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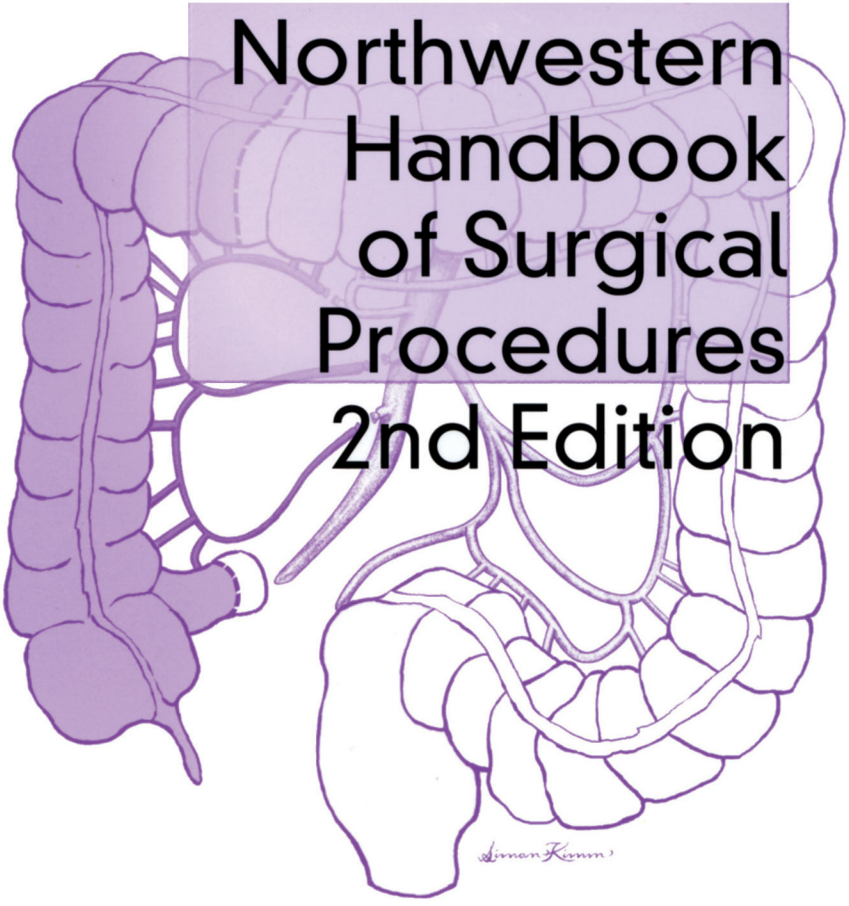
Northwestern Handbook of Surgical Procedures 2nd Edition



Nathaniel J. Soper
Dixon B. Kaufman

v a d e m e c u m

Northwestern Handbook of Surgical Procedures

2nd Edition

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Dedications

To my wife, Cindy, and my three sons, who have been supportive of my academic career throughout our lives. Also, to the many surgical trainees who have enriched my life by allowing me to share my joy of operating and the teaching of surgical techniques.

—N.J.S.

To all my colleagues that appear on these pages, and to those that do not, who have advanced the field of operative surgery, making it a more perfect therapy for those that count on our skills to enhance their well being; and above all, to Katina.

—D.B.K.

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Foreword

I am delighted that Dr. Soper and Dr. Kaufman have edited a second edition of the *Northwestern Handbook of Surgical Procedures*. This book fulfills a need in surgical education to improve the teaching of operative skills. Over the past few years, many in the academic surgical community have been re-evaluating the effectiveness of residency training. In 2006, the Surgical Council on Resident Education (SCORE) was formed by six academic and administrative organizations with oversight and/or interest in surgical graduate education. One of the major findings of this group has been that the operative experience of U.S. general surgery residents, even in some common, essential operations is inadequate. Among other things, this means that we must do a better job of preparing residents to have a maximal learning experience in the operating room when they do have the opportunity to perform a procedure.

The Northwestern Handbook of Surgical Procedures is designed to be reviewed prior to performing or participating in an operation. The authors of the book have identified the key steps of performing each procedure, to provide a framework to the learner for understanding the tasks and the sequence of those tasks necessary for successful performance. Breaking a complex performance like an operation into a series of steps is a technique well validated in the educational literature and provides the basic scaffold upon which the surgeon-in-training can add nuances and variations that are encountered in the course of experience, ultimately building a strong mental model or image of the operation.

I would urge residents or students who are using this book to discuss the steps of the procedure with faculty members before the start of an operation to understand if your views of the key tasks are aligned. It also would be helpful to discuss with the faculty member which steps you believe you understand or have mastered as opposed to those steps which seem unclear to you or about which you have concerns as to your ability. This kind of active participation in the course of an operation will make your educational experience a richer one.

Surgery is a changing field and it is difficult to know how technology will change our approach as the years go by. No doubt, you will see major changes in surgery over the course of your career. In the meantime, you should strive for the best technical grounding you can build for yourself. This requires a combination of analytic understanding and technical practice. This book aims to help you to approach an operation with an intellectual framework. I wish you success in the learning and practice of surgery.

Richard H. Bell, Jr., M.D.
Assistant Executive Director, The American Board of Surgery, Inc.
Adjunct Professor of Surgery, Northwestern University

STOP!

Before You Start: Optimizing Operative Care of the Surgical Patient

Amy L. Halverson

Optimizing the outcome of a surgical patient starts prior to the patient entering the operating room. The following questions should be addressed prior to surgery.

1. Has this patient had appropriate evaluation for comorbidities, including cardiac risk and sleep apnea?
2. What is the appropriate antibiotic prophylaxis?
3. What is appropriate DVT prophylaxis?
4. Are the available blood products appropriate for the estimated blood loss?
5. Has the surgical site been marked? Depending on your institution's policy, midline, single organ procedures, as well as endoscopies without intended laterality may not require site marking.

Safety and efficiency in the OR rely on good communication among the operating room team members. Having all team members introduce themselves facilitates subsequent communication. Prior to commencing the operation the following issues should be discussed.

1. Correct patient, site and procedure are confirmed.
2. Surgeon reviews the critical portions of the procedure as appropriate, duration of procedure and estimated blood loss.
3. Anesthesia staff review issues critical to the patient.
4. Nursing staff reviews equipment availability and other concerns.
5. Confirm that appropriate antibiotics have been given.
6. Confirm that necessary imaging is available.

At the conclusion of the procedure the following should be verified:

1. The name of procedure as recorded.
2. Instrument counts are correct.
3. The specimen is correctly labeled.
4. Postoperative recovery and care plan for the patient.

Section 1: Gastrointestinal

Section Editors: Nathaniel J. Soper and David M. Mahvi

Chapter 1

Exploratory Laparotomy: Open

Eric Hungness

Indications

Open exploratory laparotomy is indicated where a surgically correctable problem may exist in the abdomen. The most common indications for open exploratory laparotomy include conditions of acute intra-abdominal infection and acute traumatic injuries. Open exploration is particularly useful when questions arise concerning the integrity or the condition of the bowel. Whereas CT can provide very accurate anatomic information regarding retroperitoneal and solid organ structures, it is much less reliable for evaluation of the bowel. Diagnostic laparoscopy may be considered because it is less invasive; however, it also has lower diagnostic accuracy for evaluating the intestine. An advantage of open laparotomy is the ability to address the primary problem, whatever it might be.

Preop

Prior to exploratory laparotomy the patient should have appropriate venous access and should (if possible) be well-resuscitated. It is advantageous to place a Foley catheter prior to abdominal exploration. When performing exploratory laparotomy for blunt trauma have adequate operative suction (two suctions), lighting, and carefully position the patient such that the chest and/or mediastinum can be accessed intraoperatively. Antibiotic prophylaxis should be instituted prior to the incision. Choice of agent should be based on the pathogens likely to be encountered. Second-generation cephalosporins or other agents that cover aerobic and anaerobic enteric pathogens are frequently used. General endotracheal anesthesia is required, along with good muscle relaxation.

Procedure

Step 1. The patient is placed in the supine position. A midline abdominal incision is made from the xiphoid to the pubis. When rapid abdominal access is required in traumatic situations, the incision can be made most rapidly with 2-3 scalpel passes. The first pass cuts through the subcutaneous tissue down to the level of the fascia. A second pass of the scalpel can be used to incise the fascia in the midline. The peritoneum can then be entered using a scissors. It is best to complete the fascial incision prior to incising the peritoneal cavity as any tamponade-effect will be released once the peritoneal cavity is entered.

Step 2. On entering the abdominal cavity, pay attention to where bleeding or contamination appears to be arising. It is best not to be distracted by bowel injury/contamination in the setting of massive hemoperitoneum. The peritoneal cavity is packed with laparotomy pads in the four quadrants of the abdomen, but packing should be done first in the quadrant that is most likely to be the source of the bleeding.

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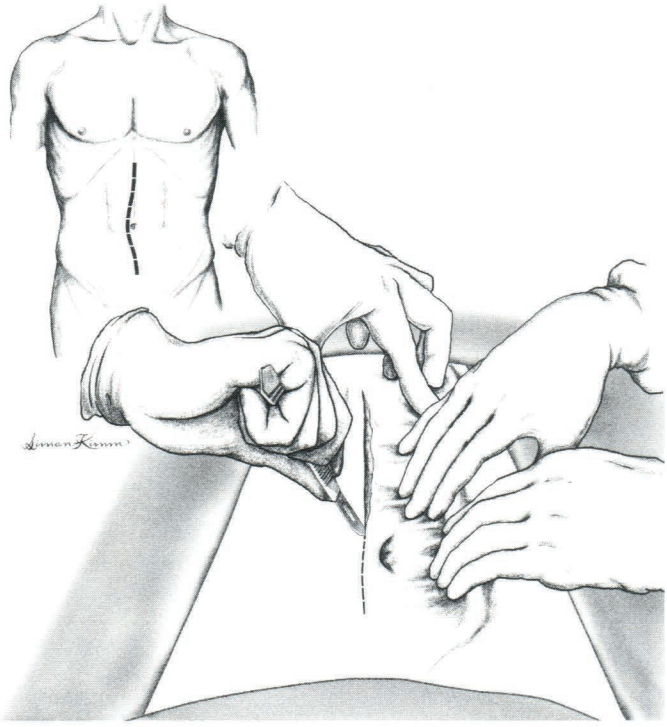

Figure 1.1. Exploratory laparoscopy.

Bowel injuries with ongoing enteric leakage can be controlled with temporary mass ligatures or application of noncrushing clamps.

Step 3. If there is massive bleeding, temporary control of hemorrhage can be obtained with compression of the aorta at the diaphragmatic hiatus. This can be performed using digital pressure, pressure from a Richardson retractor (back of one blade), or with an aortic occluder.

Step 4. Once hemorrhage is stabilized, the surgeon should explore the four corners of the abdomen while removing the temporary packs (if applicable). It is important to utilize a systematic approach to ensure that all intra-abdominal structures are visualized. Particular care should be taken to ensure that relatively inaccessible areas (diaphragm, lesser sac, pelvis) are carefully evaluated. Warm saline irrigation of the relevant quadrant should be performed while the exposure is optimized.

Step 5. Exploration is begun in the left upper quadrant. It is important to visualize the diaphragm, spleen, stomach, and gastroesophogeal junction. Appropriate control measures or repacking should be instituted as applicable if specific injuries are identified.

Step 6. Attention is next directed to the right upper quadrant, taking care to visualize the diaphragm, the diaphragmatic surface of the liver, the integrity and condition of the gallbladder, the lateral aspect of the liver, and the undersurface of the liver.

Step 7. The right lower quadrant of the abdomen is visualized next, paying particular attention for the presence of any bowel or bladder perforation or retroperitoneal hematoma in the area of the iliac vessels.

Step 8. In examining the left lower quadrant, attention is directed to assessing the integrity and condition of the sigmoid colon and looking for evidence of retroperitoneal injury.

Step 9. The integrity of the small bowel is next determined by "running" the small bowel from the ligament of Treitz to the ileocecal valve. The surgeon should make a mental note as to whether there is any evidence of a central retroperitoneal hematoma. Both sides of the small bowel should be examined. The mesentery is inspected simultaneously.

Step 10. The colon is inspected beginning at the cecum with evaluation of the appendix and periappendiceal structures. Inspection continues by examining the cecum and continuing up the right colon carefully examining the hepatic flexure. Examination continues by assessing the transverse colon with the omentum reflected cephalad. Complete evaluation of the splenic flexure may require division of the splenocolic ligament. Evaluation continues by inspecting the left colon and sigmoid colon. Complete evaluation of the right, left, or sigmoid colon may require mobilization of these structures by division of the lateral peritoneal attachments (white line of Toldt) and medial reflection.

Step 11. The anterior surface of the stomach and duodenum should be examined next. In the process, the surgeon should pay particular attention to whether there is any evidence of blood or inflammation in the lesser sac by closely examining the lesser omentum.

Step 12. The pancreas and lesser sac are evaluated next by entering the lesser sac. This is accomplished by making an incision on the undersurface of the omentum just cephalad to the transverse colon. This is most easily accomplished to the left side of the midline. Both the anterior surface of the pancreas as well as the posterior aspect of the stomach can be inspected through this incision.

Step 13. If duodenal injury is suspected the duodenum can be mobilized by performing a Kocher maneuver (lateral incision of retroperitoneum and medial reflection of the duodenum). This also allows visualization of the right renal vein and inferior vena cava. The third portion of the duodenum can be visualized by performing a Cattel maneuver (division of the lateral attachment of the cecum and medio-cephalad cecal reflection).

Step 14. If bowel or solid organ injuries are identified they should be addressed prior to closure.

Step 15. At the completion of the procedure the abdomen should be irrigated with warm saline solution (antibiotics are not required in this fluid).

Step 16. The fascia is closed with running 0-monofilament sutures beginning at the superior and inferior aspects of the incision and meeting in the middle. This skin is either closed or left open as dictated by the intraoperative findings.

Postop

Careful postoperative management and evaluation of the fluid balance should be performed. In instances of trauma or infection that require significant resuscitation, abdominal compartment syndrome can occur with severe hemodynamic and metabolic consequences. The surgical incision should be examined on a daily basis and opened if there is evidence of infection present.

Complications

The most common complication of laparotomy is wound infection. Inadequate exploration can result in missed injuries. Wound dehiscence can also occur. Hypothermic coagulopathy can complicate prolonged exploratory laparotomy in many patients. Abdominal compartment syndrome can occur.

Follow-Up

The patient should be followed until wounds are healed. Long-term follow-up depends on the nature of the underlying disease/injury.

Acknowledgment

The editors and author wish to acknowledge Michael A. West for contributing to the previous version of this chapter.

Chapter 2

Inguinal Hernia Repair with Mesh: Open

Wilson Hartz

Indications

Open repair is indicated for primary or recurrent inguinal hernia in patients who are suitable operative risks.

Preop

General, spinal, epidural, or monitored local anesthesia with sedation may be chosen as anesthetic techniques, and the choice should be discussed with the patient. Intravenous prophylactic antibiotic is given 30 minutes prior to the skin incision. Deep vein thrombosis prophylaxis should be used in patients with risk factors for thromboembolism.

Procedure

Step 1. The patient is placed in the supine position. An oblique incision over the inguinal canal is made, using the pubic tubercle as a guide for the medial end of the incision.

Step 2. After opening the external oblique fascia, the ilioinguinal nerve is identified and preserved.

Step 3. Blunt or sharp dissection and a finger are used to surround and isolate the spermatic cord at the pubic tubercle. A Penrose drain is placed around the cord. During this dissection, the genitofemoral nerve should be identified and protected.

Step 4. The hernia sac is identified and separated completely from cord structures back to the level of the internal inguinal ring. In the case of a direct inguinal hernia, the internal ring should be examined to exclude the possibility of an additional indirect sac.

Step 5. For an indirect hernia, the sac is ordinarily treated by high ligation and excision of the sac or inversion into the internal inguinal ring. If the hernia is a sliding hernia, the sac can be inverted back into the internal ring. For direct hernias, the sac is inverted into the fascial defect. If desired, a mesh plug can be used to maintain reduction of the sac by placing it over the sac and securing it to the circumference of the defect

Step 6. Place an onlay patch of mesh over the inguinal canal. The spermatic cord is brought through a "key hole." The mesh should be secured with sutures or staples medially at the pubic tubercle, laterally into muscle beyond the external ring, superiorly to the conjoint tendon, and inferiorly to the shelving edge of the inguinal ligament.

Step 7. The external oblique fascia is closed, taking care not to make the external ring too tight, which can cause venous outflow obstruction from the testicle. The skin is closed with subcuticular suture.

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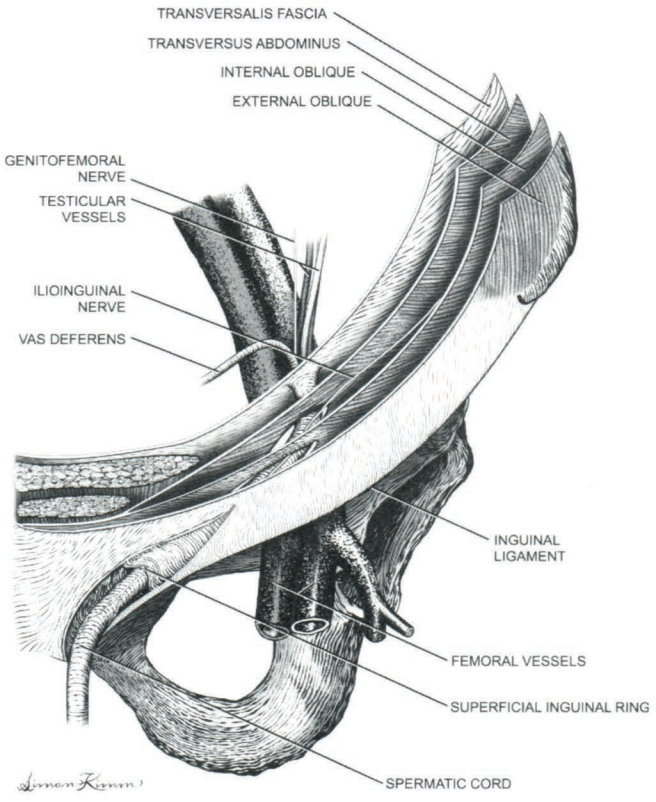

Figure 2.1. Inguinal hernia repair. Anatomy.

Postop

Patients can be discharged within a few hours after surgery if stable. Normal activities can generally resume in 2-4 weeks, although strenuous activity and heavy lifting are generally avoided for about 4-6 weeks.

Complications

Injury to the ilioinguinal nerve or genitofemoral nerve can result in chronic groin pain. Hematoma or seroma may occur. Infections may occur in the wound. If the mesh becomes exposed or infected, it may need to be removed. Mesh can migrate or erode. Recurrence occurs in 1-2% of patients operated for the first time.

Follow-Up

Patients may be seen periodically until they return to full activity.

Acknowledgment

The editors and author wish to acknowledge Ermilo Barrera, Jr. for contributing to the previous version of this chapter.

Chapter 3

Inguinal Hernia Laparoscopic Repair: Extraperitoneal Approach

Mark Toyama

Indications

Laparoscopic inguinal hernia repair is particularly indicated for recurrent or bilateral hernias. Its role in the management of first-time unilateral hernias is debatable.

Preop

Preoperative prophylactic antibiotic should be given intravenously 30 minutes prior to skin incision.

Procedure

Step 1. The patient is placed in the supine position with arms tucked at the sides. A Foley catheter is inserted into the bladder. The surgeon stands on the side opposite the hernia. Monitor(s) are placed at the foot of the table. The skin incision is placed just inferior to the umbilicus and dissection is carried down to the rectus sheath.

Step 2. A small incision is made in the anterior rectus sheath.

Step 3. The rectus abdominis muscle is bluntly dissected to expose the posterior rectus sheath.

Step 4. Blunt dissection is done to develop the space between the back side of the rectus muscle and the peritoneum. A finger or small retractor works well for this.

Step 5. A balloon dissector is then placed into the preperitoneal space and carefully advanced inferiorly to the level of the symphysis pubis. The balloon is inflated under direct vision of the laparoscope, creating a working area in the preperitoneal space.

Step 6. The balloon is removed and a 10 mm or 12 mm blunt trocar is placed into the preperitoneal space and secured. The preperitoneal space is insufflated with CO_2.

Step 7. A 30° laparoscope is placed into the preperitoneal space.

Step 8. Additional ports are placed. A combination of 2 mm and 5 mm ports can be use in a variety of configurations. The ports should be placed under direct vision, taking care to avoid puncturing the thin peritoneum.

Step 9. The preperitoneal space is bluntly dissected, reducing indirect, direct, or femoral hernias back into the peritoneal cavity.

Step 10. Very large indirect hernia sacs can be divided and the proximal end secured with a ligature, leaving the distal portion of the sac open and in situ. Care is taken to preserve all spermatic cord structures in men.

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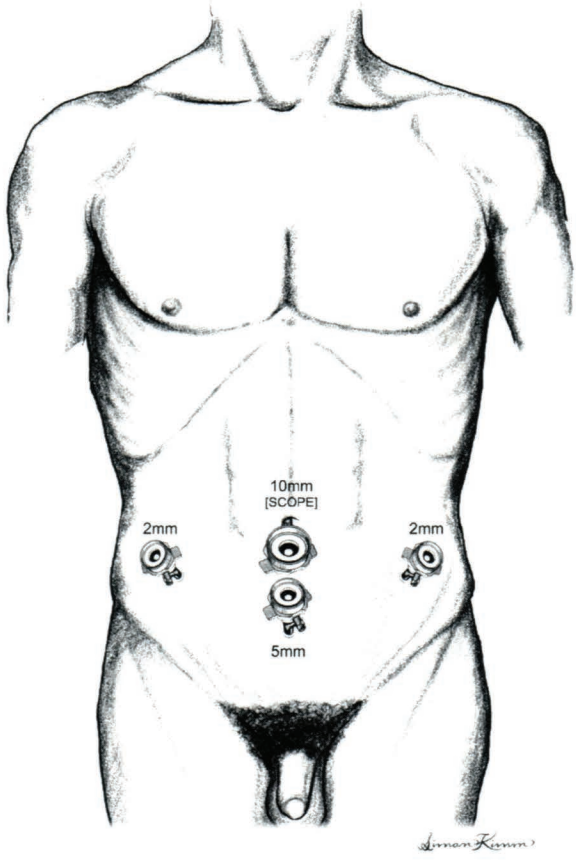

Figure 3.1. Laparoscopic inguinal hernia repair. Trocar placement.

Step 11. A large piece of mesh is then placed into the preperitoneal space and oriented to cover the direct, indirect, and femoral spaces.

Step 12. The mesh is secured with a tacking or stapling device to prevent mesh migration. The number of tacks required is variable, but this is done in such a manner as to avoid injuring or incorporating the ilioinguinal, iliohypogastric, lateral femorocutaneous, or genitofemoral nerves as well as any vascular or cord structures.

Step 13. After the mesh is placed and secured, the preperitoneum is desufflated under direct vision to ensure that the mesh remains flat and in the appropriate position.

Step 14. The skin incisions are closed with subcuticular sutures.

Postop

Postoperative manangement is similar to that of open hernia repair. The Foley catheter is removed before the patient leaves the operating room. Patients are discharged home when they can tolerate oral intake and void.

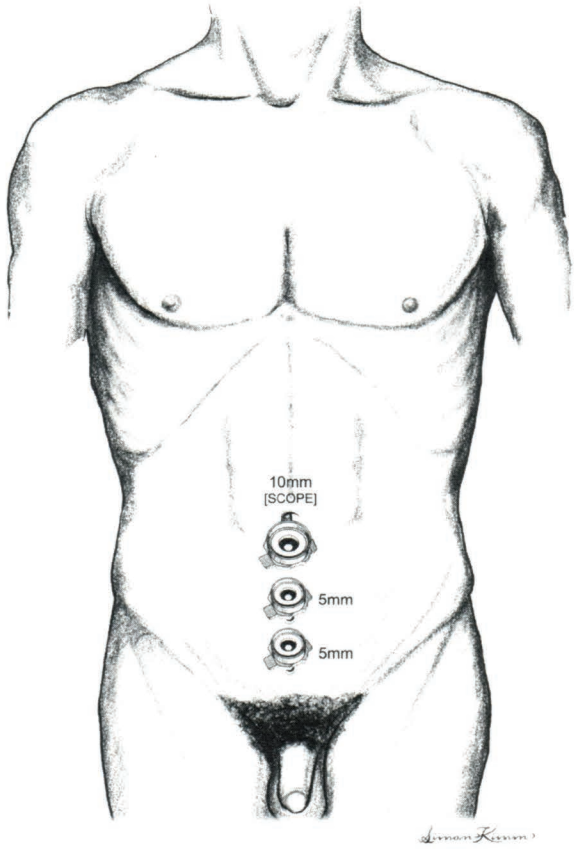

Figure 3.2. Laparoscopic inguinal hernia repair. Trocar placement.

Complications

A number of injuries are possible during laparoscopic preperitoneal hernia repair. These include nerve injury, vascular injury, bladder injury, colon or small bowel injury, testicular devascularization, and vas deferens injury. Urinary retention and/or infection may occur.

Seromas or hematomas may form in the dissected preperitoneal space. Pubic/pelvic osteitis may occur.

Wound infections are relatively rare. Mesh complications include infection, migration, and erosion. Finally, there is about a 2-5% chance of hernia recurrence.

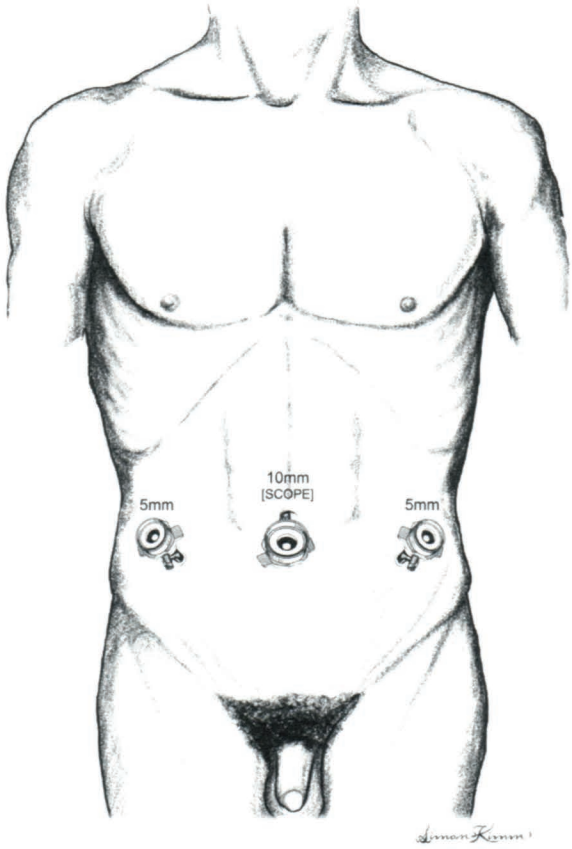

Figure 3.3. Laparoscopic inguinal hernia repair. Trocar placement.

Follow-Up

Patients are followed in the office approximately 2 weeks after their operation. Patients are instructed to avoid heavy lifting and straining for approximately 4-6 weeks after the operation.

Chapter 4

Ventral Hernia Repair: Open

Jay B. Prystowsky

Indications

In general, ventral hernias should be repaired in patients who are good operative risks to avoid the possibility of strangulation. Repair is definitely indicated in the presence of symptoms (pain, nausea, vomiting, etc.) or if the hernia cannot be reduced.

Preop

Patients should be given a preoperative systemic antibiotic for wound infection prophylaxis 30 minutes before operation. In cases where there is likely to be colon in the hernia sac or adhesions to the colon, a mechanical and pharmacologic bowel prep is indicated. Patients should be treated with sequential compression devices or subcutaneous heparin according to their preoperative risk factors for thromboembolism. Most procedures should be done under general anesthesia.

Procedure

Step 1. A skin incision should be made that will expose the full length of the hernia defect. In cases where a hernia has occurred in a portion of a previous incision, it is important to have adequate exposure to examine the remainder of the previous incision for possible defects.

Step 2. The subcutaneous tissue is dissected down to the hernia sac, at which point subutaneous flaps are raised all around the hernia until normal fascia can be identified on all sides of the hernia. The peritoneal sac is then opened. Often, there is redundant peritoneum that can be excised back to expose the fascial edges of the defect. It is critical to definitively identify fascia at all margins of the defect.

Step 3. An assessment is made of the amount of tension that would be created with a primary repair of the defect. In general, defects more than 2-3 cm in diameter will not be amenable to primary closure.

Step 4. If primary closure is entertained, relaxation incisions can be made in the anterior rectus sheath or other anterior layers of abdominal fascia to decrease closure tension.

Step 5. Primary closure can be performed with direct approximation or a pants-over-vest method.

Step 6. If mesh is to be placed, the mesh should be cut in the shape of the defect but about 2-3 cm larger in all dimensions. The mesh is sewn to the underside of the fascial edges of the defect using interrupted vertical mattress sutures of a monofilament suture. It is critical that mesh is secured to overlying fascia and that there is sufficient overlap of mesh over the edges of the fascial defect.

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Step 7. If the subcutaneous fat can be closed over the repair without tension, this should be done with absorbable sutures. Often, this is not possible, If there will be a subcutaneous cavity over the repair, it is best to place a closed suction drain over the repair and bring it out through a separate stab wound in the skin.

Step 8. The skin is closed with staples or suture.

Postop

If an extensive lysis of adhesions has been performed, it may be appropriate to leave a nasogastric tube in place until bowel activity has returned. Ordinarily, however, early feeding can be initiated. The patient should be able to ambulate on the day following surgery in most cases.

Complications

The most important early complication of ventral hernia repair is wound infection, which can present a major problem if mesh is exposed or involved. The most significant late complication is hernia recurrence.

Follow-Up

The patient should be followed until healing is complete and normal activity resumed. The patient should be instructed about the risk and signs of recurrence and asked to return as needed should symptoms develop.

Acknowledgment

The editors and author wish to acknowledge John J. Coyle for contributing to the previous version of this chapter.

Chapter 5

Ventral Hernia Repair: Laparoscopic

Eric Hungness

Indications

In general, ventral hernias should be repaired in patients who are good operative risks to avoid the possibility of strangulation. Repair is definitely indicated in the presence of symptoms (pain, nausea, vomiting, etc.) or if the hernia cannot be reduced.

Preop

The alternative of open ventral hernia repair should be discussed with the patient. If the patient chooses laparoscopic surgery, a careful review of previous operations and examination of the abdomen is carried out to help plan potential access sites. On the day of surgery, patients should be given a preoperative systemic antibiotic for wound infection prophylaxis 30 minutes before operation. In cases where there is likely to be colon in the hernia sac or adhesions to the colon, a mechanical and pharmacologic bowel prep prior to surgery is indicated. Patients should be treated with sequential compression devices or subcutaneous heparin according to their preoperative risk factors for thromboembolism. A Foley catheter and nasogastric tube are placed immediately after the induction of anesthesia.

Procedure

Step 1. The entire abdomen is prepped and draped in sterile fashion. A sterile plastic barrier is utilized to avoid contact of the prosthetic material with exposed skin.

Step 2. Access is first obtained away from prior surgical sites, on the side opposite previously dissected areas. For example, if a patient has had a low anterior resection and has an incisional hernia, access should first be obtained on the right side of the abdomen to avoid placement of the initial operating port through adhesions.

Either a Veress needle or open technique can be used for initial access to the peritoneal cavity. Veress needle access can be difficult away from the midline. If Veress needle access is initially unsuccessful, the surgeon should have a low threshold for converting to an open access technique (e.g., Hasson cannula).

Step 3. An angled laparoscope is used to permit the surgeon to see around the edges of adhesions. The abdomen is explored and adhesions are assessed. Sites are selected for subsequent port placement. In general, two ports are placed on the same side as the first trocar, and at least one other port is placed on the contralateral side to facilitate the later securing of the mesh.

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Step 4. Adhesions are divided using either sharp dissection with electrosurgical cautery (staying away from bowel) or ultrasonic shears. Traction is the key to facilitate division of adhesions, and using two hands to dissect helps in manipulation of bowel and tissues. Occasionally, initial adhesiolysis must be done through one port to "clear" space for placement of subsequent ports. Special care must be taken to avoid injury to bowel.

Step 5. Once all hernia contents have been reduced and the edges of the defect are well-exposed, the defect is transilluminated from the abdomen and the defect margins are marked with a pen on the plastic barrier drape.

Step 6. An appropriately sized piece of polytetrafluoroethylene (PTFE) mesh is selected. It must overlap the edges of the defect by at least 2-3 cm circumferentially when the abdomen is insufflated. When the mesh is laid on the plastic barrier drape ("nonadhesion-forming" side of the mesh against the plastic barrier drape), the previously made ink marks identifying the defect edges are transferred to the prosthetic material. This aids in trimming of the mesh to 2-3 cm beyond the edges of the defect.

Step 7. At least four, but preferably six or eight, nonabsorbable stay sutures are placed circumferentially around the edges of the mesh, spaced equidistantly. The sites of suture placement are marked on the abdominal wall for future passage of the sutures.

Step 8. The mesh with the sutures is passed through the largest port (generally a 12 mm port except for the smallest mesh which can be placed through a 10 mm port) by rolling the mesh as tightly as possible.

Step 9. The mesh is oriented properly and unfurled in this orientation.

Step 10. The suture passer (disposable or reusable) is passed through the previously marked skin sites and each of the suture ends is grasped. For each suture site, the suture passer must be passed twice through the same skin puncture, but different fascial sites (1 cm apart) so that the suture ends can be tied external to the fascia.

Step 11. Once this is completed, the mesh is secured circumferentially using a laparoscopic tacking device. Tacks are placed 1-1.5 cm apart. Special care should be taken to avoid plication of the mesh.

Step 12. The abdomen is inspected for hemostasis and any bowel that was dissected is examined for leakage or injury. If there are no problems, all ports are removed under direct visualization to assure that there is no port site bleeding.

Step 13. The fascia is closed at port sites larger than 5 mm. Skin is closed at all port sites with absorbable subcuticular suture and/or sterile tapes. Drains are not used.

Postop

In general, pain is fairly significant in the first 24-48 hours and ileus is not uncommon. Patients are generally hospitalized for one or two nights. Seroma formation in the previous hernia soft tissue defect is common. While this can be alarming to the patient, nothing should be done unless the seroma is symptomatic or signs of infection appear. In general, seromas and hematomas will resolve in 3-4 weeks. If drainage is required, this can be done percutaneously, but should be avoided if possible. Vigorous physical activity should be limited for 2 weeks while tissue ingrowth occurs, but there is no limitation necessary thereafter.

Complications

Occult bowel injury is a serious potential complication. Patients who do not seem to be recovering appropriately within 24-48 hours or who demonstrate signs of peritonitis (fever, elevated white blood cell count) should have an abdominal CT scan and possible urgent return to surgery.

Follow-Up

The patient should be followed until healing is complete and normal activity resumed. The patient should be instructed about the risk and signs of recurrence and asked to return as needed should symptoms develop.

Acknowledgment

The editors and author wish to acknowledge Kenric M. Murayama for contributing to the previous version of this chapter.

Chapter 6

Cholecystectomy with Cholangiography: Open

Jay B. Prystowsky

Indications

The indications for open cholecystectomy are the same as for laparoscopic cholecystectomy AND inability to perform laparoscopic cholecystectomy (which, in general, is the procedure of choice). Indications for cholecystectomy include symptomatic cholelithiasis (acute or chronic cholecystitis), gallstone pancreatitis, acalculous cholecystitis, or choledocholithiasis.

Preop

Antibiotics are administered in cases of acute disease, choledocholithiasis, or age >65 years.

Procedure

Step 1. A right subcostal incision is performed.

Step 2. The costal margin is retracted cephalad; the hepatic flexure of the colon and the duodenum are retracted inferiorly.

Step 3. Grasping the fundus of the gallbladder with a clamp, it is lifted anteriorly and away from the liver.

Step 4. The peritoneum overlying the gallbladder is incised with cautery within a few millimeters of the liver.

Step 5. Progressively retracting it away from the liver, the gallbladder is dissected from Glisson's capsule in the gallbladder fossa, moving downward towards the porta hepatis. It is important to dissect close to the wall of the gallbladder.

Step 6. The cystic artery and cystic duct are identified.

Step 7. The cystic duct is dissected down to its junction with the common duct.

Step 8. The common duct immediately proximal and distal to the entrance of the cystic duct is identified to verify anatomy.

Steps 9-15. describe intraoperative cholangiography, which may be performed in selected cases. Indications for cholangiography generally include: elevated liver enzymes, stone in common bile duct either documented preoperatively or discovered by palpation intraoperatively, dilated common bile duct, recent gallstone pancreatitis, or difficulty dissecting or identifying biliary anatomy.

Step 9. To prepare for cholangiography, a ligature is placed proximally at the junction of the cystic duct and gallbladder.

Step 10. A small opening is made in the cystic duct and a cholangiocatheter (4-5 F) is passed into the duct for about 1-2 cm.

Step 11. The catheter is secured with a ligature or clip. Two 30 ml syringes are attached to the catheter with a three-way stopcock and extension tubing. One is filled with saline, the other with contrast diluted 50%. Saline is injected to confirm there are no leaks at

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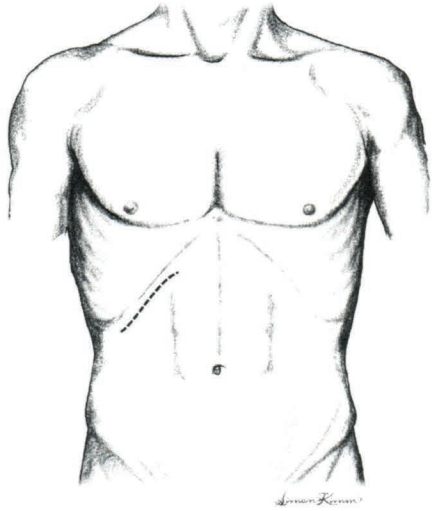

Figure 6.1. Cholecystectomy, open. Incision.

the site of catheter entrance into the cystic duct. It should be possible to aspirate bile if the catheter is properly positioned. Before injecting dye, air bubbles should be eliminated from the catheter and tubing.

Step 12. The patient is then placed in the Trendelenburg position and tilted to the right (to bring the common duct "off" the spinal column).

Step 13. Contrast is injected under fluoroscopic guidance.

Step 14. Easy flow of contrast distally into the duodenum and proximally into the right and left biliary radicals along with absence of filling defects constitutes a normal exam.

Step 15. The catheter is withdrawn and the cystic duct is ligated distal to the catheter entrance site. The cystic duct may then be transected.

Step 16. The cystic artery is ligated with nonabsorbable suture and transected between ligatures. The gallbladder is removed.

Step 17. The abdominal wall is closed in layers.

Postop

Diet may usually be instituted within 24 hours. Parenteral narcotics for pain are switched to oral prior to discharge.

Complications

Major complications include injury to the common bile duct and bile leak from the cystic duct stump; other surgical complications include wound infection and postoperative bleeding.

Follow-Up

Patients should be seen at 1-2 weeks and again at approximately 6 weeks. Most patients experience excellent relief of pain; 5% of patients will continue to have discomfort as they experienced preoperatively (postcholecystectomy syndrome).

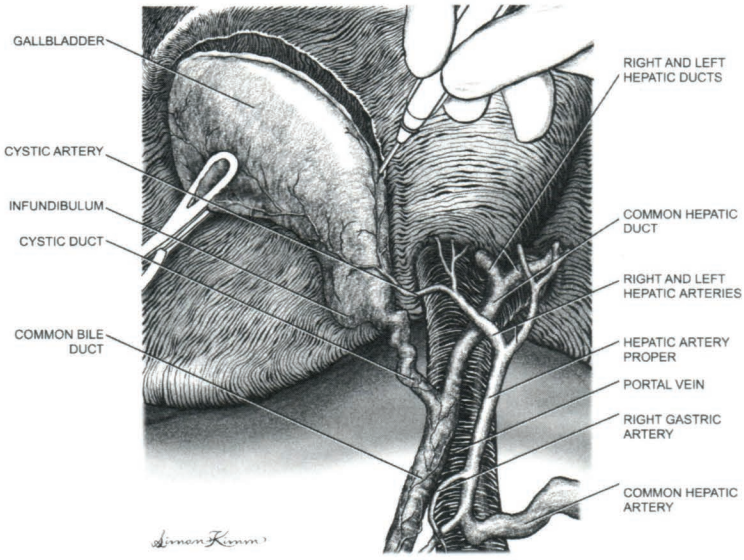

Figure 6.2. Open cholecystectomy.

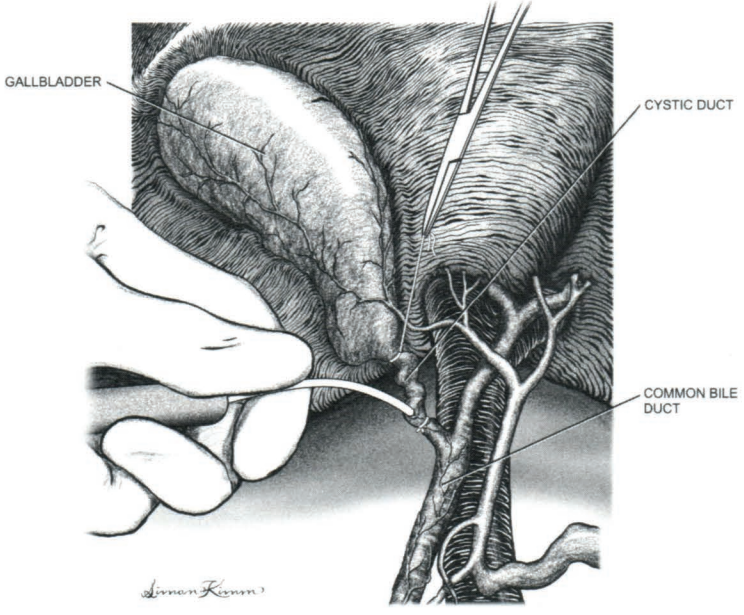

Figure 6.3. Open cholangiogram.

Chapter 7

Cholecystectomy with Cholangiogram: Laparoscopic

Nathaniel J. Soper

Indications

The indications for laparoscopic cholecystectomy include symptomatic gallstone disease (chronic cholecystitis or acute cholecystitis) or acute acalculous cholecystitis. Cholangiography may be done in selective cases. In general, the indications for cholangiography include choledocholithiasis, dilated common bile duct, recent gallstone pancreatitis without preoperative ERCP, or confusion about the anatomical orientation intraoperatively.

Preop

A first- or second-generation cephalosporin or an antibiotic of equivalent coverage is given 30 minutes prior to surgery. An orogastric tube is placed to decompress the stomach.

Procedure

Step 1. The entire abdomen is prepped and draped in standard sterile fashion. Access is gained at the umbilicus by either the Veress needle technique (closed technique) or open technique. We prefer the Hasson technique, using a 10 mm port.

Step 2. A 5- or 10-mm angled (usually, 30°) laparoscope is inserted and an exploratory laparoscopy is performed.

Step 3. The patient is placed in reverse Trendelenburg position and the other trocars are placed under direct visualization. A 10 mm trocar is placed in the subxiphoid epigastric region; a 5 mm trocar is placed in the right subcostal, midclavicular line; and a 5 mm trocar is placed in the right subcostal, anterior axillary line location.

Step 4. If the patient has had acute cholecystitis, there may be adhesions to the gallbladder. These adhesions can usually be swept away bluntly. The duodenum and/or colon may be adherent to the surface of the gallbladder. Therefore, while electrosurgical cautery can generally be used to facilitate the dissection of adhesions, cautery should be avoided if the duodenum or hepatic flexure of the colon is in proximity.

Step 5. The fundus of the gallbladder is grasped with an instrument placed through the right anterior axillary line port, and the tip of the gallbladder is retracted cephalad. The infundibulum of the gallbladder is retracted caudad and to the patient's right with a second grasper that is placed through the midclavicular port.

Step 6. A Maryland dissector placed through the epigastric port is used to clear the peritoneum over the infundibulum and hepatocystic triangle. The L-hook cautery also works well to dissect the neck of the gallbladder away from its bed. Dissection is undertaken both from the medial aspect, as well as from the lateral aspect while utilizing

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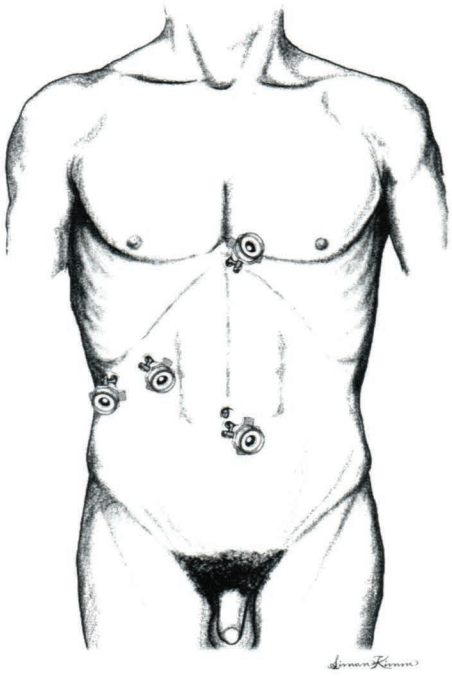

Figure 7.1. Laparoscopic cholecystectomy. Port placement.

countertraction on the infundibulum using a grasper manipulated with the surgeon's left hand. Using this technique, the lower part of the gallbladder is dissected away from the liver and a 'window', through which can be seen the liver, is created. There should be two, and only two, structures crossing this window; the cystic duct and cystic artery. This is the 'critical view of safety', which should be displayed prior to cutting or clipping any structures.

Step 7. Prior to dividing the cystic duct, a decision must be made regarding the need for a cholangiogram. If a cholangiogram is to be performed, a clip is placed across the cystic duct near the infundibulum. A transverse opening is created in the cystic duct. A "flash" of bile confirms that the opening is in the cystic duct. A cholangiocatheter is placed into the cystic duct and threaded distally toward the common bile duct. The catheter options include a balloon or straight catheter, and either a cholangiocatheter clamp or clips can be used to secure the catheter.

Two 30 ml syringes are attached to the catheter with a three-way stopcock and extension tubing. One is filled with saline, the other with contrast diluted 50%. Saline is injected to confirm there are no leaks at the site of catheter entrance into the cystic duct. It should be possible to aspirate bile if the catheter is properly positioned. Before injecting dye, air bubbles should be aspirated from the catheter and any extension tubing. Fluoroscopy or multiple static films can be used to verify the presence or absence of common bile duct stones and to display the biliary anatomy. If there are no stones, the operation can proceed. If there are common duct stones, there are four options:

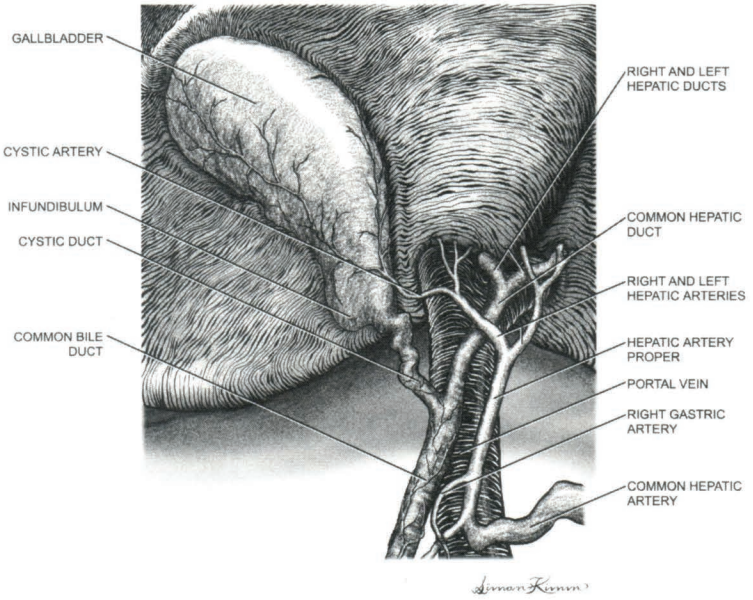

Figure 7.2. Laparoscopic cholecystectomy. Anatomy.

1. Complete cholecystectomy and perform postoperative ERCP;
2. Complete cholecystectomy and perform intraoperative ERCP;
3. Laparoscopic common bile duct exploration; or
4. Convert to open common bile duct exploration.

This decision depends on availability of a skilled endoscopist and the surgeon's experience with laparoscopic common bile duct exploration (see Chapter 9).

If the cholangiogram has been completed and a common bile duct exploration is not necessary or has been completed, the cystic duct is divided between clips (ordinarily, two clips are placed on the end toward the common bile duct).

Step 8. The cystic artery is cleared of surrounding attachments. Special care is taken to ensure that the artery is not the right hepatic artery by following it and observing its termination in the gallbladder. When this has been verified, the cystic artery is divided in continuity between clips.

Step 9. The infundibulum of the gallbladder is retracted anteriorly and cephalad, progressively dissecting the gallbladder from the liver bed using cautery and blunt or sharp dissection. Just before dividing the last attachments, the gallbladder bed is examined for hemostasis and the clips are examined for appropriate location and security. The right upper quadrant is irrigated and aspirated dry.

Step 10. Once amputated the gallbladder is placed into a specimen retrieval bag and removed through the periumbilical port. If the gallbladder is exceedingly large, full of gallstones, or contains large stones, it may not be easy to remove the gallbladder. Options include crushing the stones inside the gallbladder with a clamp, removing some of the stones/stone fragments to help decompress the gallbladder, and/or by enlarging the port incision.

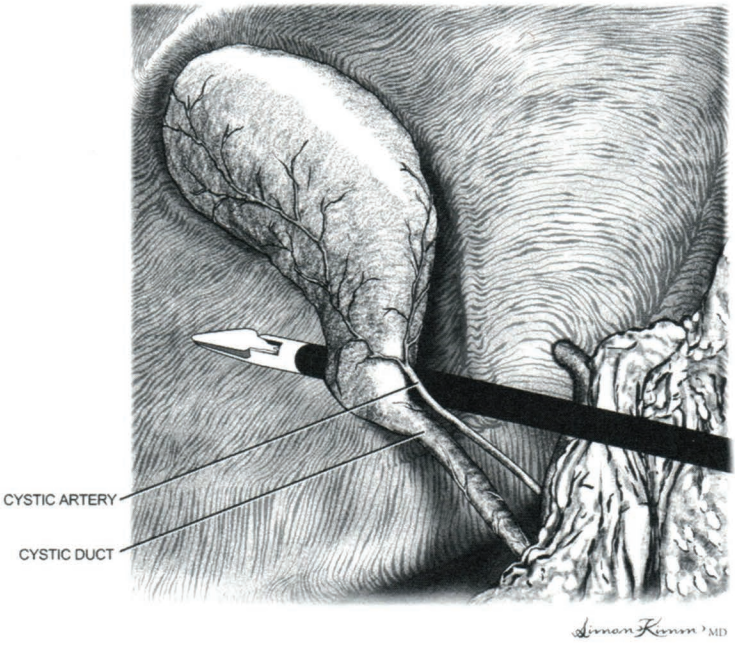

Figure 7.3. Laparoscopic cholecystectomy.

Step 11. The 10 mm incisions are closed at the fascial level. All skin incisions are closed with absorbable subcuticular sutures.

Additional Steps. Conversion to open should occur if the anatomy is unclear, there is excessive bleeding, or if a complication such as common duct injury occurs. If the gallbladder is perforated during dissection, additional care should be taken to remove all of the spilled stones and clean up any spilled bile.

Postop

Patients are started on clear liquids on the evening of surgery and may have their diet advance ad libitum. Patients are either sent home the day of surgery or in 23 hours.

Complications

Major complications include bleeding, common duct injury, leakage of bile from the cystic duct stump, duodenal injury, or other bowel injury.

Follow-Up

The patient should be seen in 1-2 weeks to examine wounds and be seen later by either the surgeon or referring physician to confirm resolution of preoperative symptoms.

Acknowledgment

The editors and author wish to acknowledge Kenric M. Murayama for contributing to the previous version of this chapter.

Common Bile Duct Exploration: Open

Jay B. Prystowsky

Indications

In general, open common duct exploration is indicated when stones are discovered by cholangiography during open cholecystectomy. It may be indicated when stones are discovered during laparoscopic cholecystectomy, and the surgeon is not familiar with the technique of laparoscopic duct exploration. Palpable stones in the common bile duct at the time of open cholecystectomy are another indication. An alternative therapy for stones in the common bile duct is postoperative endoscopic extraction via ERCP. Common duct exploration should be strongly considered when stones are large or multiple or there are anatomic considerations that would make the stones not amenable to endoscopic extraction.

Preop

Antibiotic prophylaxis is indicated. The early steps of the operation are described under open cholecystectomy with cholangiography.

Procedure

Step 1. Once the common duct has been identified, its anterior wall should be exposed for about 2.5-3 cm; care should be taken to avoid dissection along its lateral walls since that is where its blood supply exists.

Step 2. A #15 blade is used to create a small rent in the anterior wall of the duct, and Potts scissors are used to enlarge the rent in a longitudinal fashion for about 2 cm; stay sutures are placed on either side of the common bile duct incision to keep the aperture open.

Step 3. Randall stone forceps are passed distally and then proximally to clear the duct of stones by directly grasping them.

Step 4. A choledochoscope is useful to identify residual stones and assist in their extraction.

Step 5. An appropriately sized T-tube is placed into the common duct, and the common duct closed over the tube with a series of interrupted 4-0 absorbable sutures.

Step 6. A cholangiogram is performed to ascertain that the duct is clear of stones.

Step 7. A drain is placed near the common bile duct opening and brought out through a separate stab incision.

The remainder of the case proceeds as for open cholecystectomy.

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