal perforation. A basic principle in any hysterectomy is to hug the uterus as closely as possible, staying near the posterior surface of the uterus and cervix using both blunt and sharp dissection. This eventually makes it possible to find a reasonable plane to enter the rectovaginal space at the superior portion of the cul-de-sac between the uterosacral ligaments.

The tissue below this level is not usually involved in the frozen pelvis and will give way readily once the uterosacral ligaments are divided. It is unnecessary to operate beyond this level to any great extent because the surgery already extends distal to the cervicovaginal junction. In some circumstances, it may be necessary to enter the vagina anteriorly to define the relationship between the posterior cervix and adherent bowel (**FIGURE 4**).

Identifying and repairing bowel injury

If the bowel has been prepped, and rectal enterotomy occurs during dissection, closure and drainage are the only necessary

steps, and a temporary colostomy can be avoided. Bowel resection may be necessary if the bowel has sustained damage.

If bowel injury is suspected, irrigate the bowel through the rectum with sterile milk or dye solution using a Foley catheter with a 30-cc bag. Another widely used option to assess rectosigmoid integrity is to insufflate the submersed rectosigmoid with air. Bubbles signal a breach in the integrity of the bowel wall.

Postoperative care

After surgery, the principles of early mobilization and ambulation are key. The single most important postoperative intervention is early ambulation, which can minimize pulmonary problems, ileus, bladder atony, and thromboembolic disease secondary to deep venous thrombosis.

To protect against venous thromboembolic disease, use pneumatic compression devices and early ambulation. In women with other risk factors for deep venous thrombosis, such as malignancy, diabetes, obesity, and smoking, consider subcutaneous heparin.

Unless the bowel was resected or extensive adhesiolysis was performed, I generally allow the patient to have clear liquids on the first postoperative day. I then advance oral intake after gastrointestinal motility returns or when the patient complains of hunger.

Remove the urethral catheter on the first postoperative day unless cystotomy or extensive dissection of the ureters or bladder was performed. ■

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To assess rectosigmoid integrity at the conclusion of the operation, insufflate the submersed rectosigmoid with air. Bubbles signify a breach in the bowel wall