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## Indications

Acute appendicitis  
Right lower quadrant pain of unknown etiology, especially in women of reproductive age  
Interval appendectomy

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## Preoperative Preparation

See Chap. 46.  
Place an indwelling bladder catheter for any laparoscopic procedure that involves the pelvis or lower abdomen.

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## Pitfalls and Danger Points

Injury to bladder from trocars or instruments.  
Injury to cecum from traction or dissection.  
Incomplete appendectomy, resulting in a retained stump.  
See Chap. 46.

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## Operative Strategy

The laparoscopic approach allows the surgeon to make a thorough visual inspection of the abdominal cavity and hence is especially useful in cases in which the diagnosis is questionable. The procedure differs from open appendectomy in that the base of the appendix usually presents first and is

divided first followed by the mesentery. A pretied ligature or staples are used to secure the base. The stump is generally not inverted. The choice of approach (open versus laparoscopic) should not influence the decision to drain or not to drain (see Chap. 46) or the duration of antibiotic therapy. These decisions should be based on the extent of the purulent and inflammatory process found at laparoscopic exploration. Other causes of lower abdominal pain, such as an inflamed Meckel's diverticulum or torsion of an ovarian cyst, may also be treated laparoscopically. The laparoscopic approach is not advisable if an appendiceal mucocele is found, as spillage of mucocele contents may seed the peritoneal cavity with malignant cells.

This chapter describes a standard three-trocar approach to appendectomy. Single-site laparoscopic techniques are being applied to appendectomy but are beyond the scope of this text. See the references at the end for further information on these advanced techniques.

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## Documentation Basics

- Findings
- Perforated?
- Drains

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## Operative Technique

Position the patient supine on the operating table. Tuck both arms at the sides; if the arms remain on arm boards, they limit the ability of the camera holder and the first assistant to move cephalad as needed. Position the monitors at the foot of the bed. If only one monitor is being used, place it along an imaginary line of sight from the umbilicus through McBurney's point. Decompress the bladder with a Foley catheter. A typical room layout is shown in Fig. 47.1.

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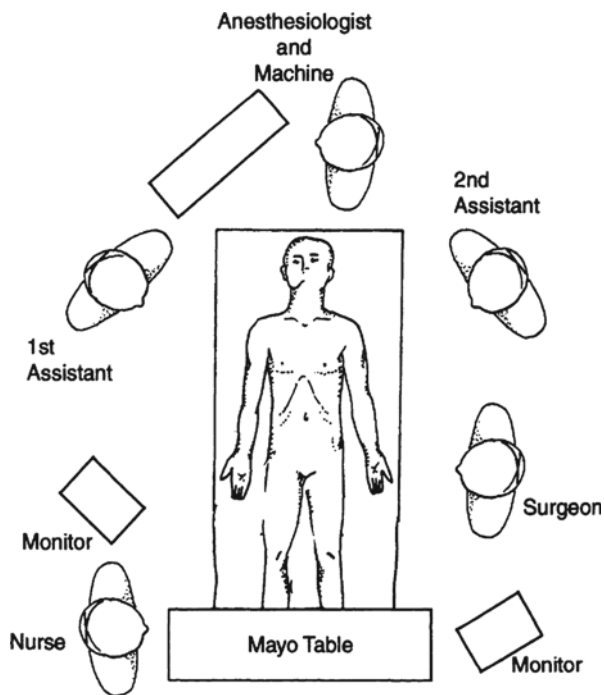


Fig. 47.1

It is important to have sufficient working distance from the right lower quadrant. Consider the location of the umbilicus relative to McBurney's point. For most patients a supra-umbilical location is best for the first trocar. Place secondary trocars in the right midclavicular or anterior axillary line and left lower quadrant (lateral to the rectus muscle to avoid the inferior epigastric vessels) (Fig. 47.2).

Thoroughly explore the abdomen and confirm the diagnosis. Examination of the female adnexae is facilitated by gently sweeping up one tube and ovary to displace the uterus to one side and then the other. Use a closed grasper or Babcock clamp to push and elevate gently, rather than grasp, the adnexae (Fig. 47.3).

Exposure is enhanced by placing the patient in Trendelenburg position with the right side up. Gently sweep the omentum and small intestine medially to expose the cecum, which may be recognized by its size and white color and the presence of taeniae (Fig. 47.4a). In the most common situation, the appendix lies underneath the terminal ileum and is tethered posteriorly by its mesentery (Fig. 47.4b). Pulling the cecum cephalad causes at least part of the appendix, most commonly the base, to come into view (Fig. 47.4c). The maneuver commonly used during open surgery (pulling the cecum cephalad, toward the patient's left shoulder) may obscure the view by pulling the cecum closer to the umbilically placed laparoscope. A straight cephalad pull, toward the patient's right shoulder, avoids this problem.

Pass an endoscopic Babcock clamp through the left lower quadrant trocar and gently pull the cecum toward the patient's left shoulder in such a way as to roll the lateral aspect of the

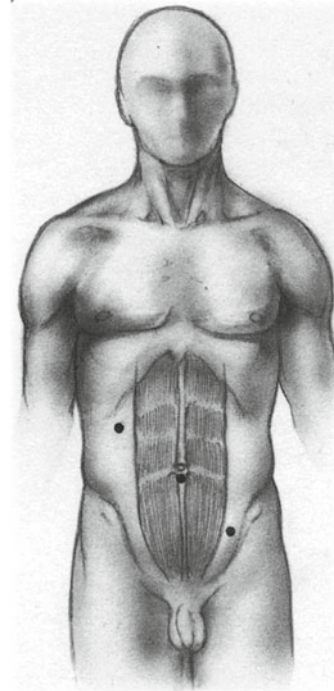


Fig. 47.2

cecum toward you. The base of the appendix should come into view. Grasp the appendix near its base with a Babcock or an atraumatic grasper. Pull straight up toward the anterior abdominal wall. Identify the base and confirm its location by the convergence of taeniae on the cecum.

There are two major ways to secure the base of the appendix: with an endoscopic stapler or a pretied suture ligature. Both methods are described here.

### Stapled Closure

Withdraw the Babcock clamp and replace it with a Maryland dissector or right-angle clamp. Insert the point of this dissection instrument into the groove between the fatty mesentery of the appendix and the appendix, immediately adjacent to the base (Fig. 47.5). Sometimes the appendiceal mesentery is thin or transparent at this point. Take care not to injure the cecum with the tip of the clamp. If necessary, begin creating the window just above the termination of the appendix to ensure that the tips of the clamp do not inadvertently injure the cecum behind the mesentery, where it cannot be seen. Gently open and spread, withdraw, close, and reinsert the instrument until the tip passes completely through the mesentery at this point. Enlarge this window until it is at least 1 cm in diameter. We prefer the endoscopic right-angle clamp for the task of enlarging the window once it has been established. Reconfirm that the window is exactly at the base of the appendix.

Withdraw the dissecting instrument and insert an endoscopic stapler through the 12 mm left lower quadrant port.

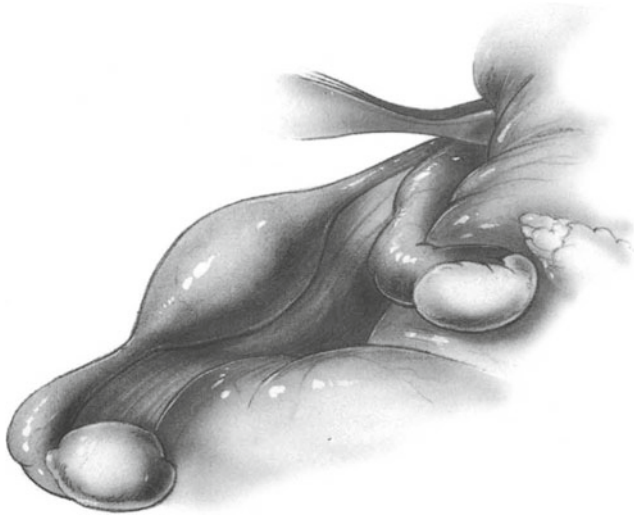


Fig. 47.3

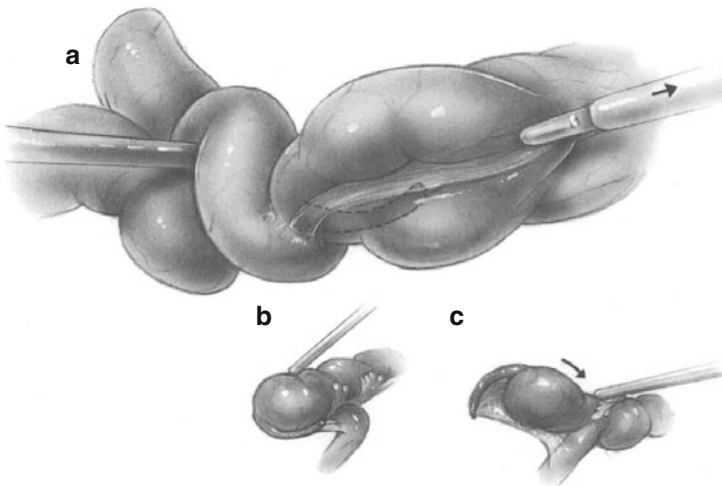


Fig. 47.4

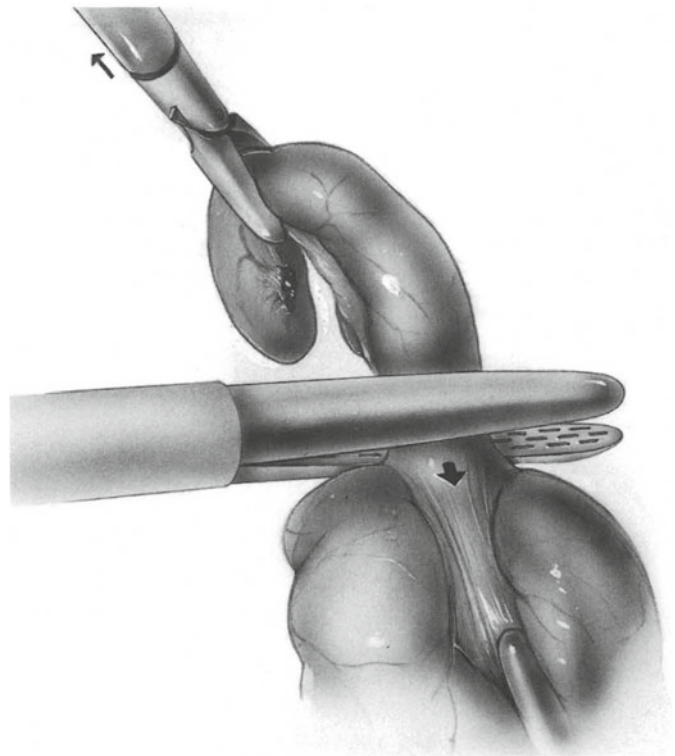


Fig. 47.6

The hinge of the stapler must be completely outside the trocar for the stapler to open properly. It may be necessary to pass the stapler behind and beyond the appendix, along the right gutter toward the right subphrenic space to have sufficient distance to open the stapler fully. Open the stapler. Withdraw the stapler (and trocar if necessary) and maneuver the narrower jaw (anvil) through the window in the mesentery. Visualize the tip of the anvil emerging on the far side of the appendix. Rotate the stapler as needed to optimize visualization of the appendix, mesentery, stapler, and cecum. Pull up on the appendix and push down on the stapler as you close the jaws of the stapler (Fig. 47.6); this move maximizes the chances of positioning the stapler properly (across the base so no appendiceal remnant is left). Close, but do not fire, the stapler. Rotate the stapler back and forth to visualize the proposed site of transection fully. Fire the stapler.

Open the stapler and release any adherent tissue. It may be necessary to divide a small amount of tissue with scissors. If this must be done, visually confirm that the staple line extends to the full length of the appendiceal base (Fig. 47.7). Move the stapler to a safe location; close and remove it.

If necessary, reposition the appendix, now tethered only by its mesentery, so the mesentery is clearly seen. Frequently the mesentery is widest at its attachment to the appendix and then narrows as the branches of the appendicular artery converge on the trunk vessel. By identifying a narrower portion of the mesentery, it may be possible to secure it with a single

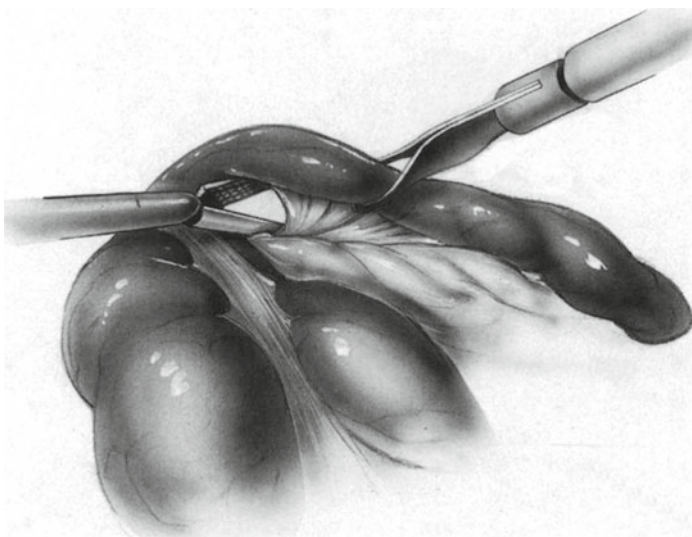


Fig. 47.5

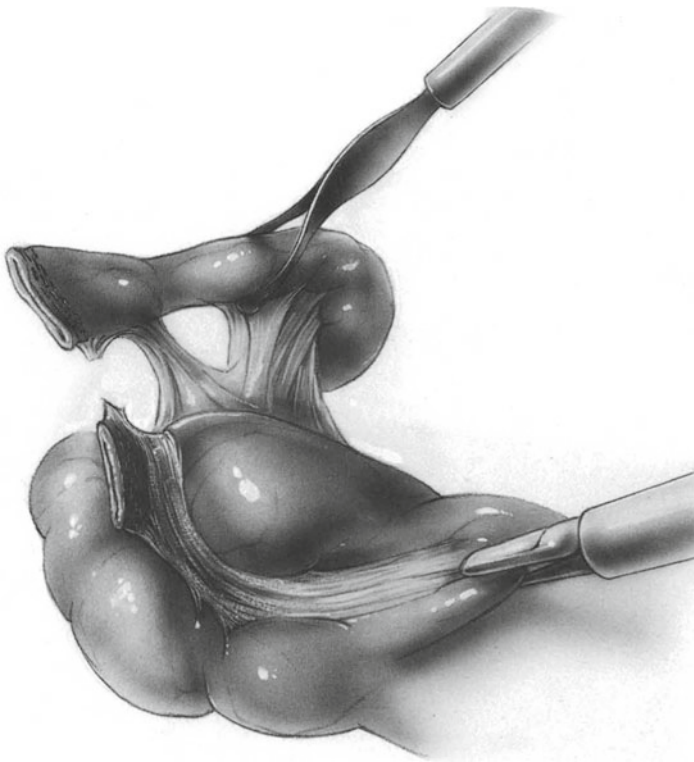


Fig. 47.7

application of the stapler. Reload the stapler and pass and fire it as previously described. Alternatively, use endoscopic clips to secure individual vessels (Fig. 47.8). Carefully inspect the staple lines for completeness and hemostasis. Control any bleeding by endoscopic clips or suture.

Ultrasonic dissection forceps may be used instead of the stapler to divide and control the mesentery.

### Pretied Ligature

Alternatively, the mesentery may be divided first by clips or an ultrasonic dissecting forceps. A pretied ligature is then used to secure the base.

Identify individual branches of the appendicular artery and make windows in the mesentery between these vessels using a Maryland dissector or a right-angle clamp. Place clips on the vessels and divide them, as shown in Fig. 47.8. Do not attempt to skeletonize the vessels, as they are likely to tear. Sequentially divide the mesentery along a line from the free edge toward the appendiceal base.

After completely dividing the mesentery, pass a pretied ligature into the field through the left lower quadrant trocar. Shorten the loop slightly. Avoid letting the ligature come in contact with the viscera, as the loop is easier to manipulate while still dry and relatively stiff (rather than damp and limp).

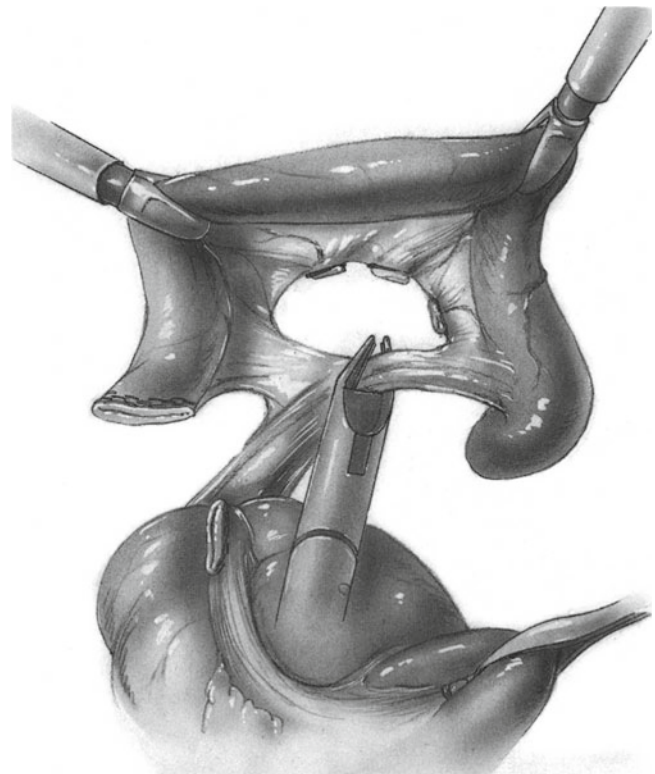


Fig. 47.8

Drop the appendix. Pass a Babcock clamp or atraumatic grasper through the loop of the ligature and grasp the appendix at its midportion. Pull the appendix through the loop while maneuvering and shortening the loop. Use the knot pusher as a finger to position the knot at the base and slowly tighten the ligature (Fig. 47.9).

We prefer to place two ligatures side by side on the base and a clip or a third ligature on the specimen side. Divide the appendix (Fig. 47.10a). Inspect the stump to verify the ligatures are in a good position (Fig. 47.10b). Cauterize the exposed mucosa lightly.

### Removal of the Appendix

A small, minimally inflamed appendix may be drawn completely into the left lower quadrant trocar; the trocar (containing the specimen) can then be completely removed and replaced. A specimen bag is used for larger, more inflamed, gangrenous or perforated appendices.

### Management of the Retrocecal Appendix

The appendix is occasionally completely retrocecal and cannot be visualized without mobilizing the cecum and



Fig. 47.9

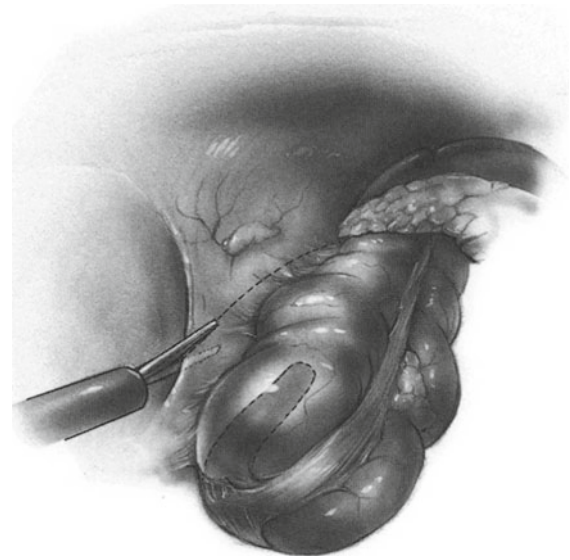


Fig. 47.11

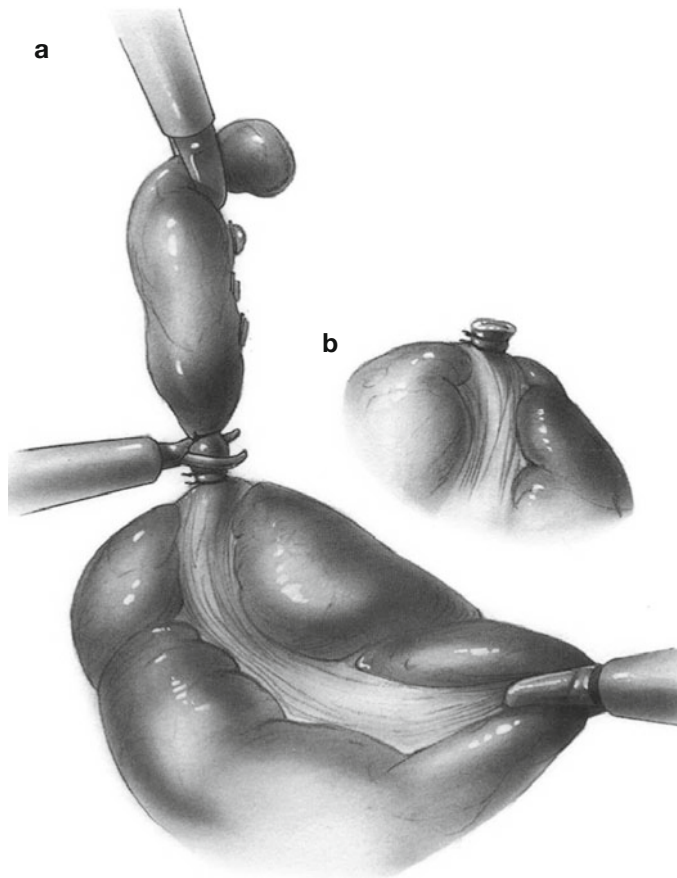


Fig. 47.10

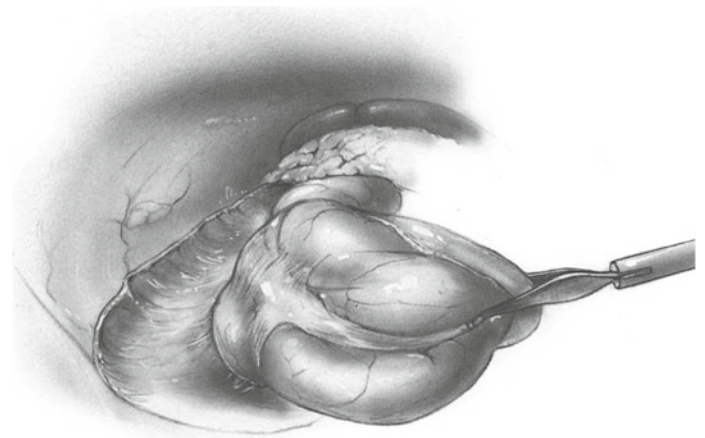
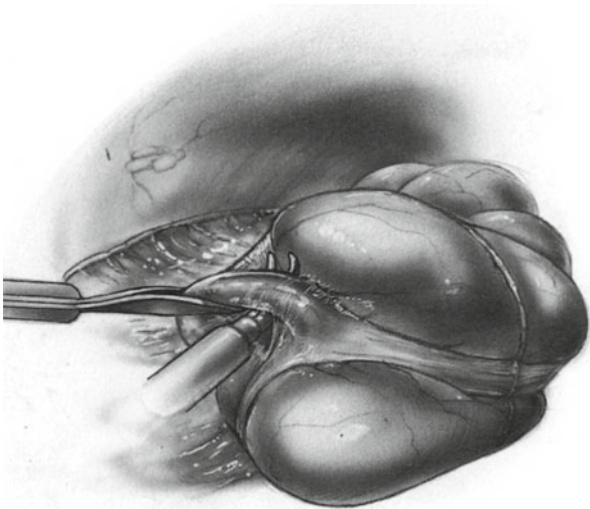


Fig. 47.12

right colon. Incise the line of Toldt from the cecum up to the vicinity of the hepatic flexure (Fig. 47.11) with hook cautery, scissors (with cautery attachment), or ultrasonic shears. Grasp the cut edge of peritoneum adherent to the right colon and pull the right colon medially while lysing any residual adhesions by sharp and blunt dissection (Fig. 47.12).

The appendix is then found on the back wall of the cecum, generally adherent to the cecum with fibrous bands. It may be so encased in fibrous tissue; it is difficult to identify at first. Tactile perception from the Babcock clamp may help identify the appendix, which feels like a small, firm cylinder compared with the softer cecum.

Grasp the appendix near its base and sequentially lyse the fibrous adhesions that tether the appendix to the cecum (Fig. 47.13). Sharp dissection with scissors or ultrasonic shears is best. Remove the appendix in the usual fashion.



**Fig. 47.13**

### Closure of Trocar Sites and Postoperative Care

If purulent material is encountered, close the fascia as usual but leave the skin open. Necrotizing fasciitis has been reported as a rare complication and is more likely in obese patients.

The patient may have an ileus for several days, especially if the appendix was gangrenous or perforated. Because the events of the first postoperative week are determined by the extent of the pathology, the immediate advantage of the laparoscopic approach may not be obvious.

Continue antibiotics as you would as if the operation had been performed as an open procedure. In other words, if you would have given antibiotics for 1 week following open appendectomy for perforated appendicitis with local peritonitis, follow this regimen after laparoscopic appendectomy for the same pathology.

### Complications

Abdominal wall infection (discussed above)  
 Pelvic or abdominal abscess  
 Retained appendiceal stump (causing recurrent appendicitis)

### Further Reading

- Masoomi H, Nguyen NT, Dolich MO, Wikholm L, Naderi N, Mills S, Stamos MJ. Comparison of laparoscopic versus open appendectomy for acute nonperforated and perforated appendicitis in the obese population. *Am J Surg.* 2011;202:733–9.
- Masoomi H, Mills S, Dolich MO, Ketana N, Carmichael JC, Nguyen NT, Stamos MJ. Comparison of outcomes of laparoscopic versus open appendectomy in adults: data from the nationwide inpatient sample (NIS), 2006–2008. *J Gastrointest Surg.* 2011;15:2226.
- Soper N, Scott-Conner CEH. *The SAGES manual volume I – laparoscopic appendectomy.* New York: Springer Science+Business Media; 2012.
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- St Peter SD, Adibe OO, Juang D, Sharp SW, Garey CL, Laituri CA, et al. Single incision versus standard 3-port laparoscopic appendectomy: a prospective randomized trial. *Ann Surg.* 2011;254:586.