Appendectomy

By Mohan Krishna Redlapalle

Outline

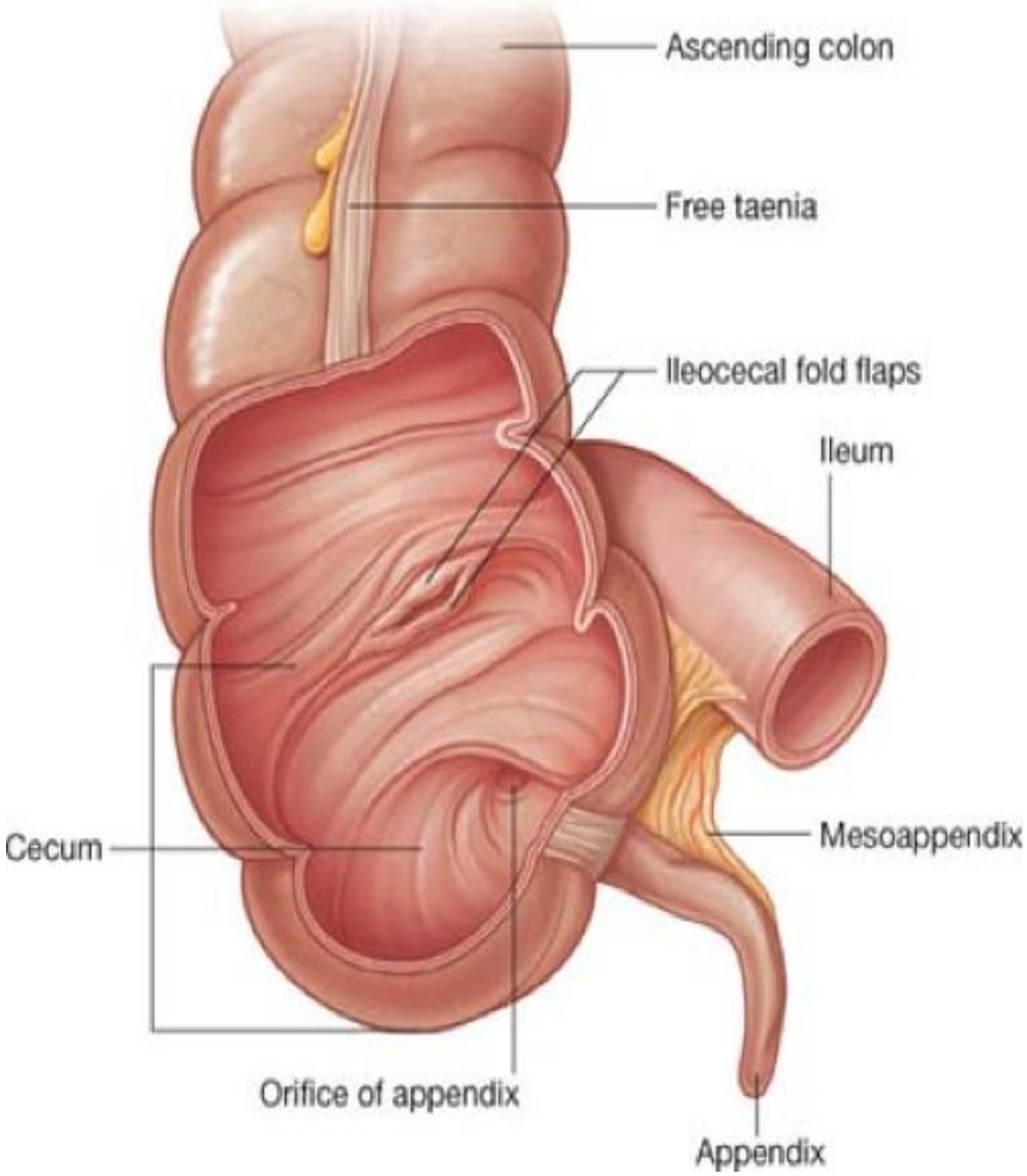
- Let us revise vermiform Appendix
- Definition of Appendectomy
- Indications
- Types
- Open Appendectomy
- Laparoscopic (Key hole) Appendectomy
- Complications
- References

The appendix

- The vermiform or worm like appendix, arising from the posteromedial wall of the caecum, about 2cm below the ileocecal orifice.

Dimensions:

- The length varies from 2 to 20 cm
- or 2-9 in. with an average of 9cm.
- It is longer in children than adults.
- The diameter is about 5mm.
- The lumen is quite narrow and may be obliterated after mid adult life.



Positions

- The appendix lies in the right iliac fossa.
- Although the base of the appendix is fixed, the tip can point in any direction.

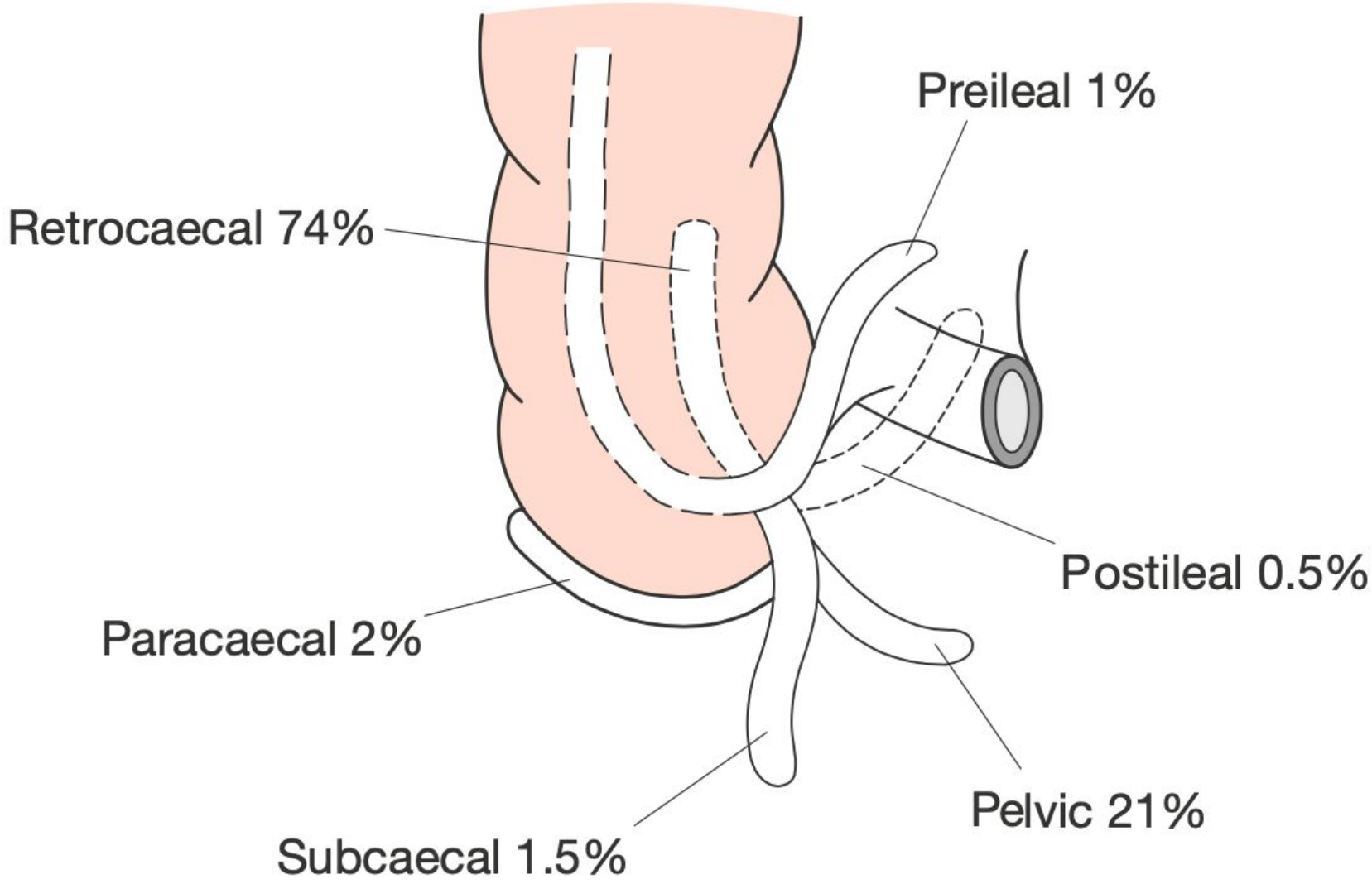
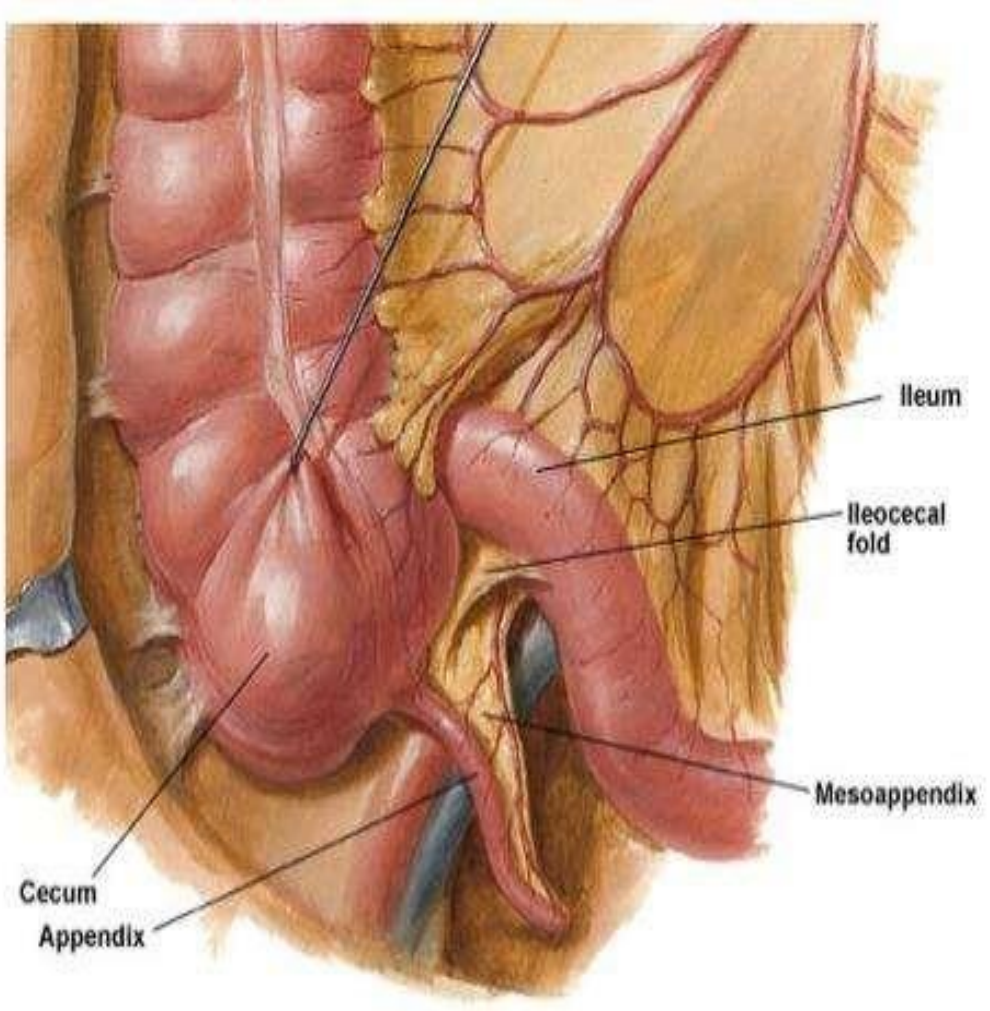


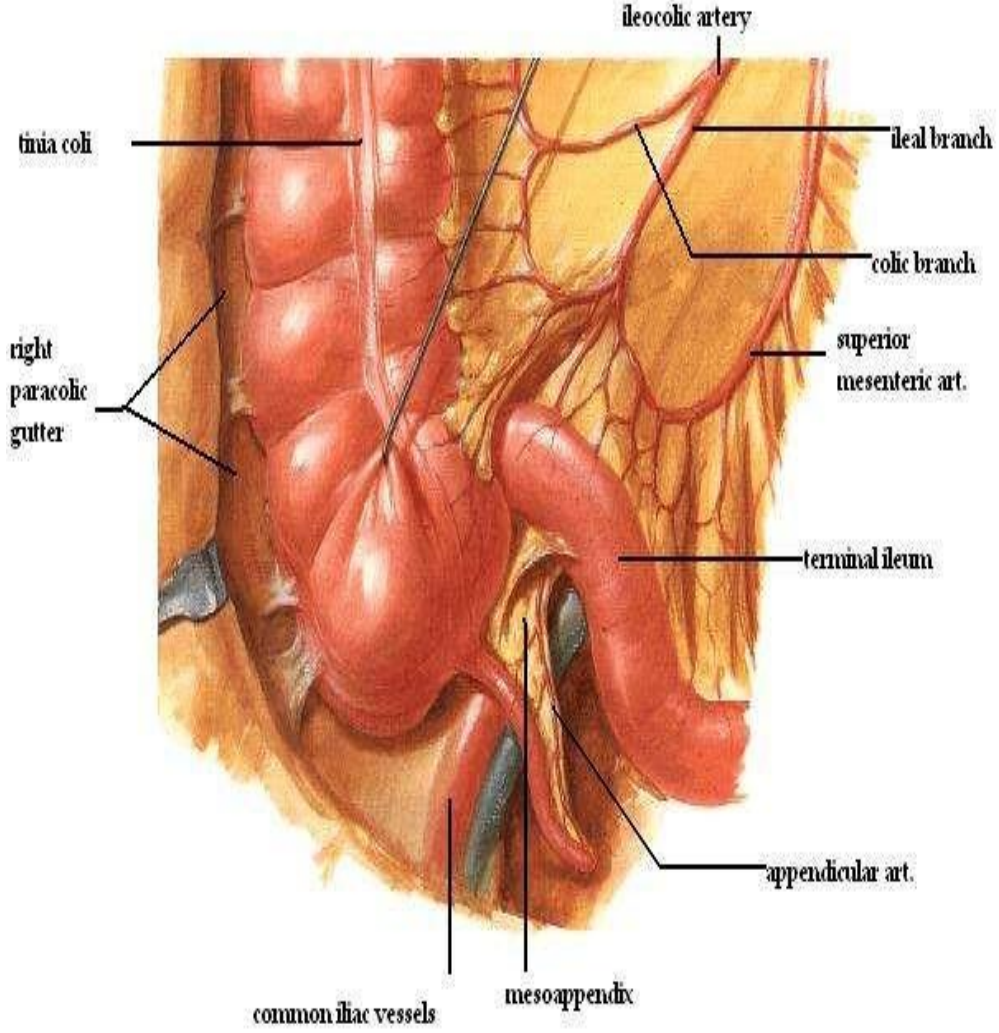
Figure 72.1 The various positions of the appendix (after Sir C Wakeley, London, formerly PRCS).

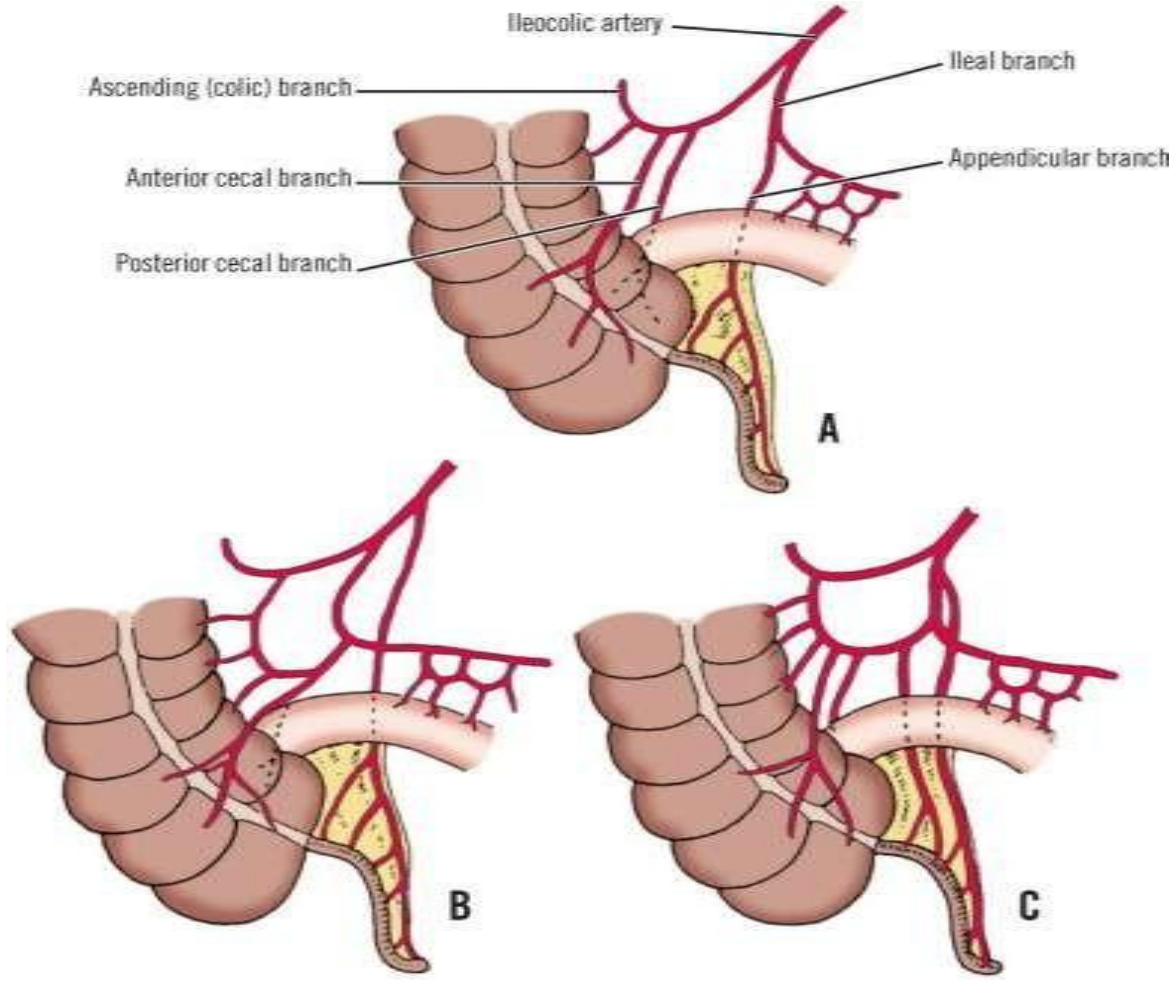
Peritoneal relations



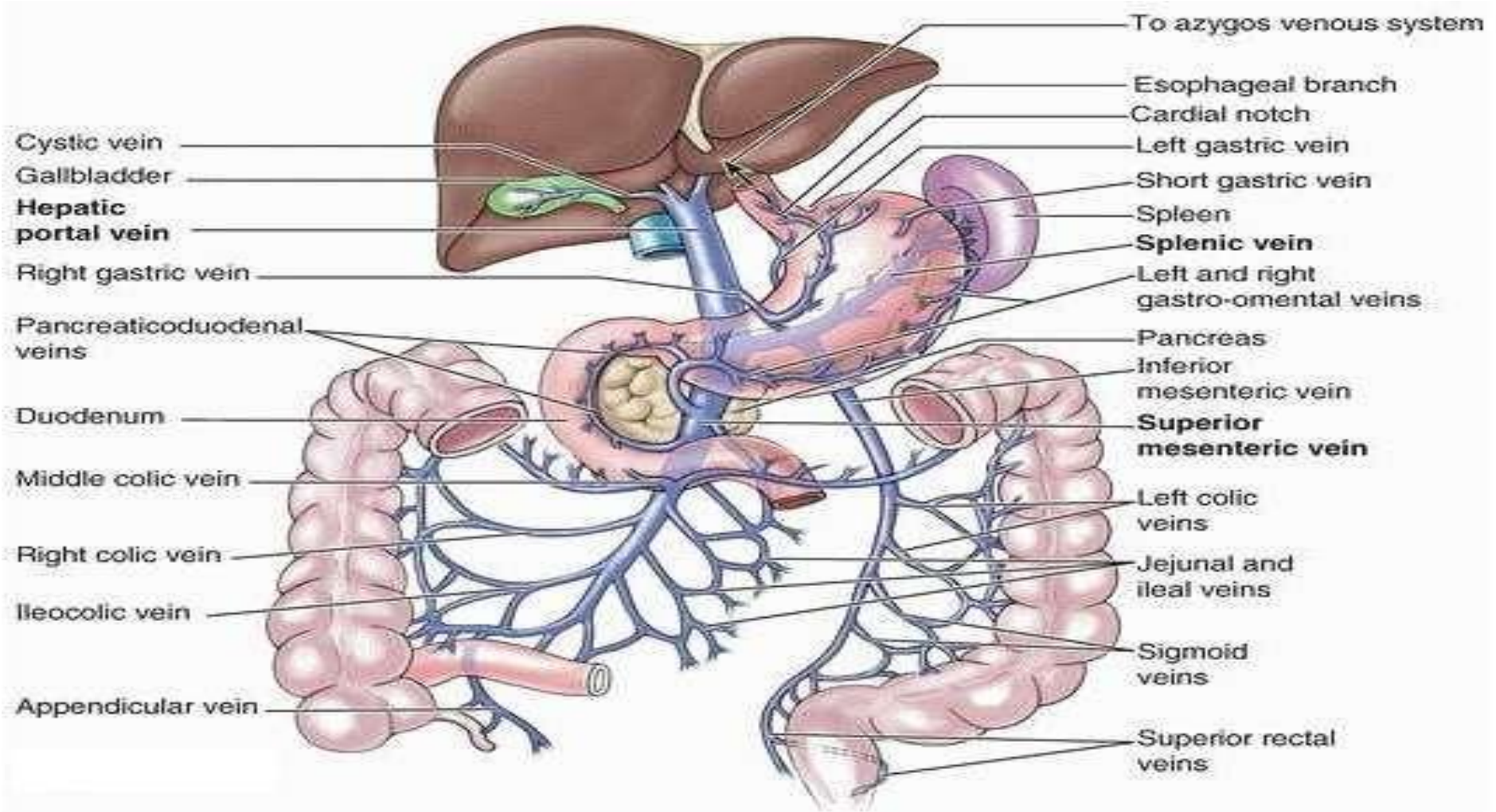
- The appendix is suspended by a small, triangular fold of peritoneum, called the mesoappendix, or appendicular mesentery.
- The fold passes upwards behind the ileum, and is attached to the left layer of the mesentery.

Arterial blood supply





Venous blood supply



Nerve supply

- Sympathetic nerves are derived from segments T9 to T10 through the celiac plexus.
- Parasympathetic nerves are derived from the Vegas N.

Now, What is Appendectomy?

What is an Appendectomy?

- An appendectomy, also termed appendicectomy, is a surgical operation in which the vermiform appendix is removed.
- Appendectomy is normally performed as an urgent or emergency procedure to treat complicated acute appendicitis. Appendectomy may be performed laparoscopically or as an open operation

Types of Appendectomy

- **Open**
- **Laparoscopic**

- General anesthesia.
- Laparoscopic: nasogastric tube & empty bladder.
- Palpation for mass in R.I.F.

INDICATIONS

- Acute appendicitis
- Recurrent appendicitis, Stump Appendicitis
- As Interval appendectomy after drainage of abscess or in appendiceal mass
- Carcinoid tumor : at the tip <2cm
- Mucocele of the appendix
- Appendicular graft; ileal conduit
- On table colonic lavage

Contraindications

- Extensive adhesions
- Radiation or immunosuppressive therapy,
- severe portal **hypertension**
- Gross coagulopathies.
- Laparoscopic appendectomy is contraindicated in the first trimester of **pregnancy**
- Concerns for Crohn’s disease or Meckel’s diverticulum should be of priority.

If an acutely inflamed appendix had been found and removed, the rest of the abdomen does not need to be explored.

Local lavage

- However, if the appendix is not inflamed, the surgeon needs to exclude other pathologic processes;
  - Terminal ileitis
  - Meckel's diverticulum
  - Tubal or ovarian cause in female
  - Crohn's disease

Open Appendectomy (Conventional)- An overview

- Under general anesthesia, skin is incised. Two layers of superficial fascia are cut.
- External oblique aponeurosis is opened in the line of incision.
- Internal oblique and transverse muscles are split in the line of fibres.
- Peritoneum is opened in the line of incision.
- Caecum is identified by taeniae, and ileocaecal junction.
- Omentum when adherent is separated.
- Appendix is held with Babcock's forceps.
- Mesoappendix with appendicular artery is ligated. Using thread or silk, a purse—string suture is placed around the base of the appendix.
- Base of the appendix is crushed with artery forceps and transfixed using vicryl (absorbable). Appendix is cut distal to the suture ligature and removed.
- Stump is cleaned with antiseptics. Purse string suture is tightened so as to bury the stump.

Special circumstances:

-Edema of the cecal wall.

-Base of the app. severely inflamed.

-Gangrenous app. base.

-Retrograde appendectomy.

-Drainage of the peritoneal cavity ??

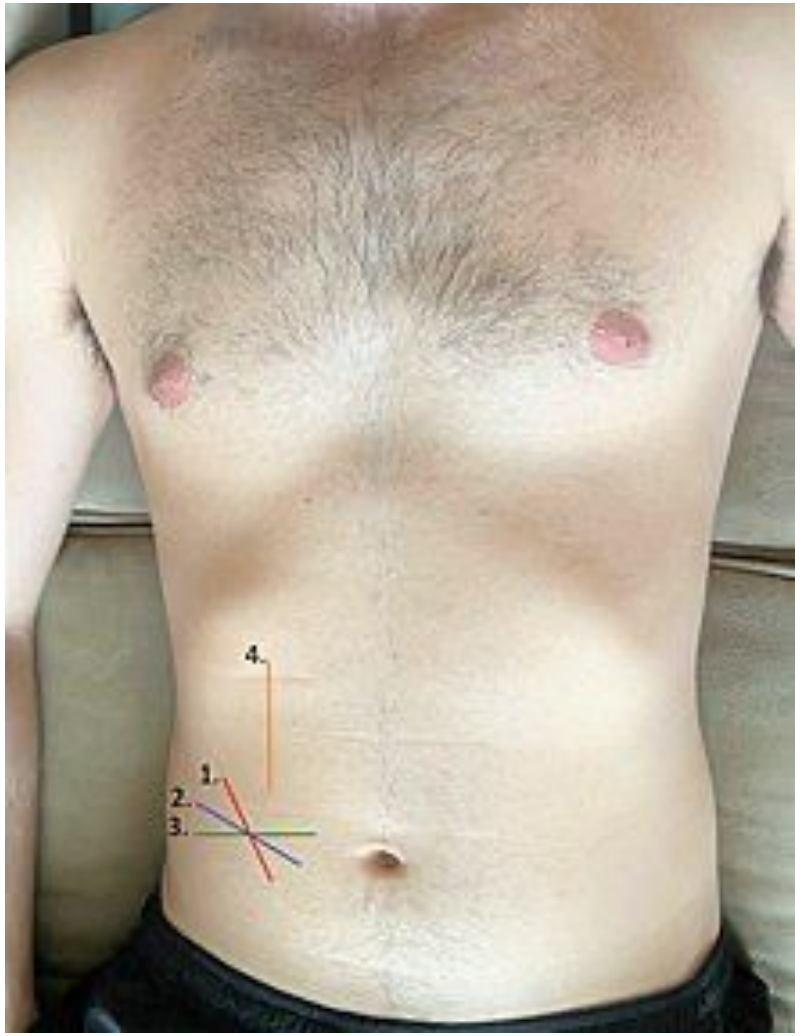
PRE-OP PREPARATION

- INVESTIGATION
  - **Urinalysis- exclude *infection***
  - **Full blood count- *leukocytosis***
  - **Ultrasound scan – non compressible diameter of > 6mm**
  - **Rehydrate patient with IV fluids; N/S**
  - **Pass urethral catheter**
  - **N-G tube**
- **IV antibiotics prophylaxis- broad Prophylactic antibiotics are indicated preoperatively with a single-drug regimen, usually a cephalosporin.**

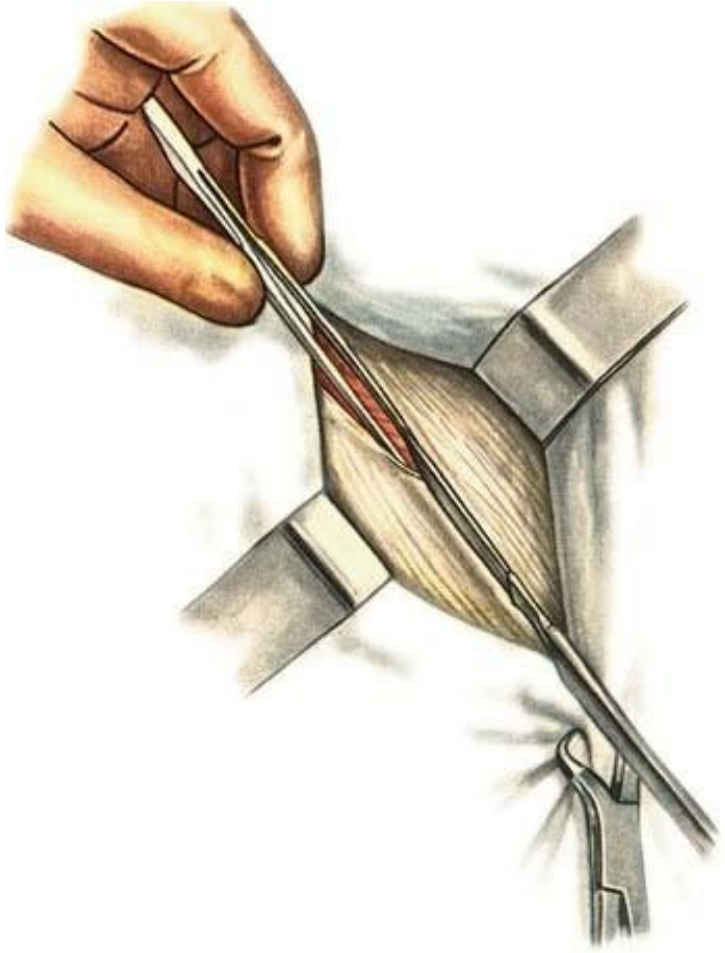
Open Appendectomy (Conventional) - Incision

•The incision is placed at the point of maximum tenderness.

- APPROACHES:
  - **3. Rutherford Morison's ;** muscle cutting. The muscles are cut upwards and laterally- **cutting the internal oblique and transverses abdominis-** extension of Mc Burney
  - **4. Right Paramedian;**
  - **Lower mid-line;** when in doubt of peritonitis, pelvic appendix,



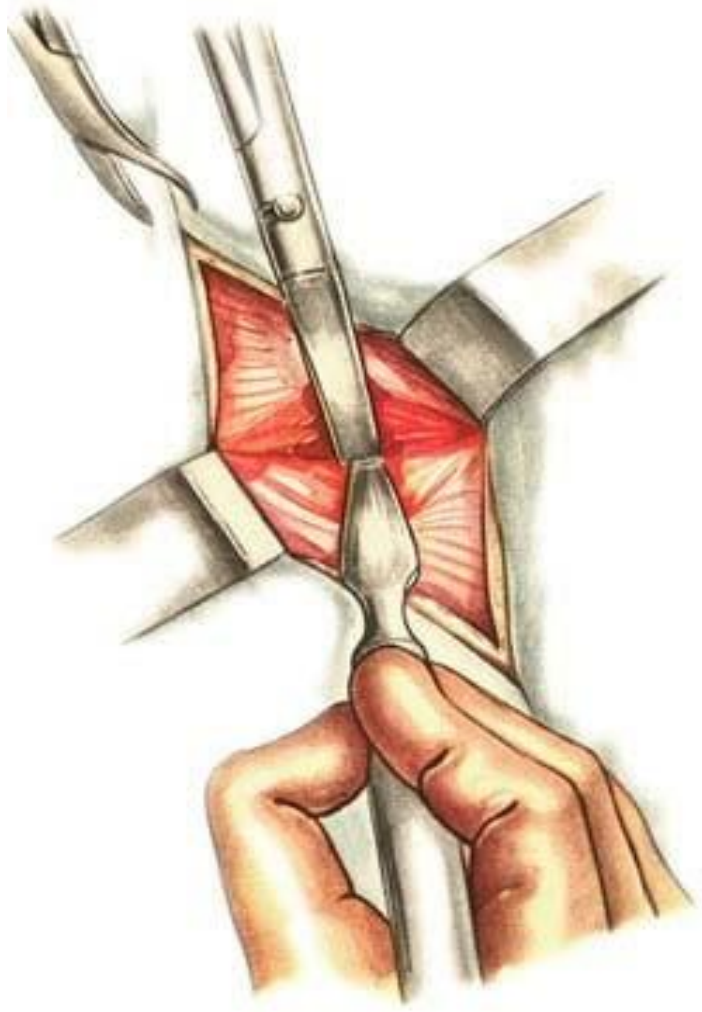
The dissection of aponeurosis:



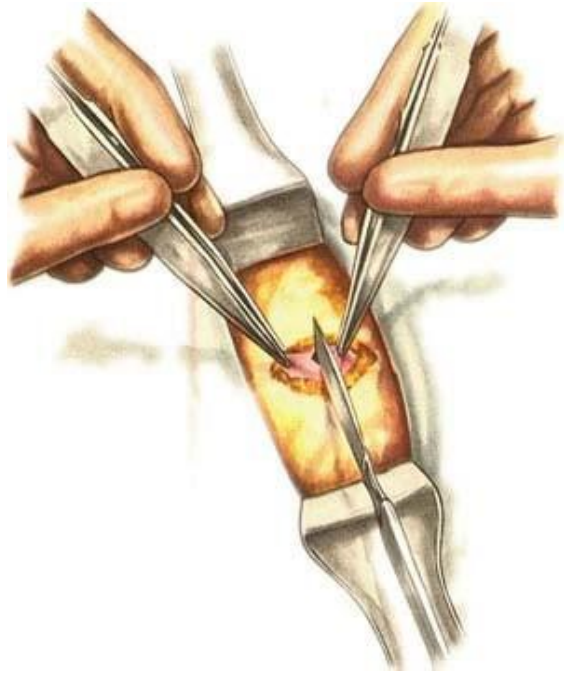
- Subcutaneous fat lays after skin. It can be dissected with scalpel or moved in a blunt way by swab (or by the opposite side of scalpel).
- Superficial fascia slightly incised and under it we may see fibers of aponeurosis of abdominal external oblique muscle.
- This fibers should be cut along by Cooper's scissors.

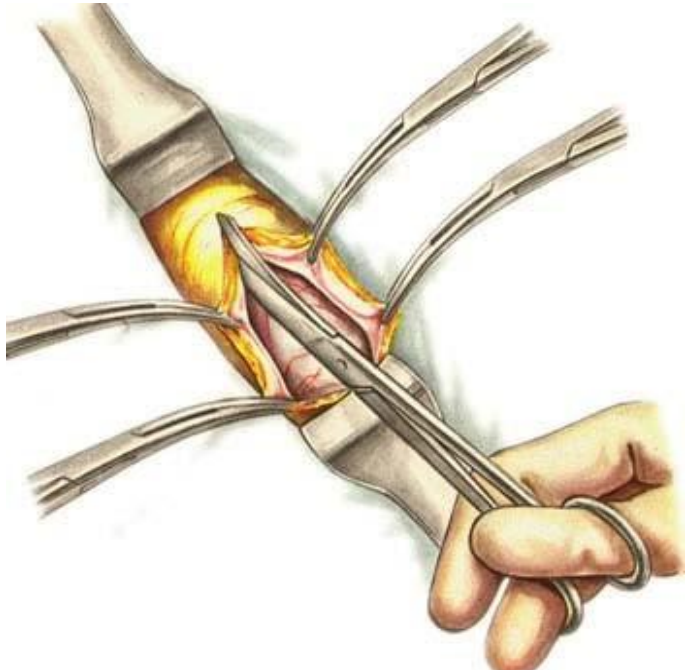
Splitting of internal oblique and transversal abdominal muscles.

- Fibers of internal oblique and transversal abdominal muscles are moved apart with a help of 2 closed hemostatic forceps.
- Preperitoneal fat is situated after muscle layer. It also should be moved apart in a blunt way.

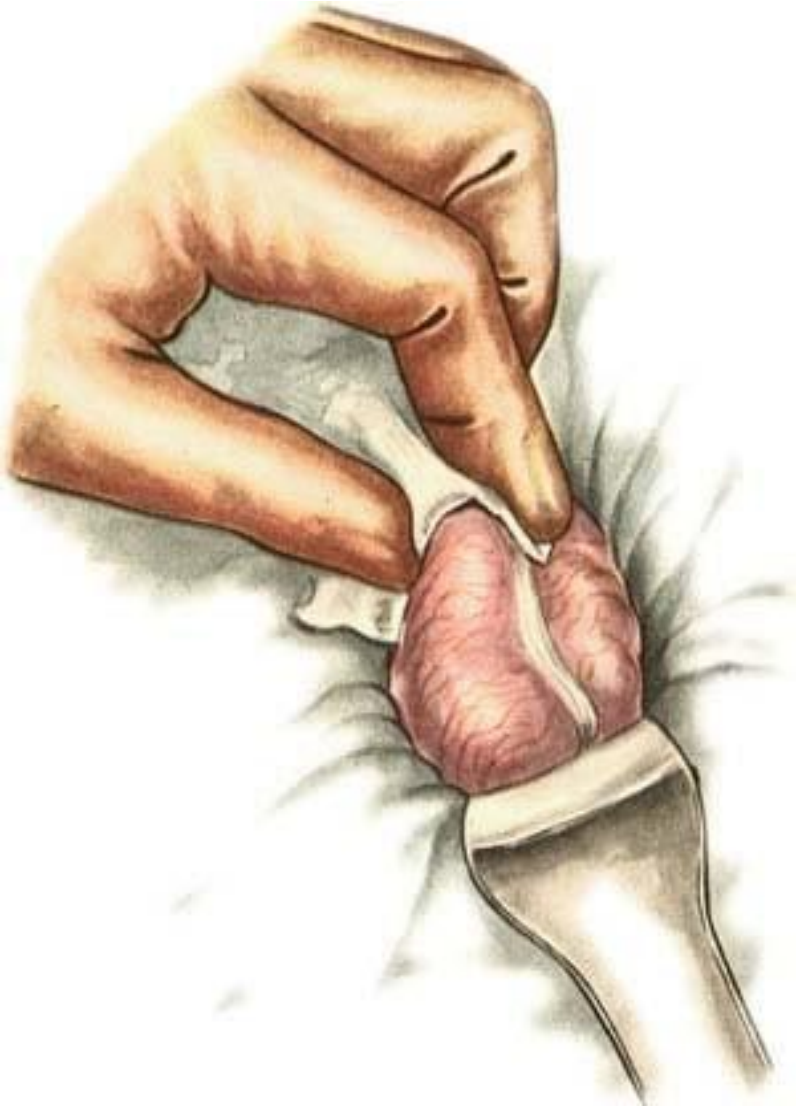


- Parietal peritoneum is picked up by 2 hemostatic forceps. Surgeon should check, that intestine is not under the forceps. After it, the peritoneum should be cut.
- Gauze tissues are fixed to the brims of peritoneum by Mikulicz's clamps





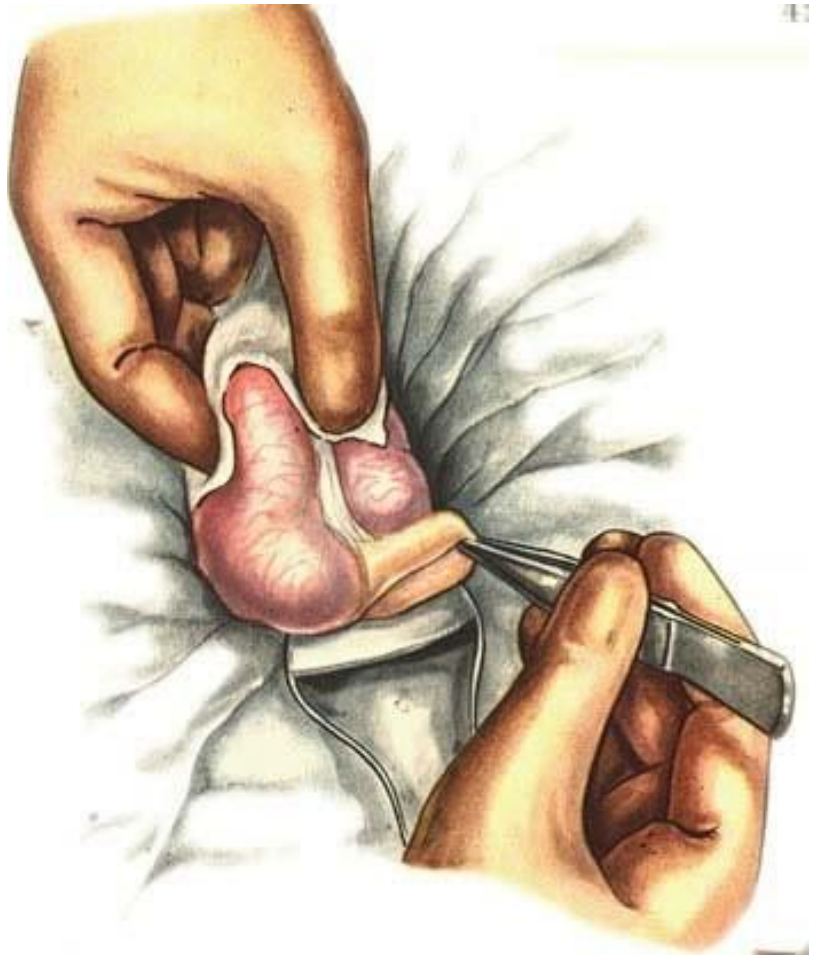
Extermination of the cecum in the wound:



- Cecum is often situated at the area of typical section.
- In some situations the section can be widened upper or lower.
- Before the extermination, the surgeon should make a revision by index to make sure, that there is no commissures, that can prevent the extermination.
- If there is no obstacles, then surgeon carefully pulls the intestine by it's anterior wall, and so the intestine can be exterminated into the wound.

The extraction of appendix:

- Appendix often comes into the wound after the cecum.
- Surgeon carefully takes the appendix by mouse-tooth forceps and pulls it from the abdominal cavity.
- In some cases, appendix can be pulled out by index.
- Extracted appendix is fixed by soft clamp, which should be placed on the mesentery near the top of appendix.

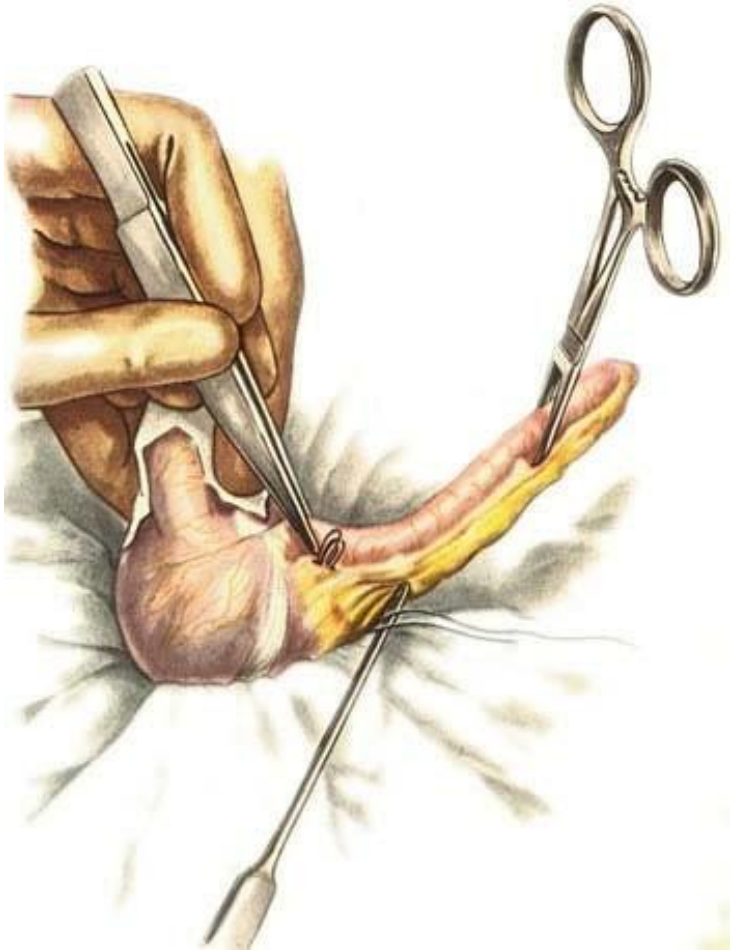


Methods of appendectomy

- Antegrade (in the case of mobile cecum)
- Retrograde (in the case of immobile cecum)

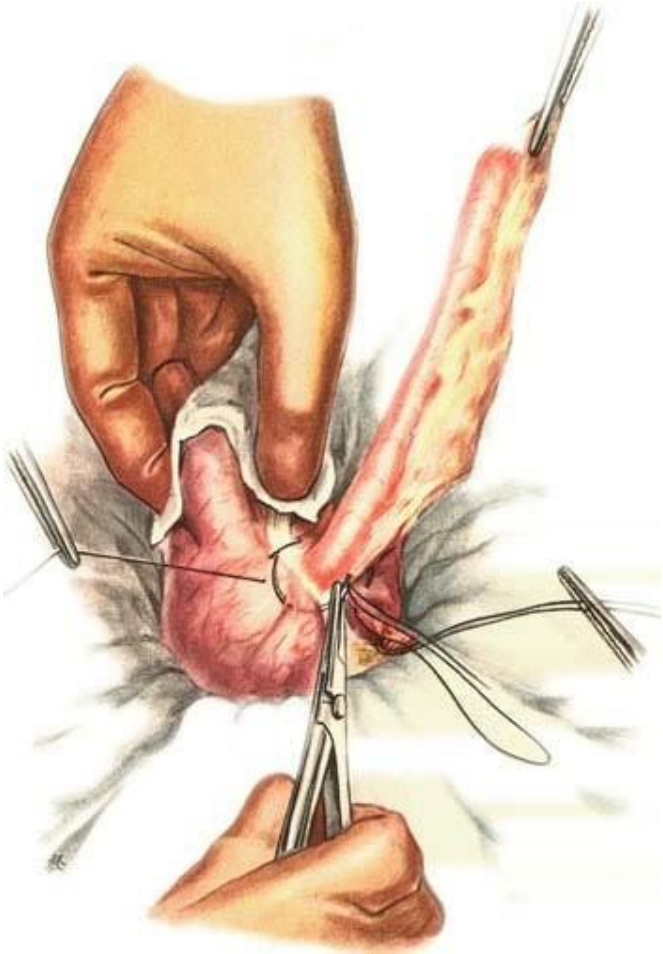
Anterograde Open Appendectomy

Bandaging of the appendix’s mesentery:



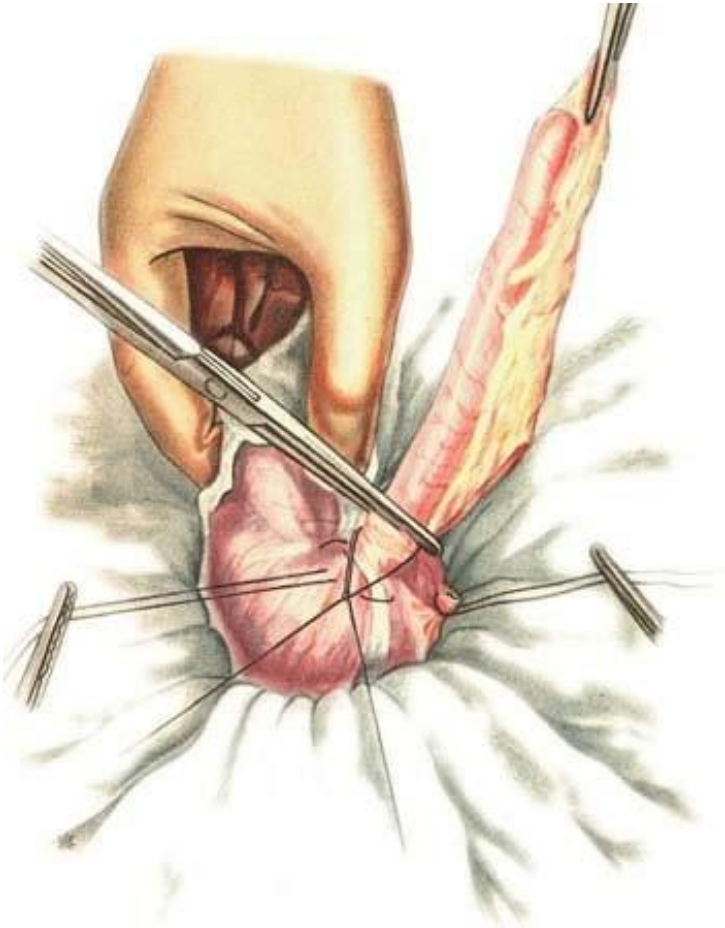
- The mesentery is bandaged by thick silk or catgut thread near the base of appendix with a help of Deschamps’ ligature needle or a hemostatic clamp. The ligature shouldn’t be put too low, because arteries
- that saturates the wall of the cecum can be damaged.

Putting in a purse-string suture:



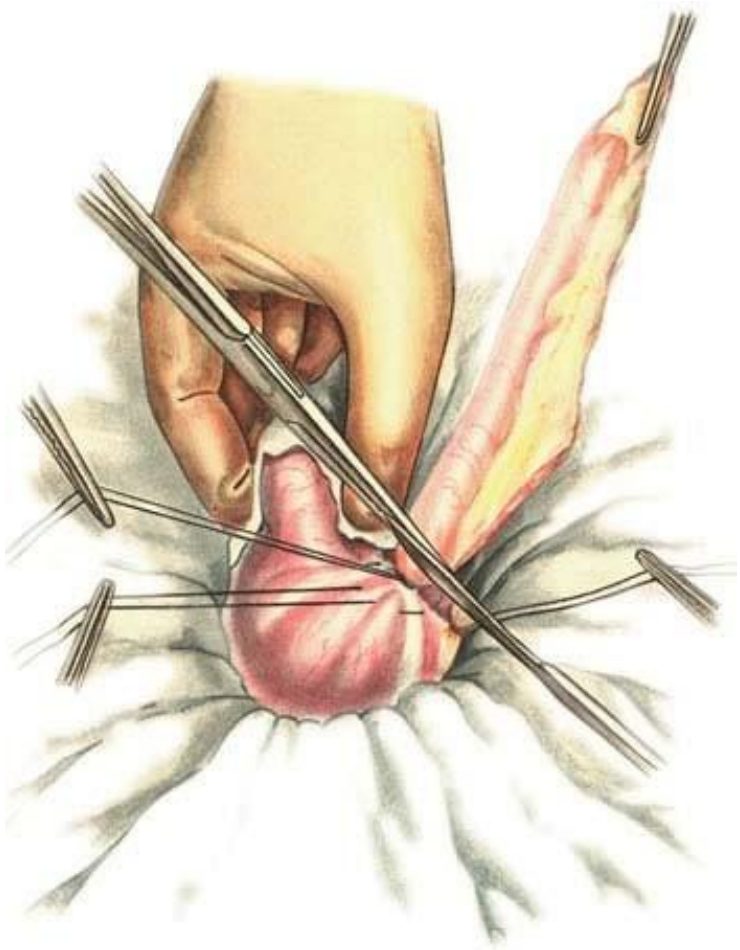
- A seromuscular purse-string suture is put on the cecum at the distance near 1- 1,5 cm from the base of appendix

Bandaging of the appendix:



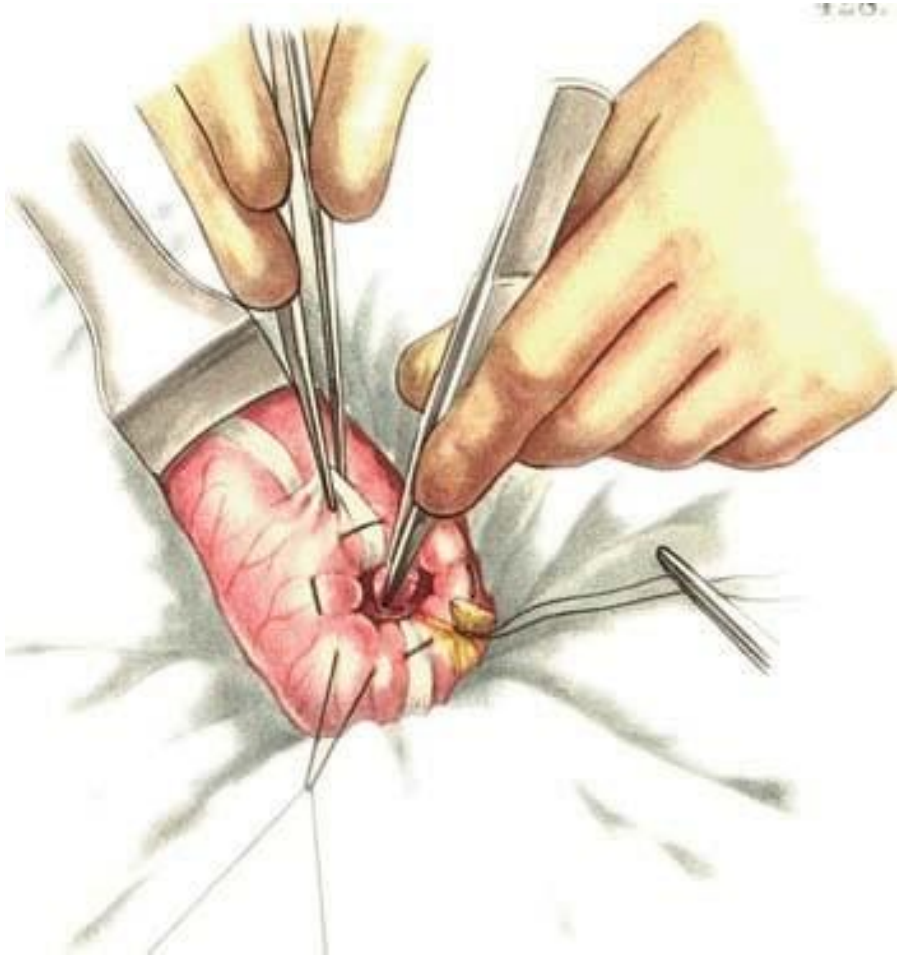
- Surgeon puts 2 clamps near the base of appendix and removes one of them so that on the wall of appendix forms a furrow. A catgut ligature is put in the area of this furrow.

Cutting of the appendix

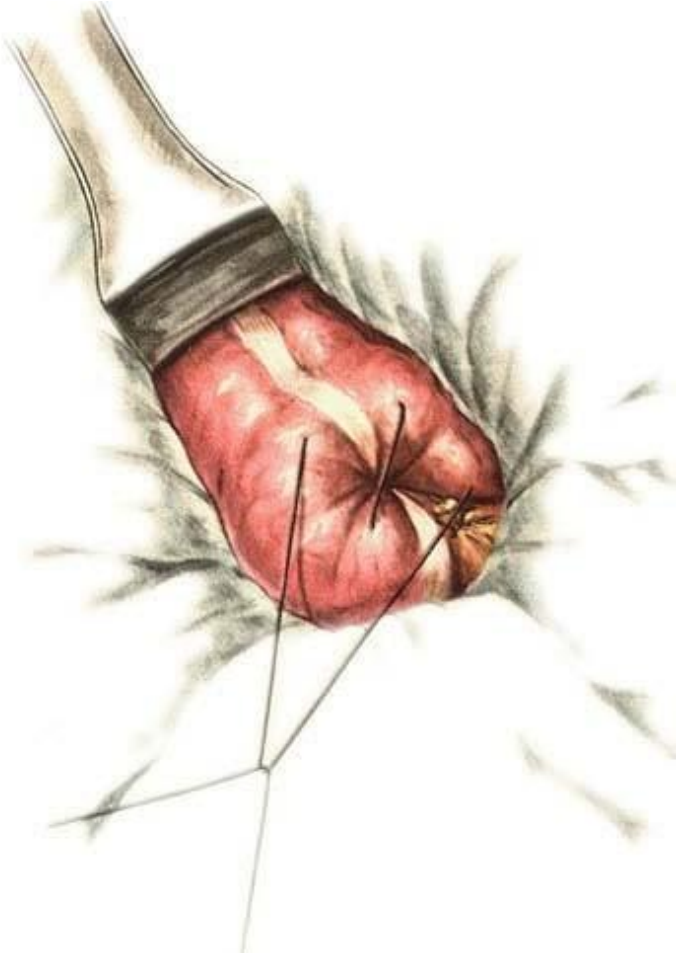


- Appendix is cut between the ligature and another clamp. The stump of appendix should be seared by iodine and dipped in the purse-string suture.

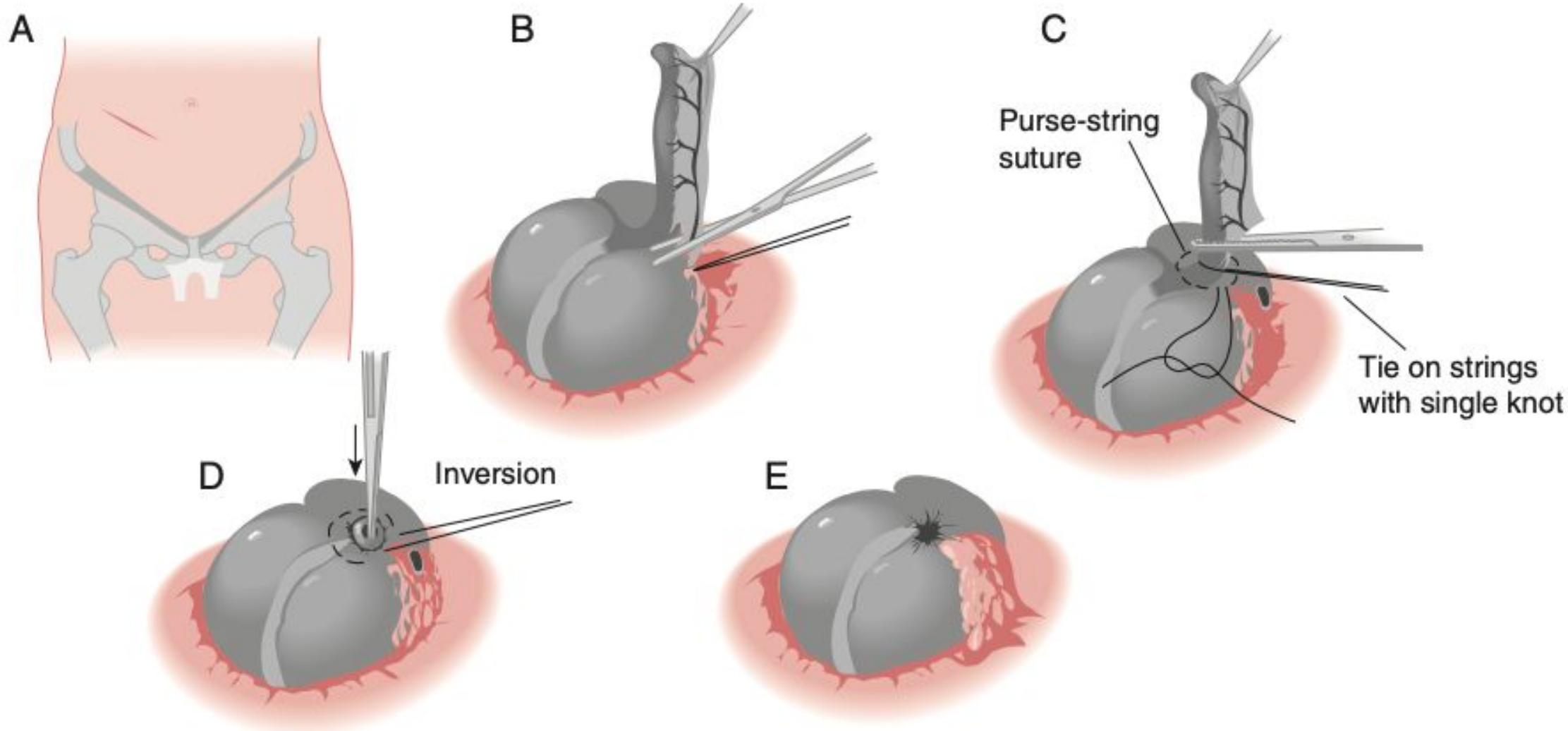
Dipping of the stump into the purse-string suture



Putting in a Z-shaped suture



- Sometimes a seromuscular Z-shaped suture is put over the purse-string suture for more leak tightness



▲ **Figure 28–1.** Technique of open appendectomy. **A:** Incision. **B:** After delivery of the tip of the cecum, the mesoappendix is divided. **C:** The base is clamped and ligated with a simple throw of the knot. The next step—inversion of the stump—is optional. **D:** A clamp is placed to hold the knot during inversion with a purse-string suture of fine silk. **E:** The loosely tied inner knot on the stump assures that there is no closed space for the development of a stump abscess.

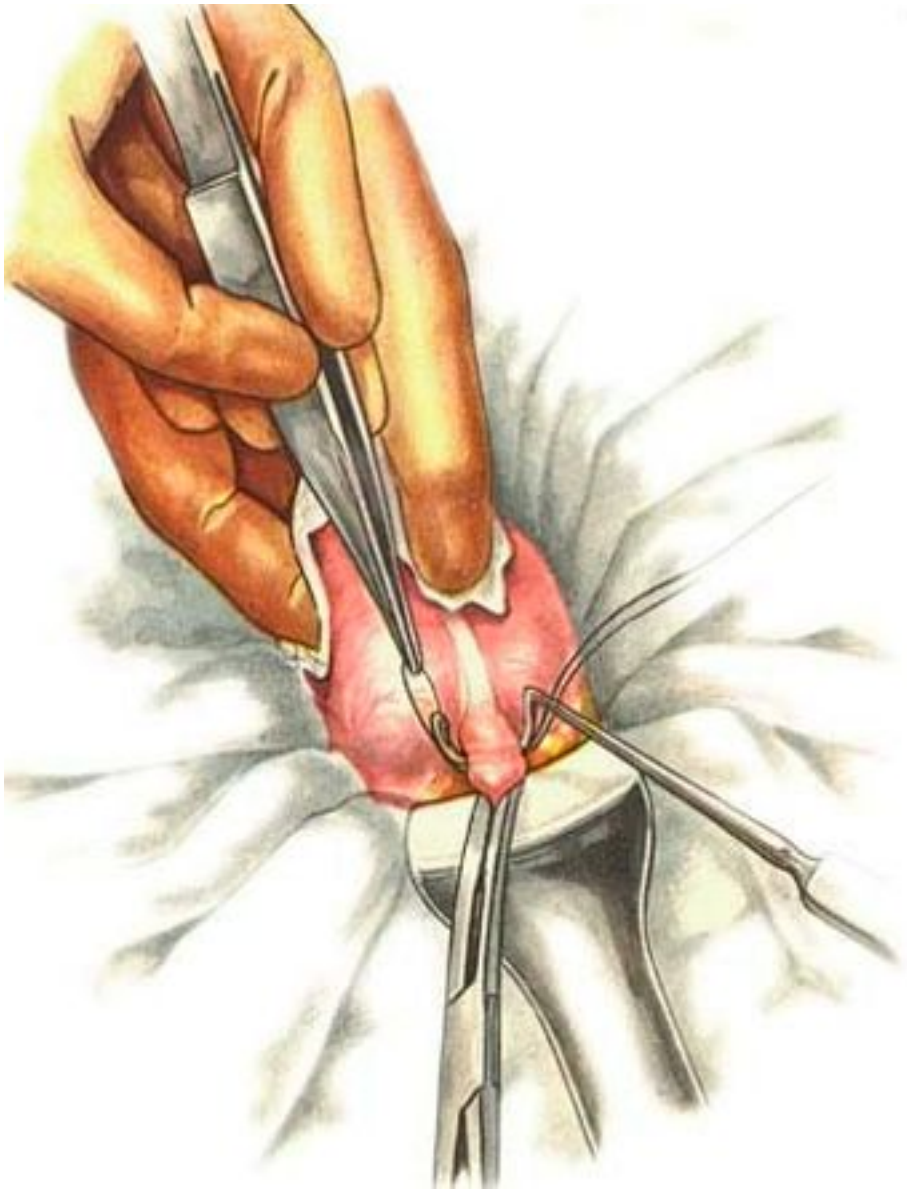
Retrograde Open Appendectomy

Cross-clamping of appendix

- Surgeon puts a clamp near the base of appendix and removes it so that on the wall of appendix forms a furrow.

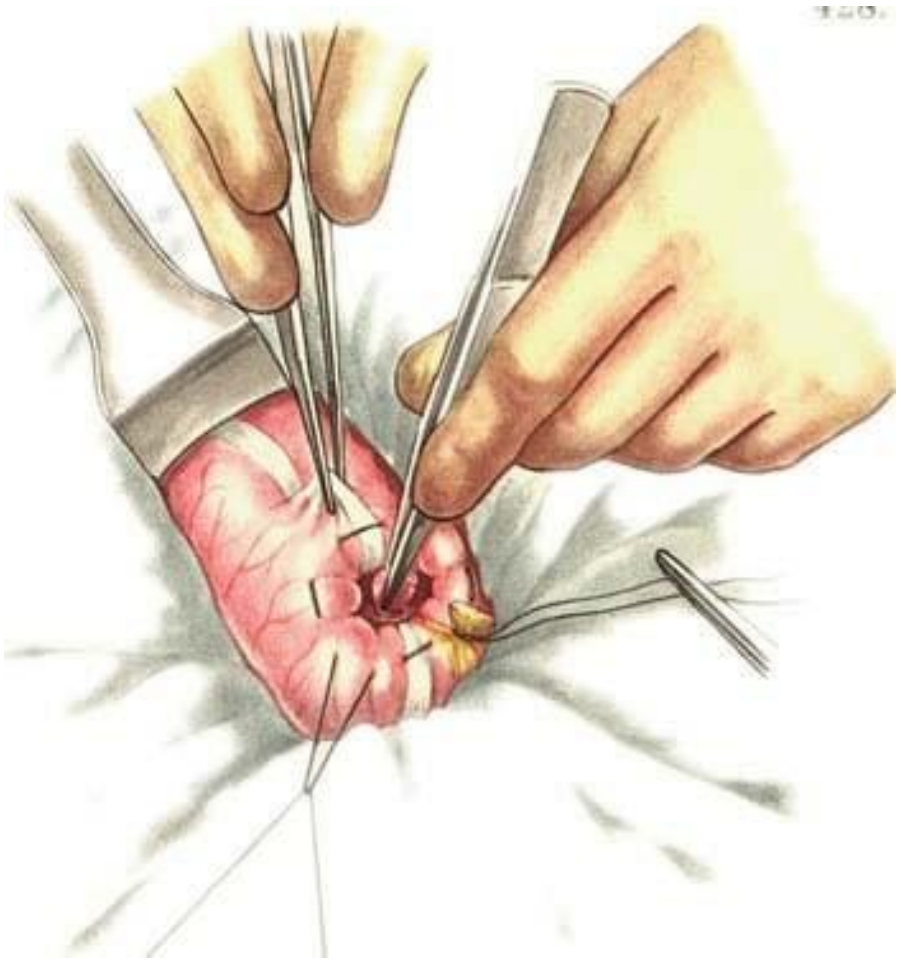
Bandaging of the appendix

- A catgut ligature is put in the area of this furrow.



Cutting of the appendix

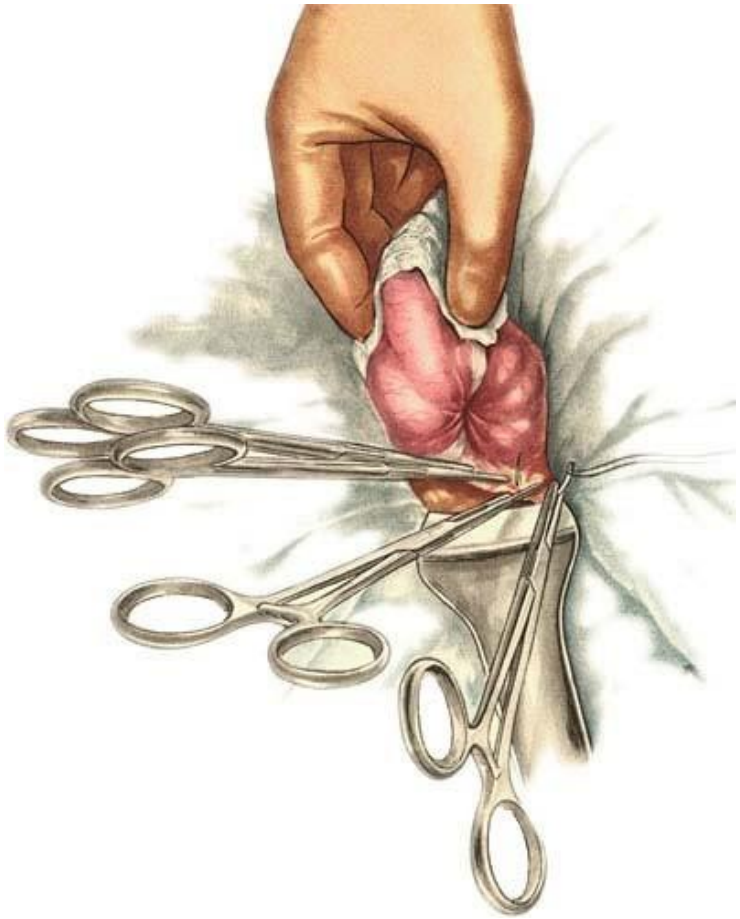
Dipping of the stump into the purse-string suture



Cutting of the appendix’s mesentery between the hemostatic clamps

- a surgeon starts a bandaging of mesentery, gradually isolating it from the base to the top. Mobilisated appendix moves off. Mesentery stump is bandaged by catgut thread.

Sewing and bandaging of the mesentery



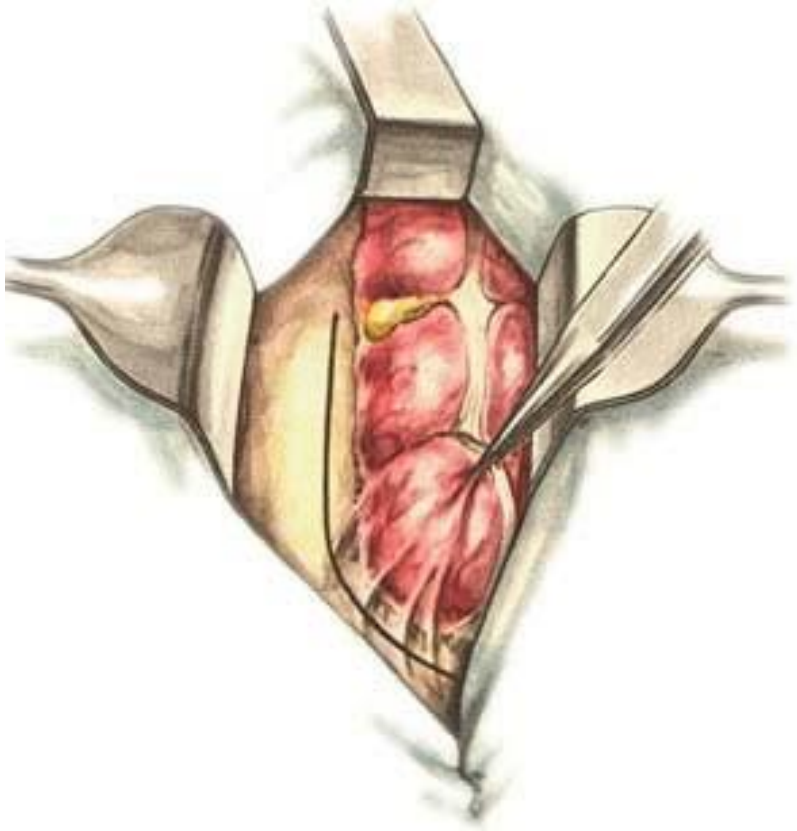
Putting in a Z-shaped suture

- Sometimes a seromuscular Z-shaped suture is put over the purse-string suture for more leak tightness

Appendectomy. Retroperitoneal position of appendix

- If there is no commissures in the abdominal cavity and the appendix can not be found, then a surgeon should think about the retroperitoneal position of appendix. In this case appendix is situated behind the ascending colon and it's top can reach the lower pole of kidney

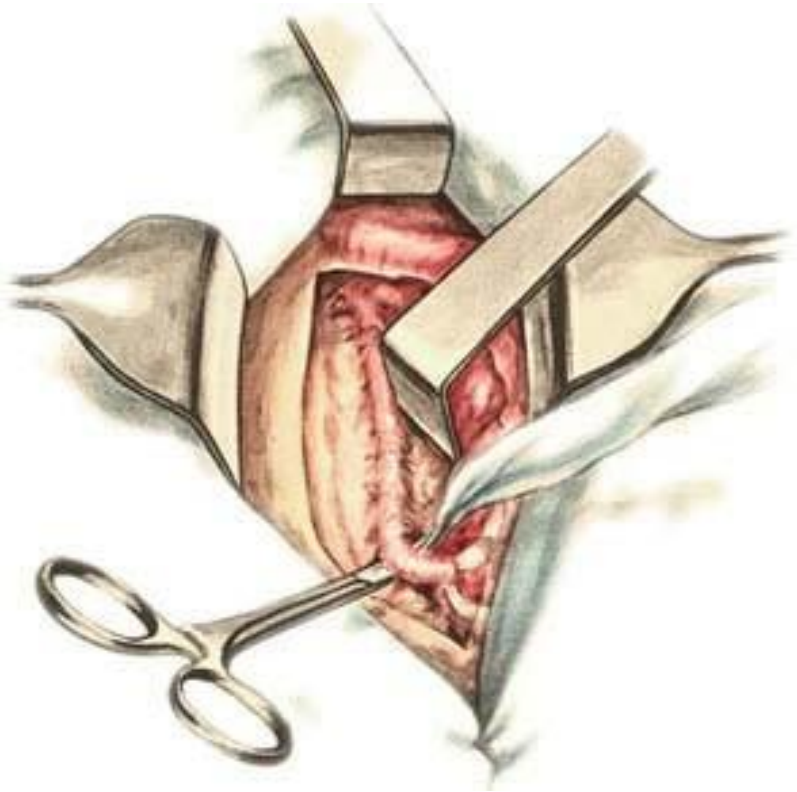
The section line of parietal peritoneum:



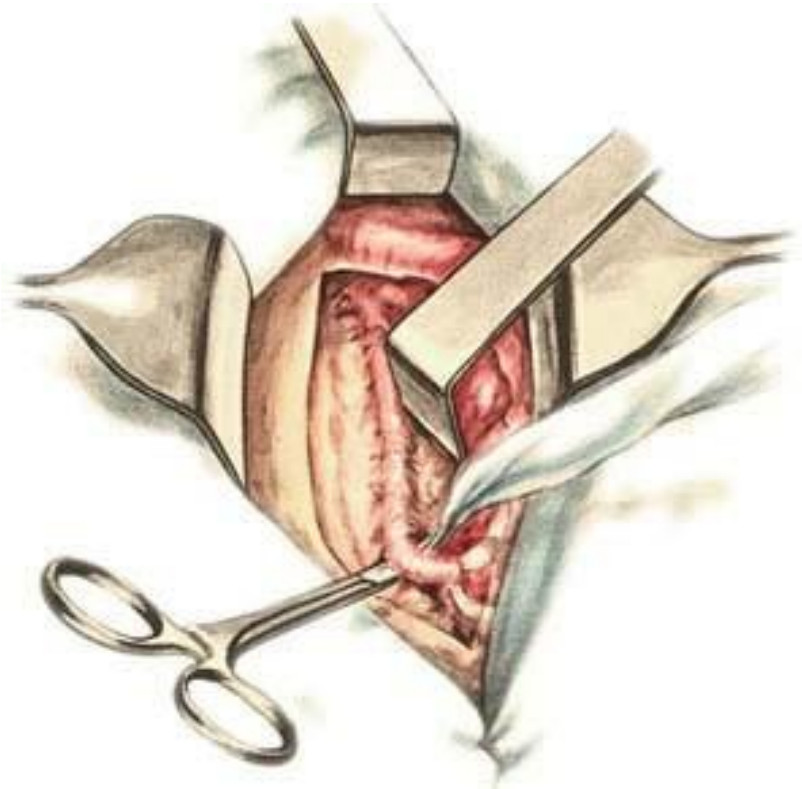
- Surgeon cuts the parietal peritoneum for a distance of 10-15 cm, stepping back on 1 cm outside from cecum and ascending colon.

Bringing of gauze handle under the base of appendix:

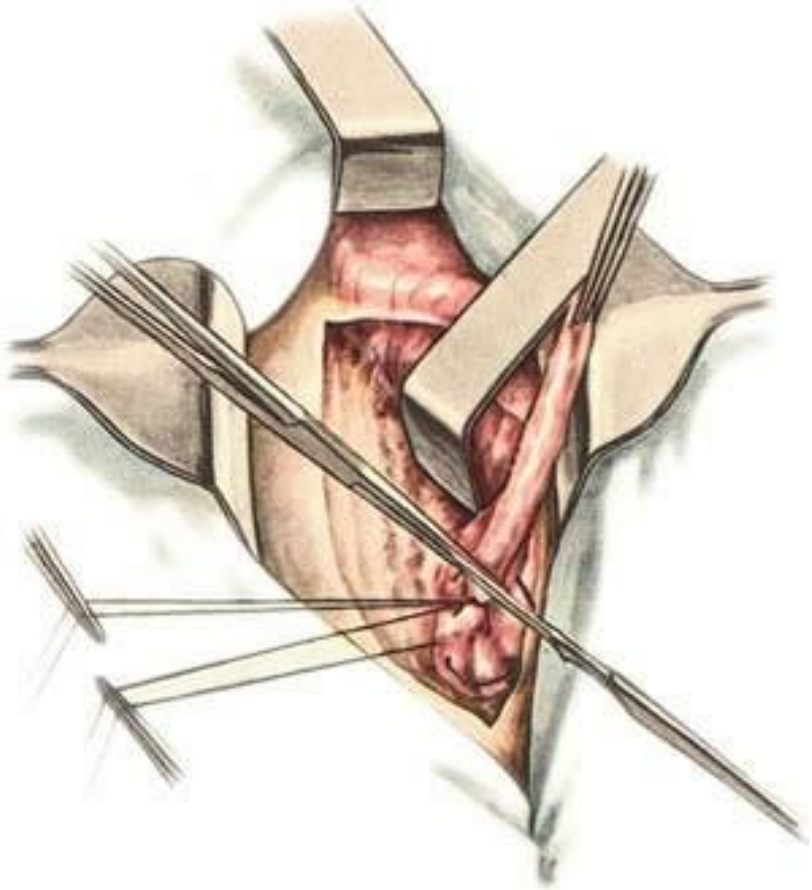
- Cecum should be moved inside, founding the appendix/ It should be taken on the gauze handle near its' base



Ligation of appendix vessels:



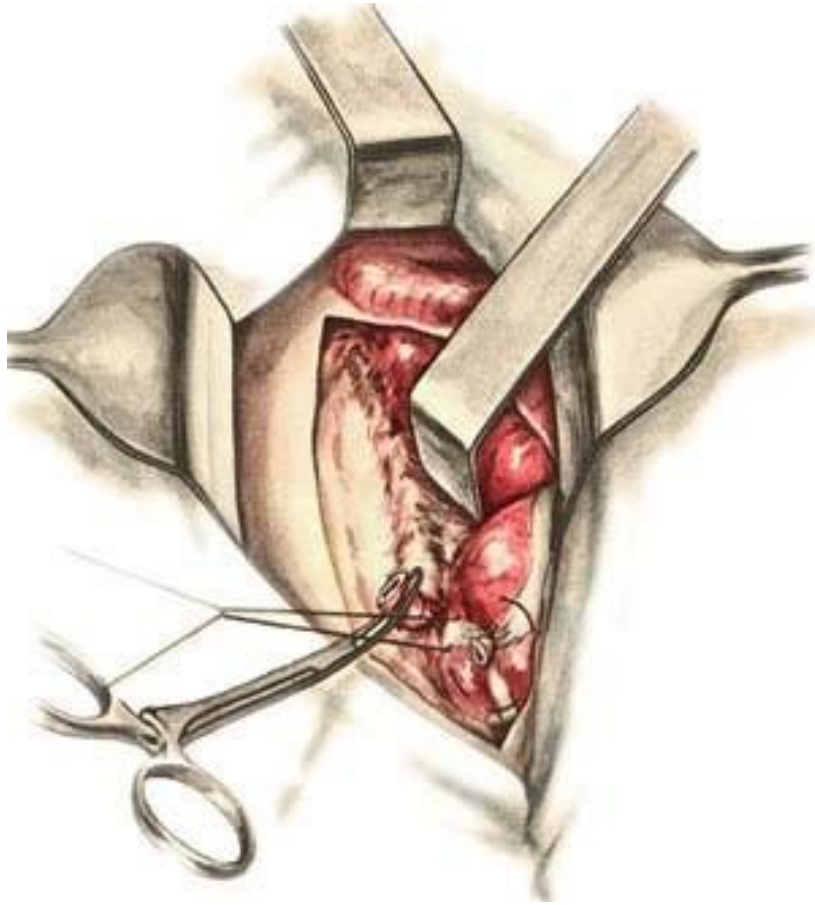
Cutting of the appendix:



- Appendix is cut under the clamp

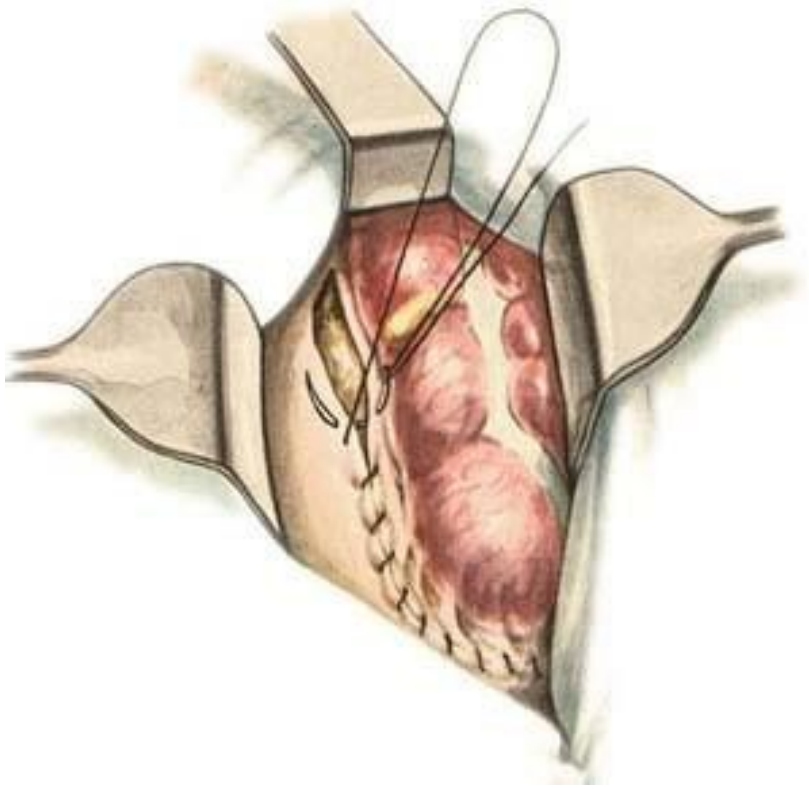
Dipping the stump of appendix.

- Appendix stump is dipped in the purse- string suture



Sewing of parietal peritoneum:

- After moving off the appendix the intestine is laid back and the borders of dissected peritoneum sews back by uninterrupted catgut suture.
- The wound of abdominal wall sews tightly, if there were no destructive changes in the appendix. But sometimes the inflammation process spreads into the retroperitoneal fat. In such cases the retroperitoneal space should be drained.

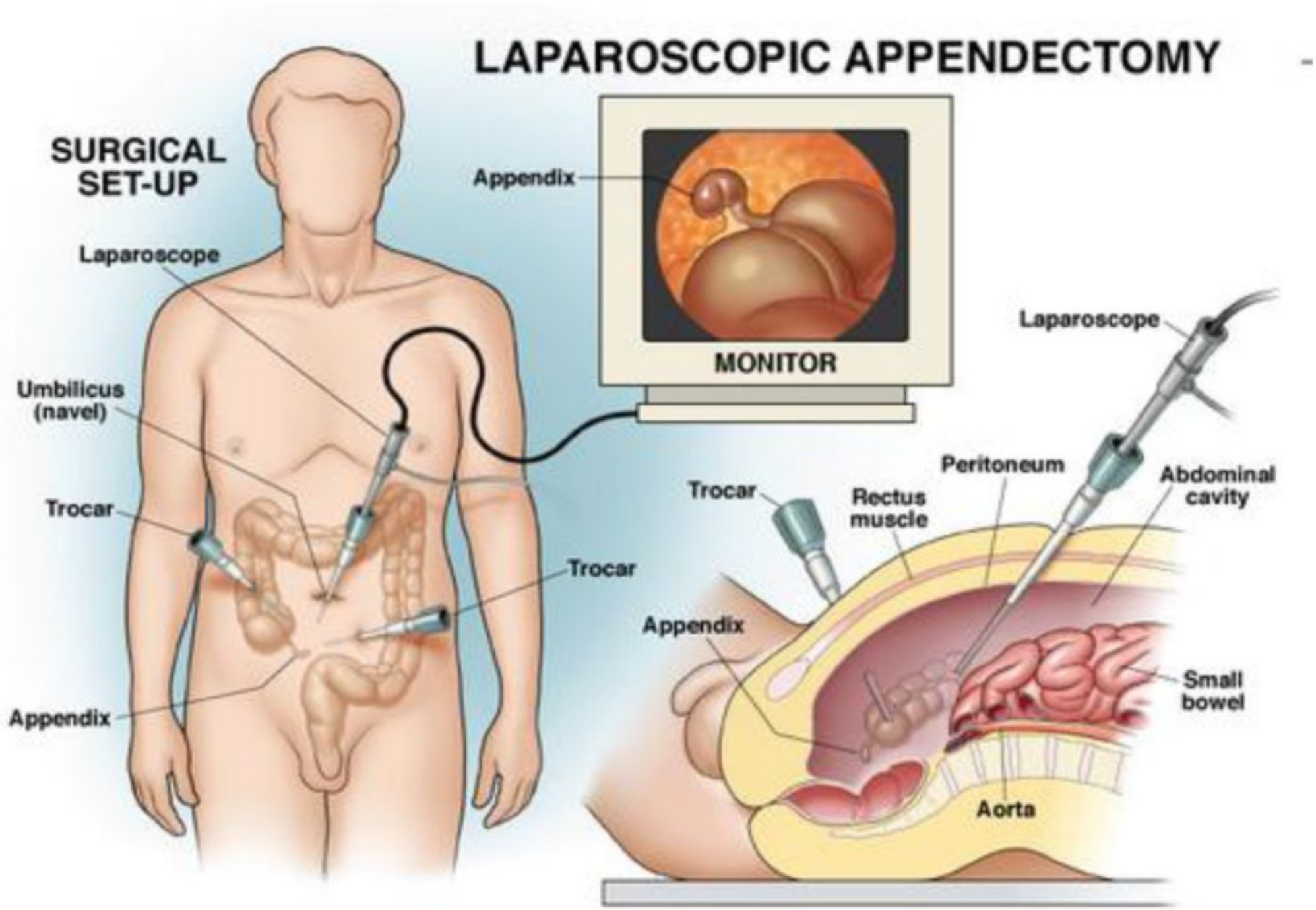


CLOSURE

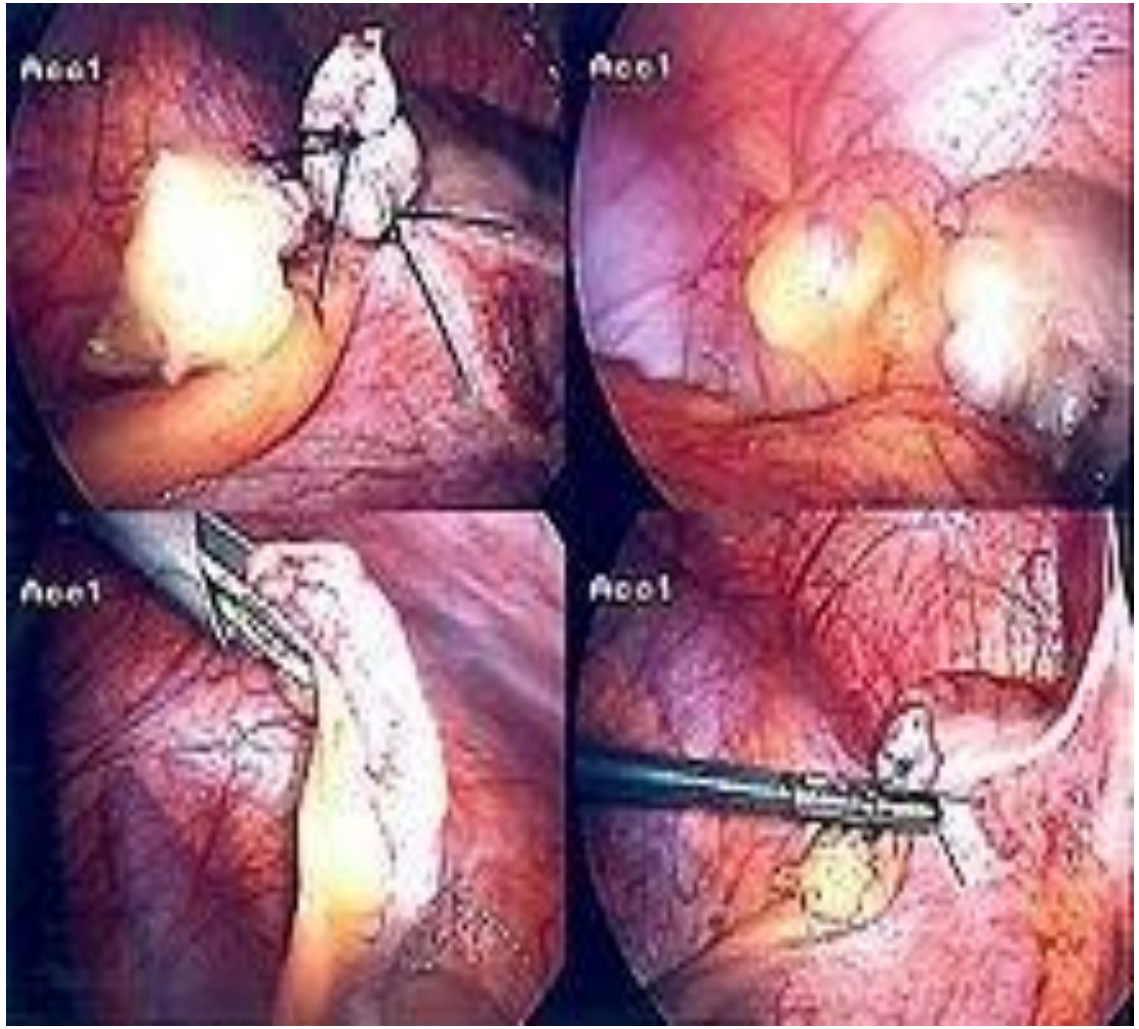
- The peritoneum is grasped with curved Kelly clamps and approximated with 3-0 continuous absorbable sutures.
- The transversus and internal oblique muscle layers are irrigated and loosely approximated with 2-0 absorbable sutures
- The external oblique fascia is repaired with continuous 0-0 absorbable sutures
- The subcutaneous tissue is irrigated, and the skin is approximated with staples.
- If there had been excessive contamination of the wound, it should be left open and the subcutaneous tissue packed with saline-soaked gauze. A delayed primary closure can be performed by day 3 to 4.

The final stage:

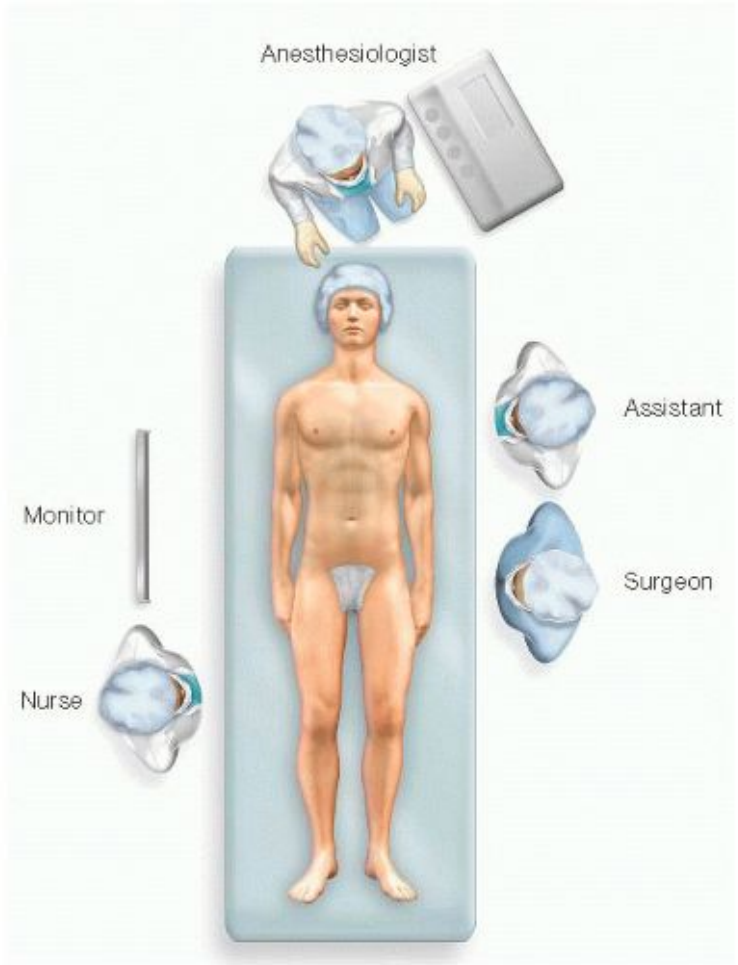
- After moving out the appendix cecum moves back in the abdominal cavity. Surgeon should check that there is no bleeding from the mesentery and then the wound of the abdominal wall sews tightly in layers. Peritoneum sews by uninterrupted catgut suture, muscles, aponeurosis and subcutaneous fat - by nodal catgut suture, skin – by nodal silk suture.
- In some cases abdominal cavity should be drained by thin rubber or polyvinyl chloride tube.
- Putting in a rubber tube is indicated in such cases, when there was purulent exudate in the abdominal cavity of phlegmonous changes of cecum.


LAPAROSCOPIC APPENDECTOMY
SURGICAL SET-UP
Laparoscope
Umbilicus (navel)
Trocar
Trocar
Appendix
Appendix
MONITOR
Laparoscope
Peritoneum
Abdominal cavity
Trocar
Rectus muscle
Appendix
Small bowel
Aorta

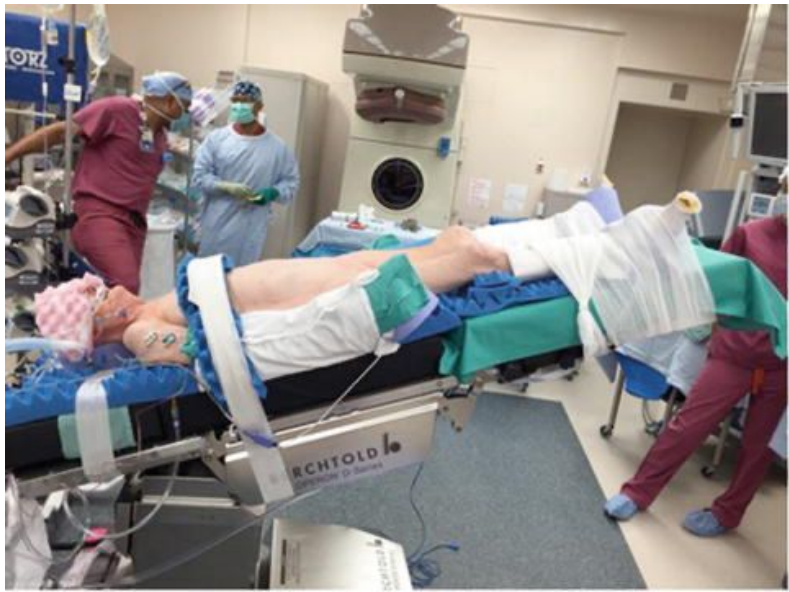
- Nowadays, laparoscopic appendectomy becomes very popular. This variant is considered to be less traumatically, but not always technically can be done. Even if the operation started from laparoscopic method, surgeon must always be ready to make the traditional appendectomy.
- The valuable aspect of laparoscopy in the management of suspected appendicitis is as a diagnostic tool, especially in women of child-bearing age.



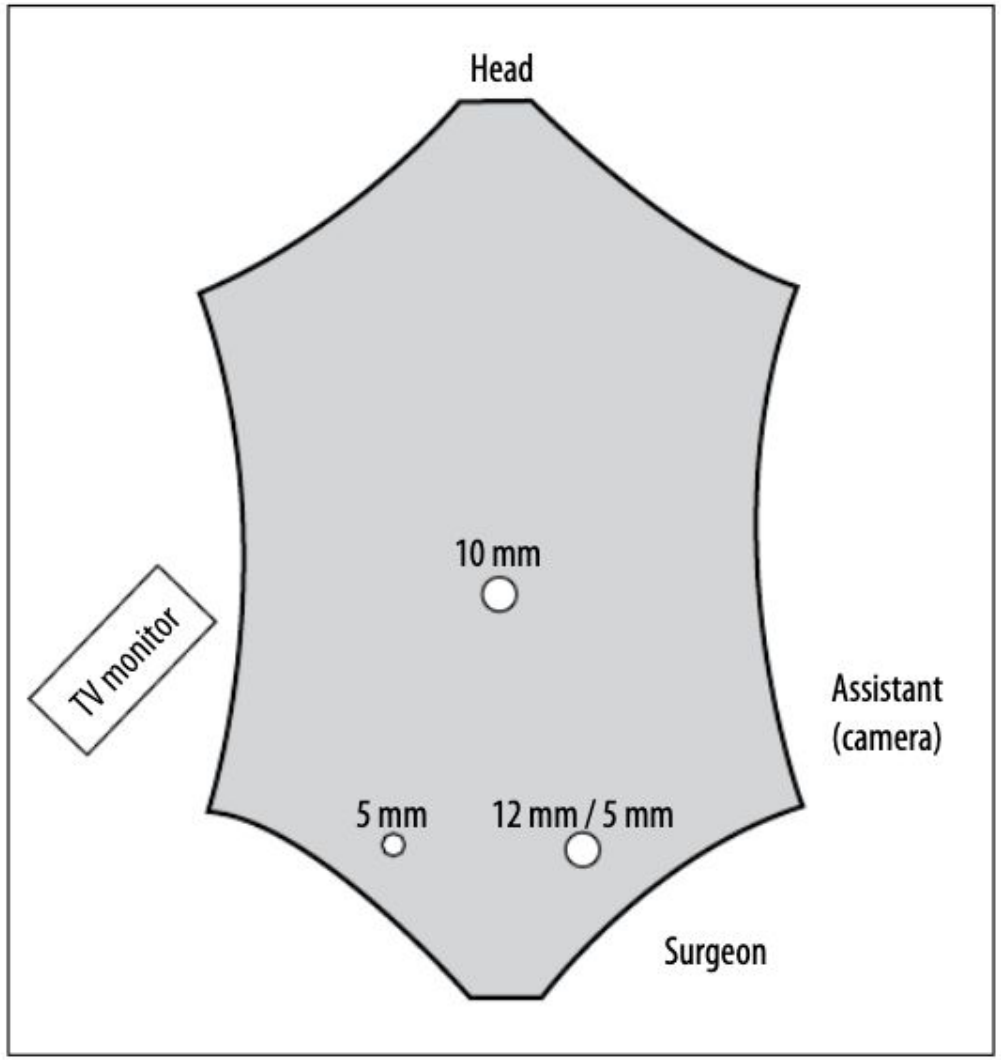
The Set up – position of the patient and the surgical team



- Place the patient in step Trendelenburg position to allow the intestines to slide out of the pelvis, and perform a thorough exploration to confirm the diagnosis.
- The surgical procedure is performed under general anesthesia.
- The bladder is decompressed with a Foley catheter to avoid injury during insertion of the supra-pubic ports.



Position of trocars and instruments



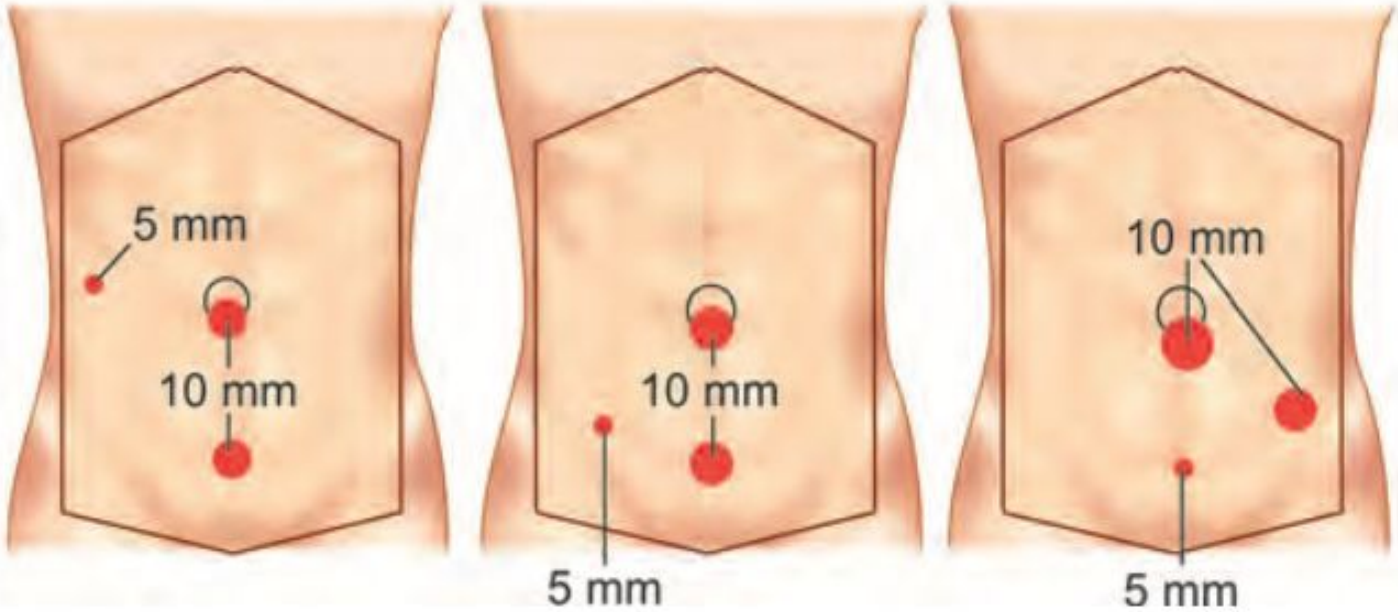
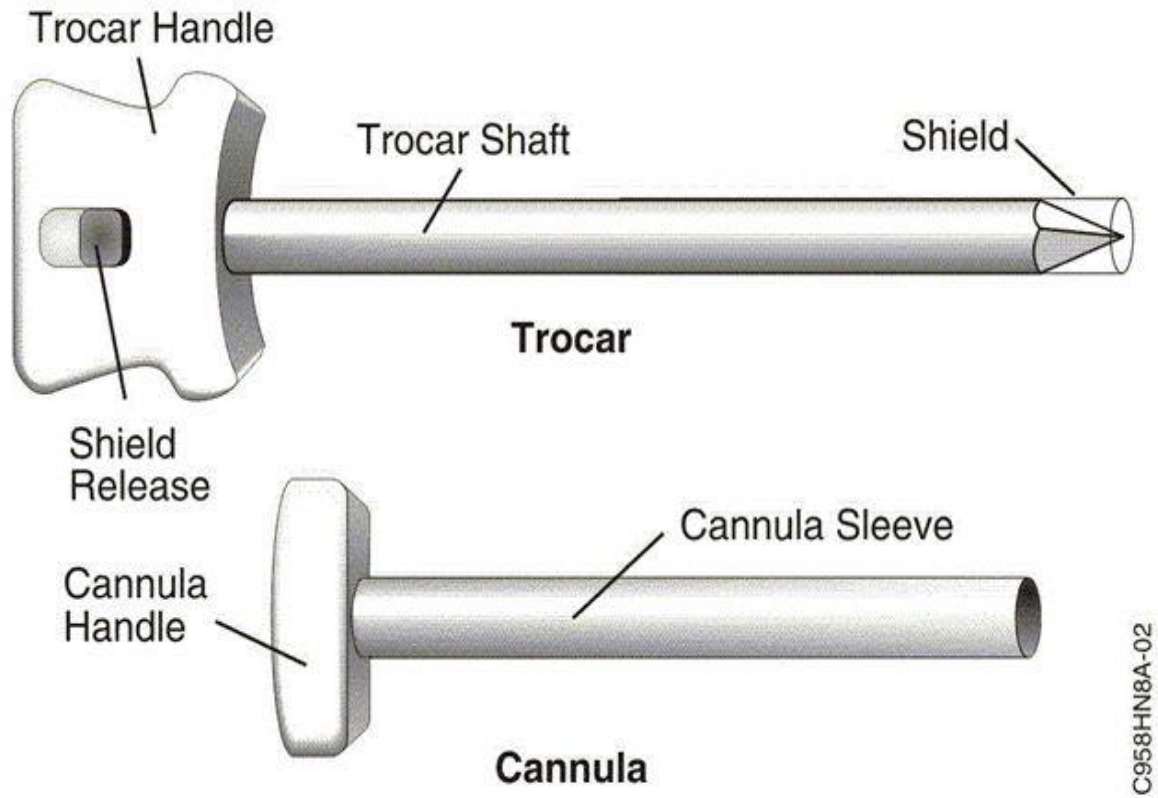


Fig. 24.28: Different possible port placements for appendicectomy.


Trocar Handle
Trocar Shaft
Shield
Trocar
Shield Release
Cannula Sleeve
Cannula Handle
Cannula
C958HN8A-02

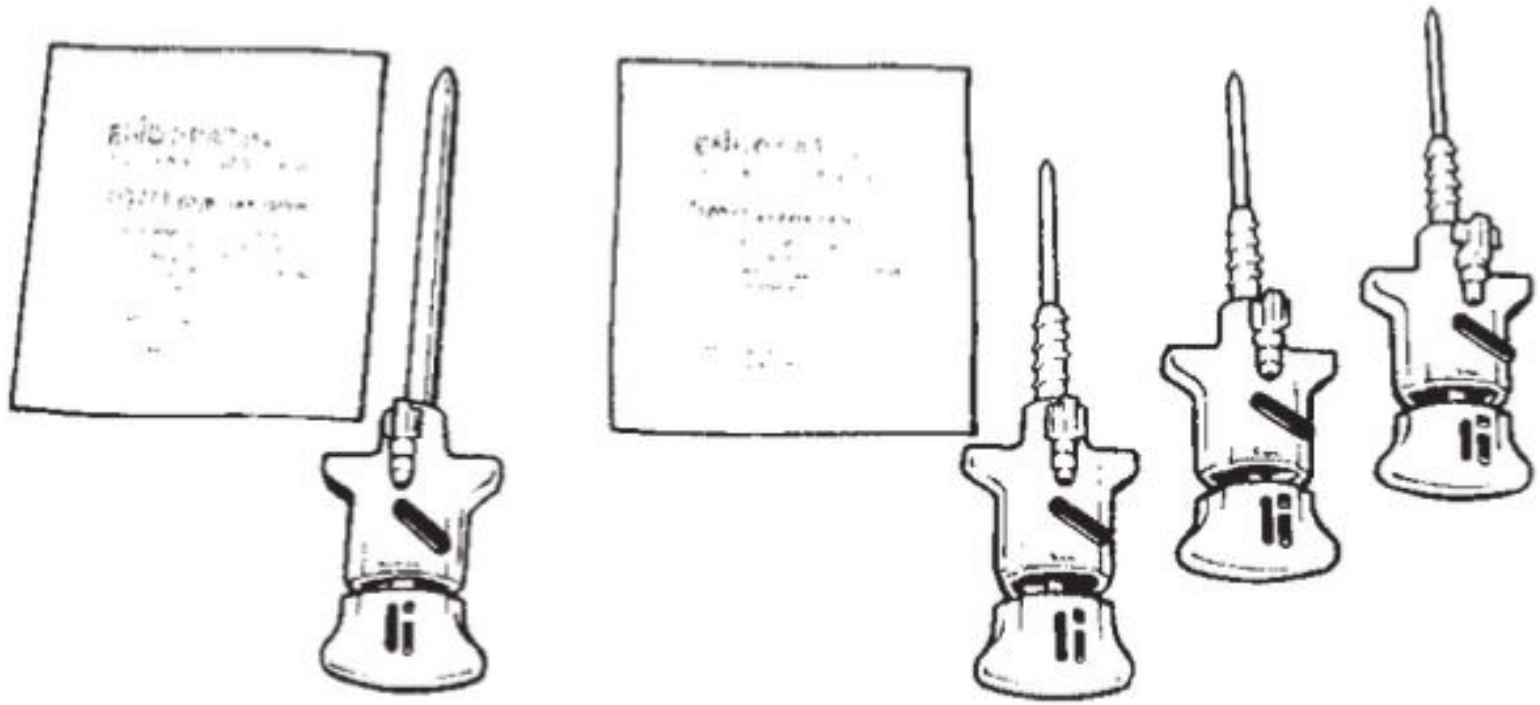


Fig. 4.34 Endopath. Disposable surgical trochars

Fig. 4.37 5mm grasper

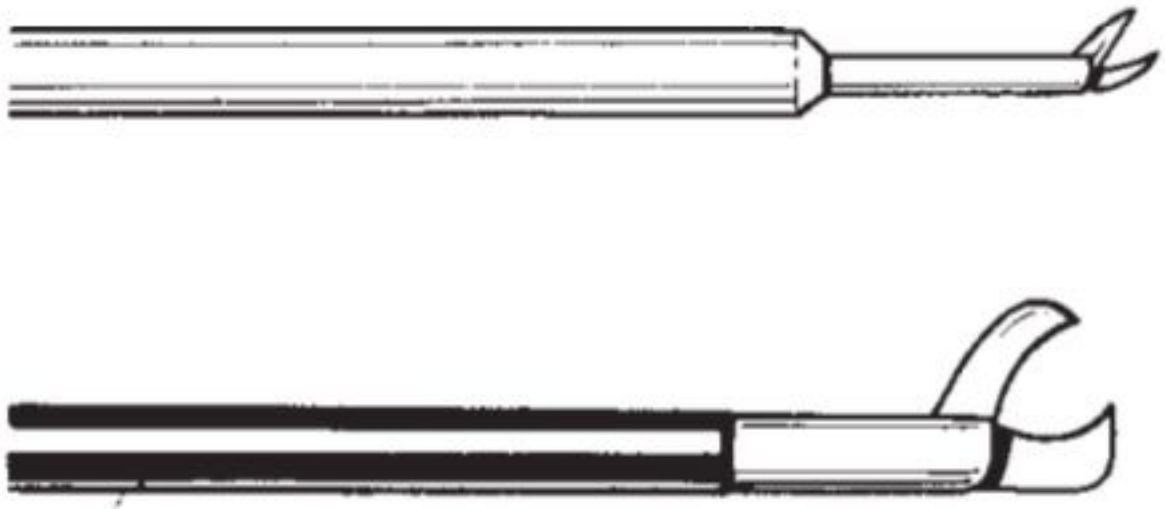


Fig. 4.39 Laparoscopic scissors. Designed as either curved, hooked, or straight, there is a variety available

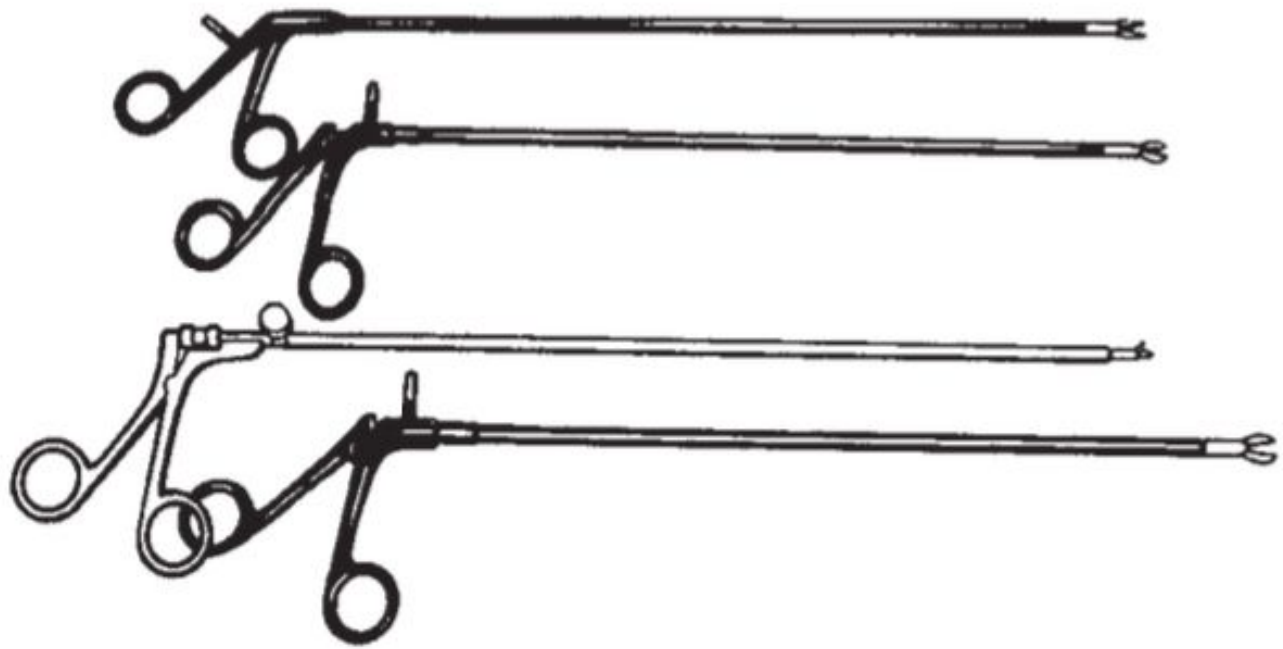


Fig. 4.36 5mm instruments

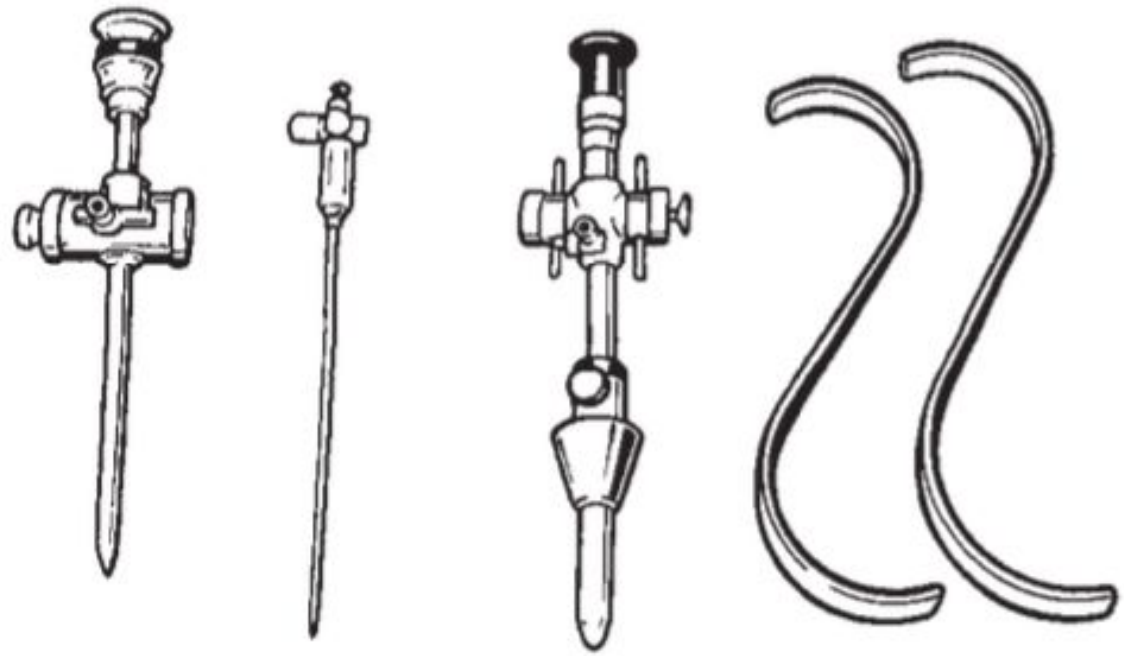


Fig. 4.35 10mm trochar, Veress needle, Hasson trochar, and 'S' refractors

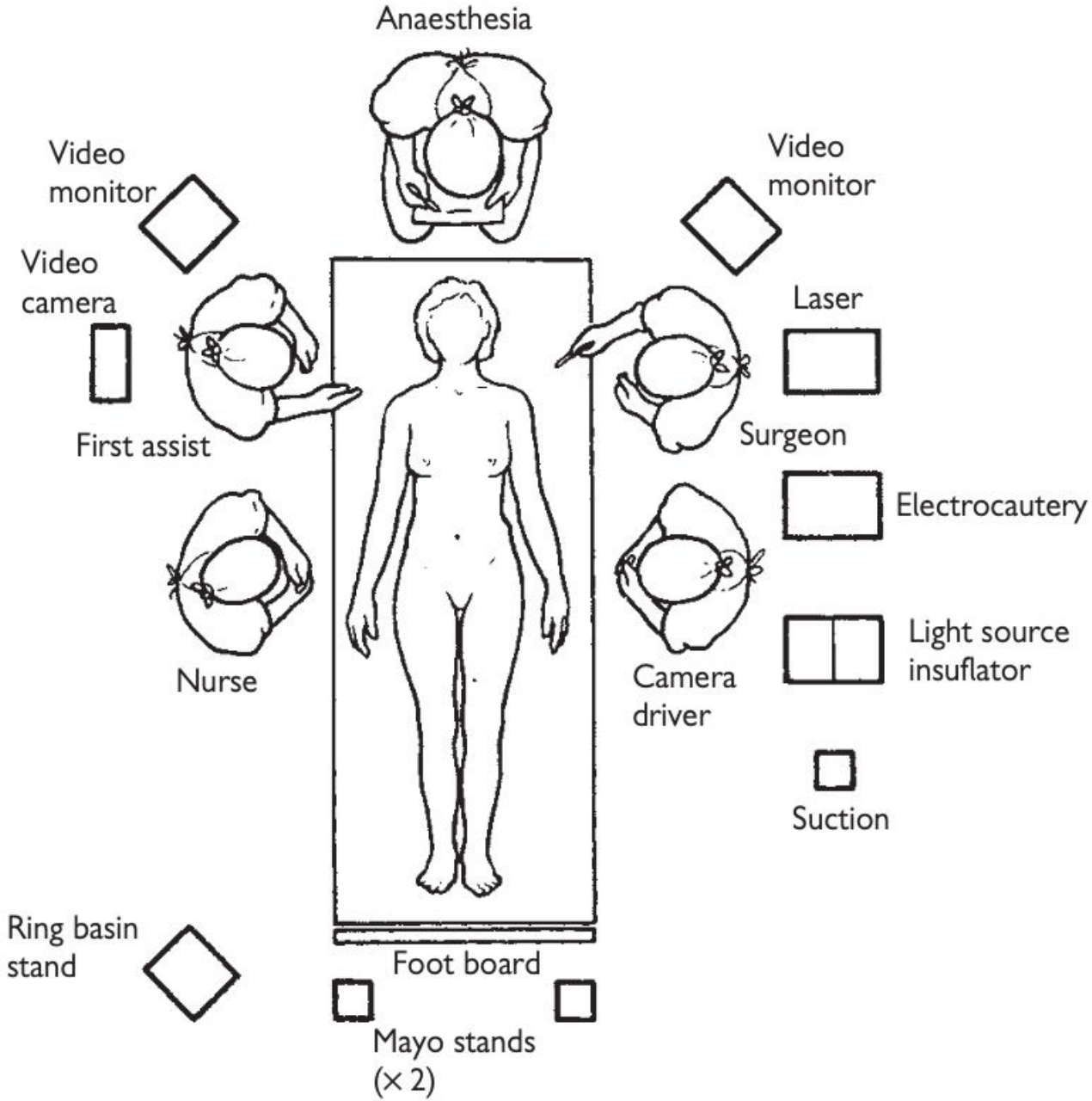


Fig. 4.42 Room set-up (appendicectomy)

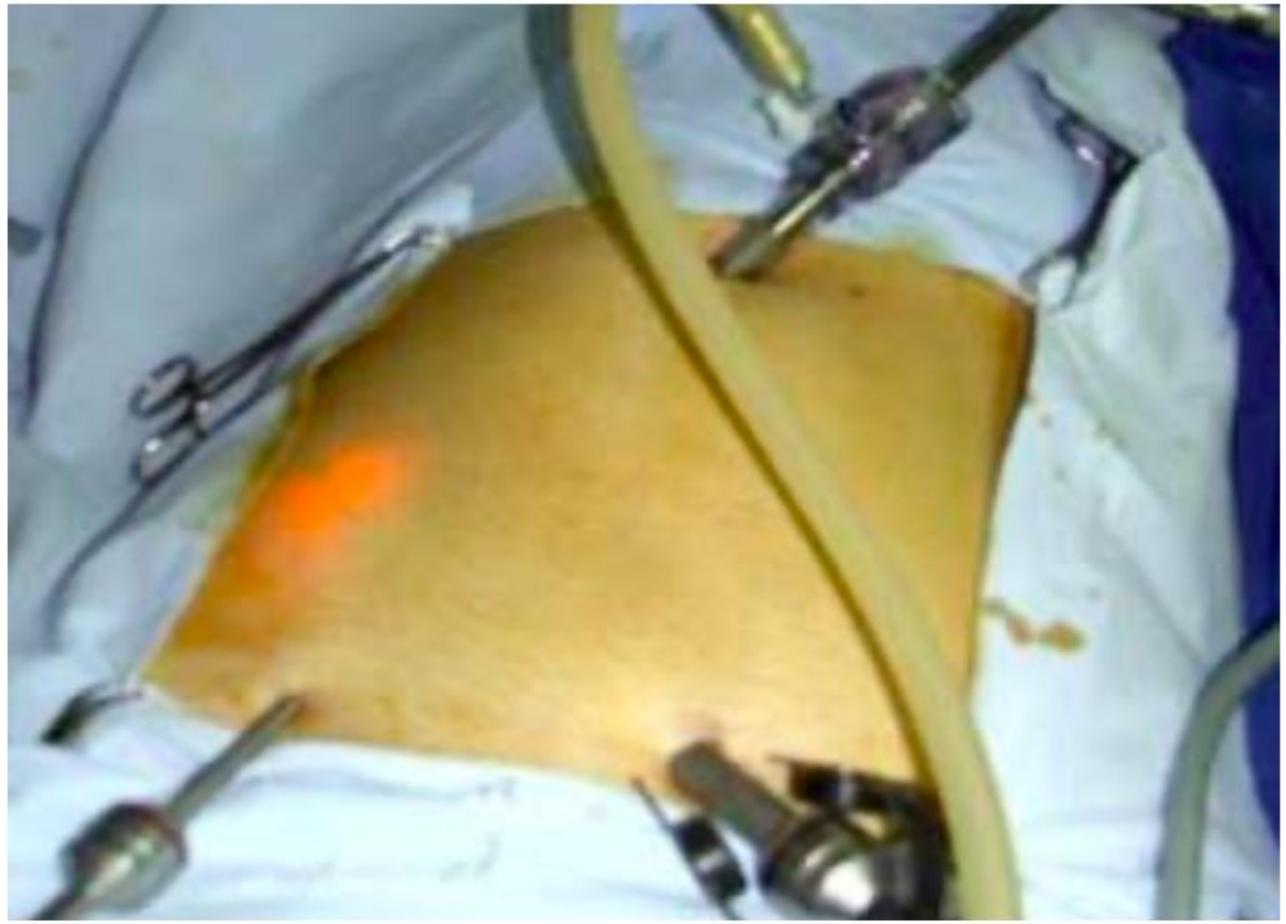


Figure 2. Port placement for laparoscopic appendectomy.

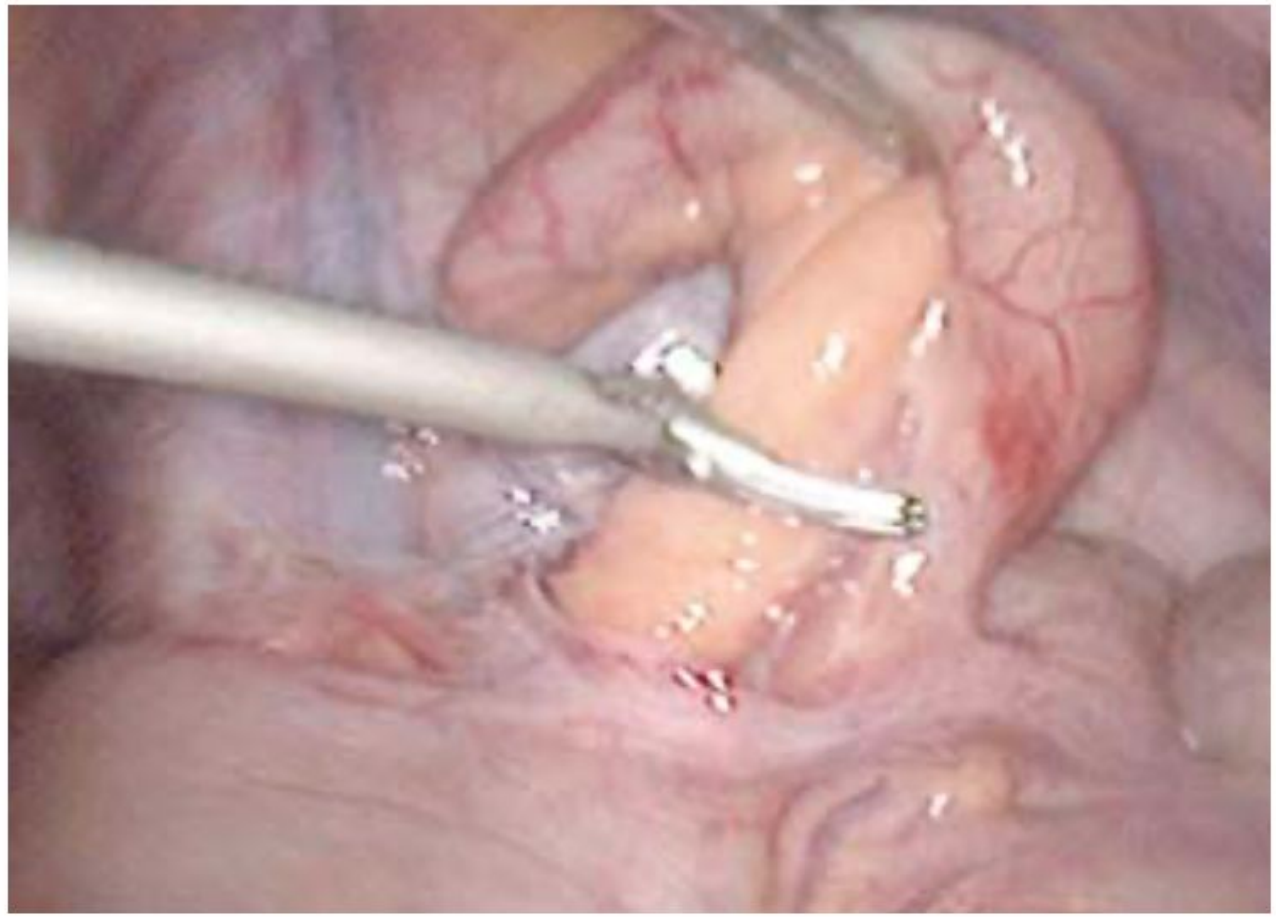
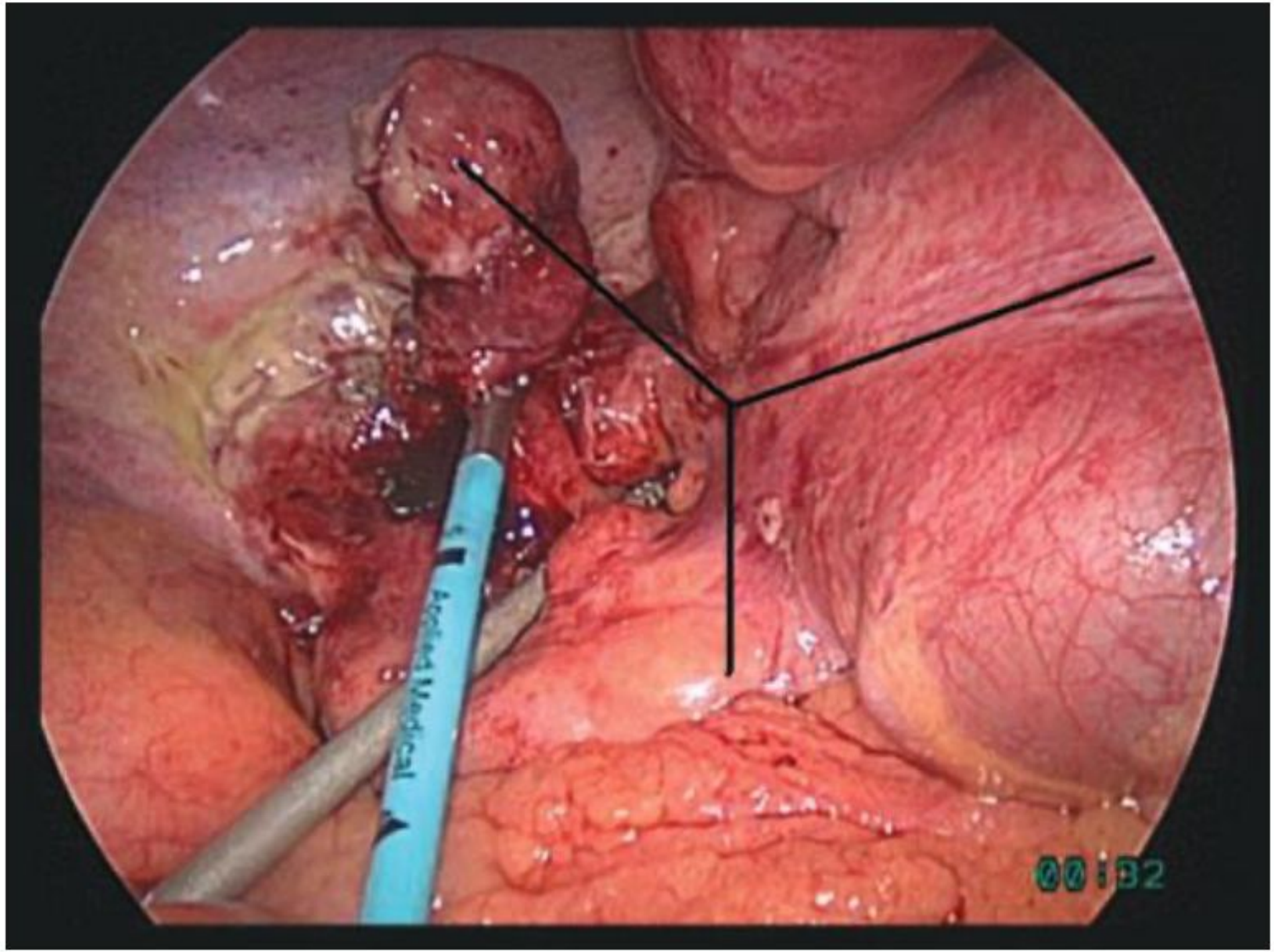


Figure 3. The dissection and division of the mesoappendix by harmonic scalpel.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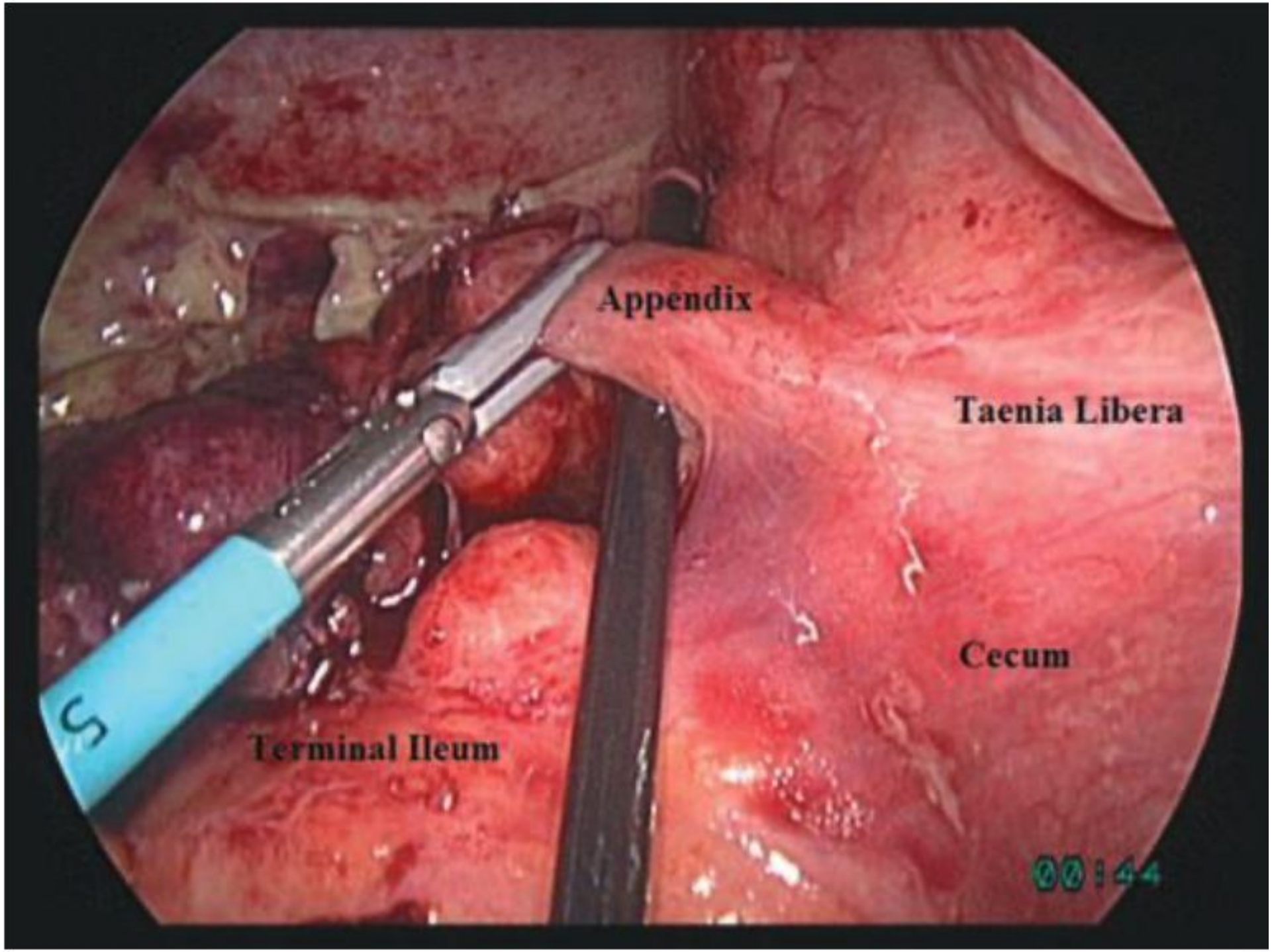

Appendix
Taenia Libera
Cecum
Terminal Ileum
00:44

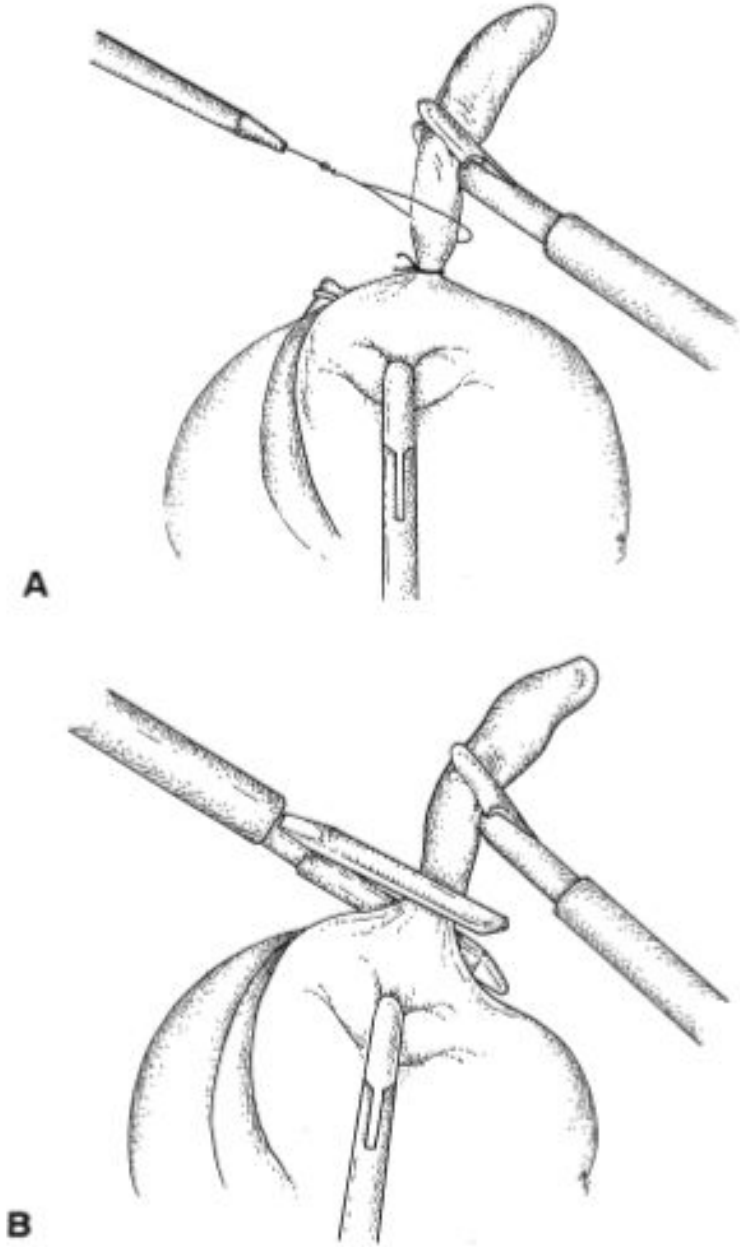


Figure 30.4. A. Division of the appendiceal base using pretied sutures. B. Division of the base using the endoscopic stapling device.

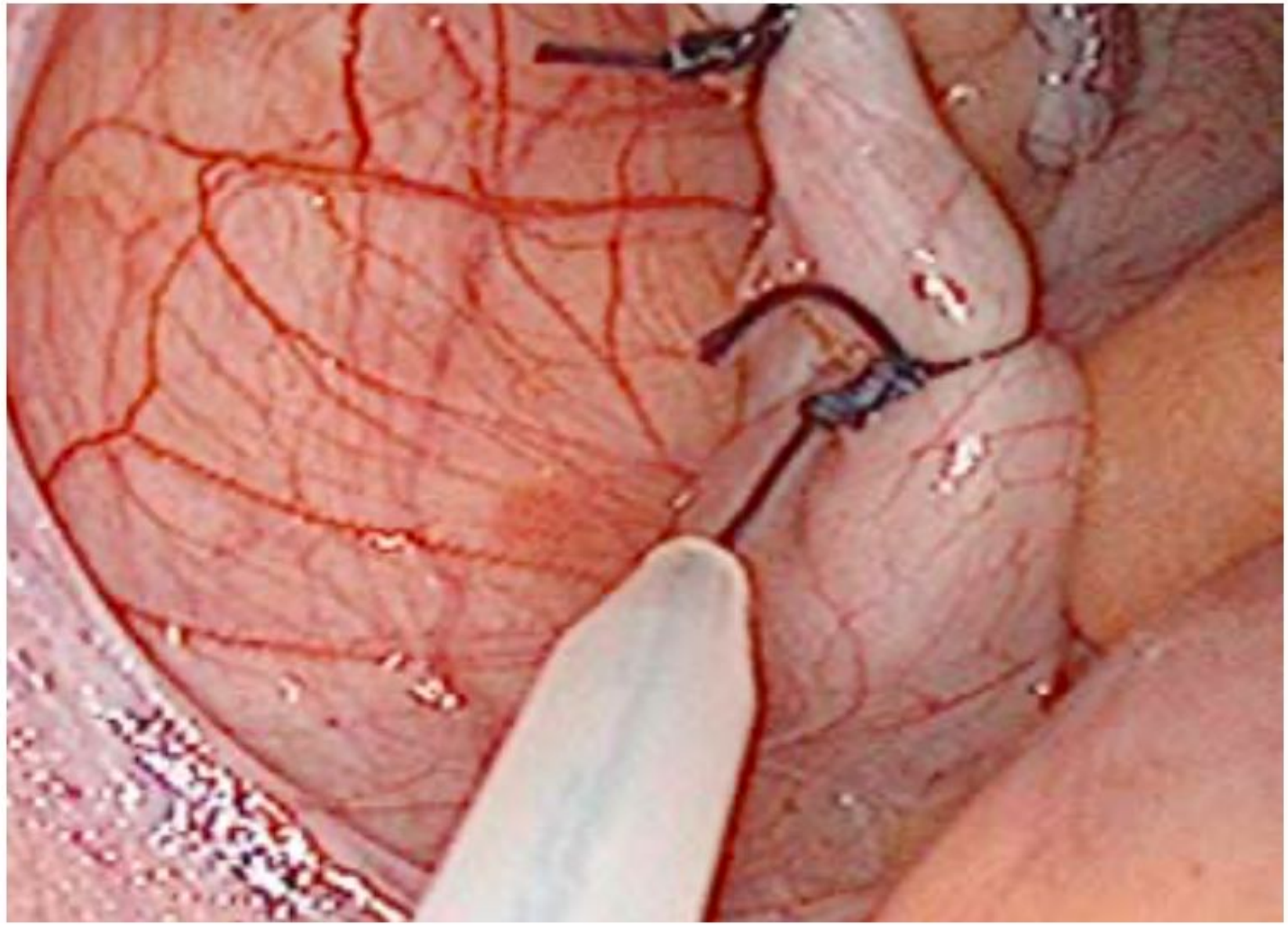


Figure 4. Endo-loop ligatures are tied at the base of the appendix.

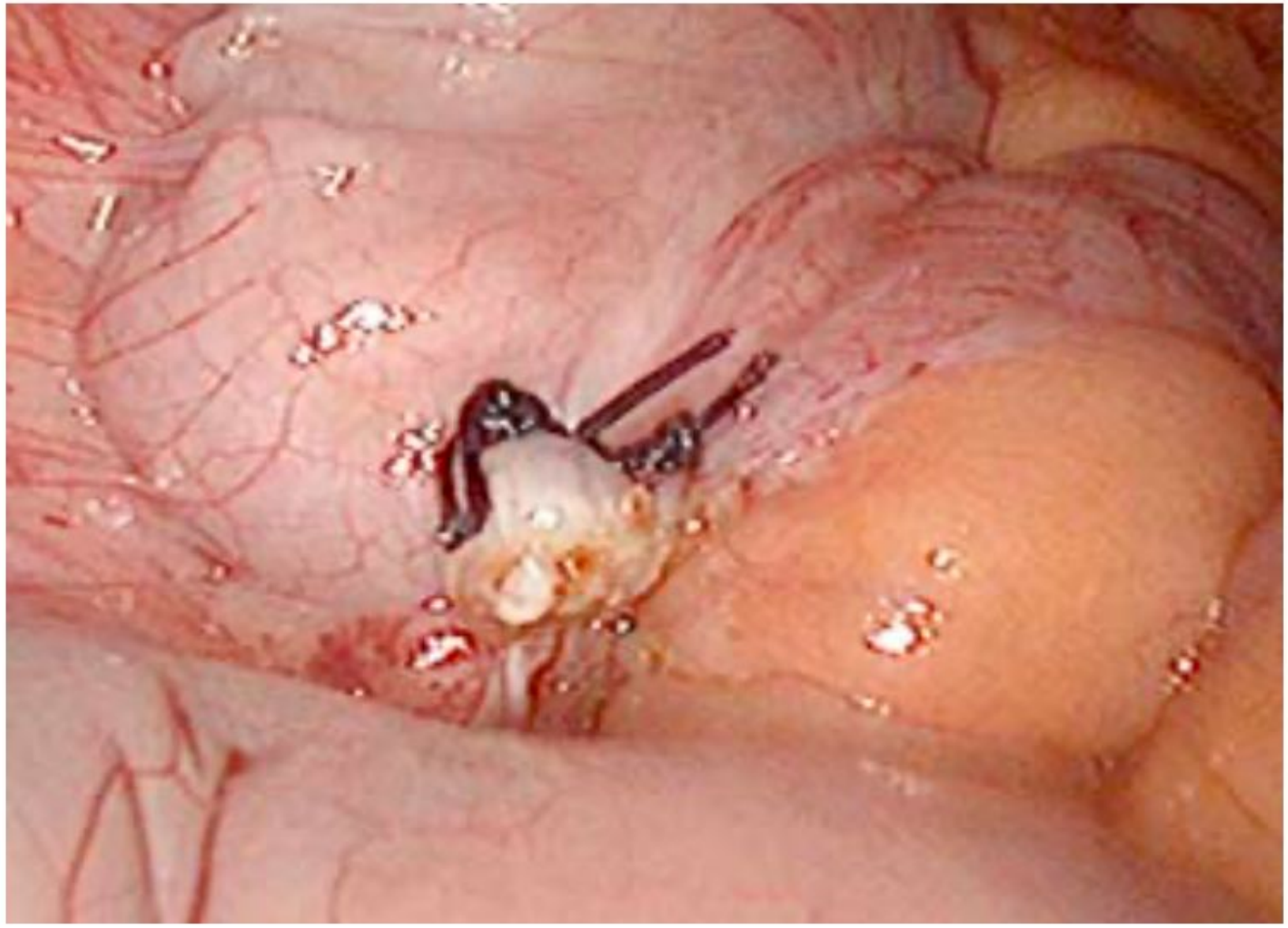


Figure 5. The base of the appendix is secured by two endoloops.

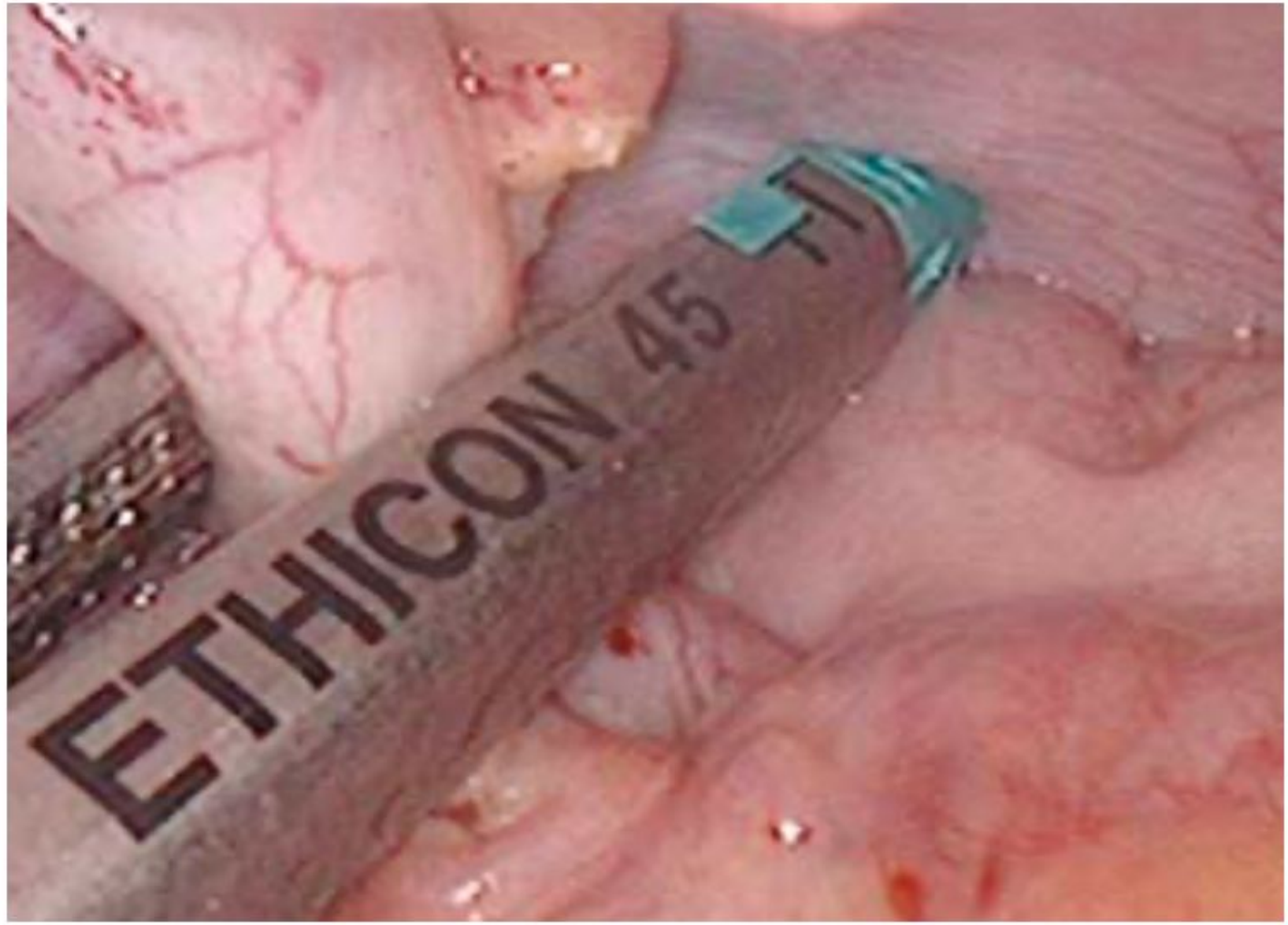


Figure 6. Appendix is transected at its base with a stapler (45mm, tick charge).

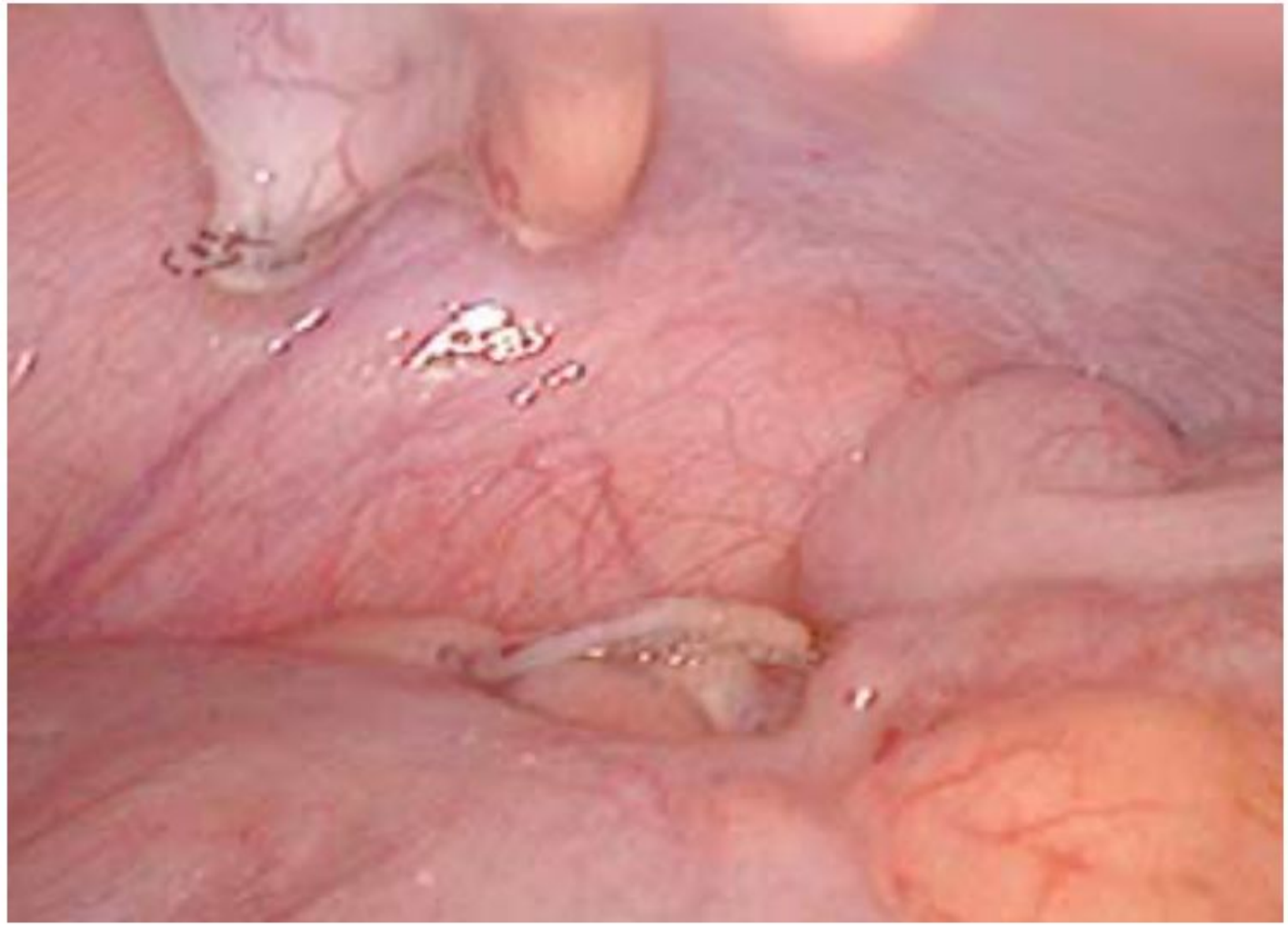


Figure 7. The base of appendix is secured by a stapler.

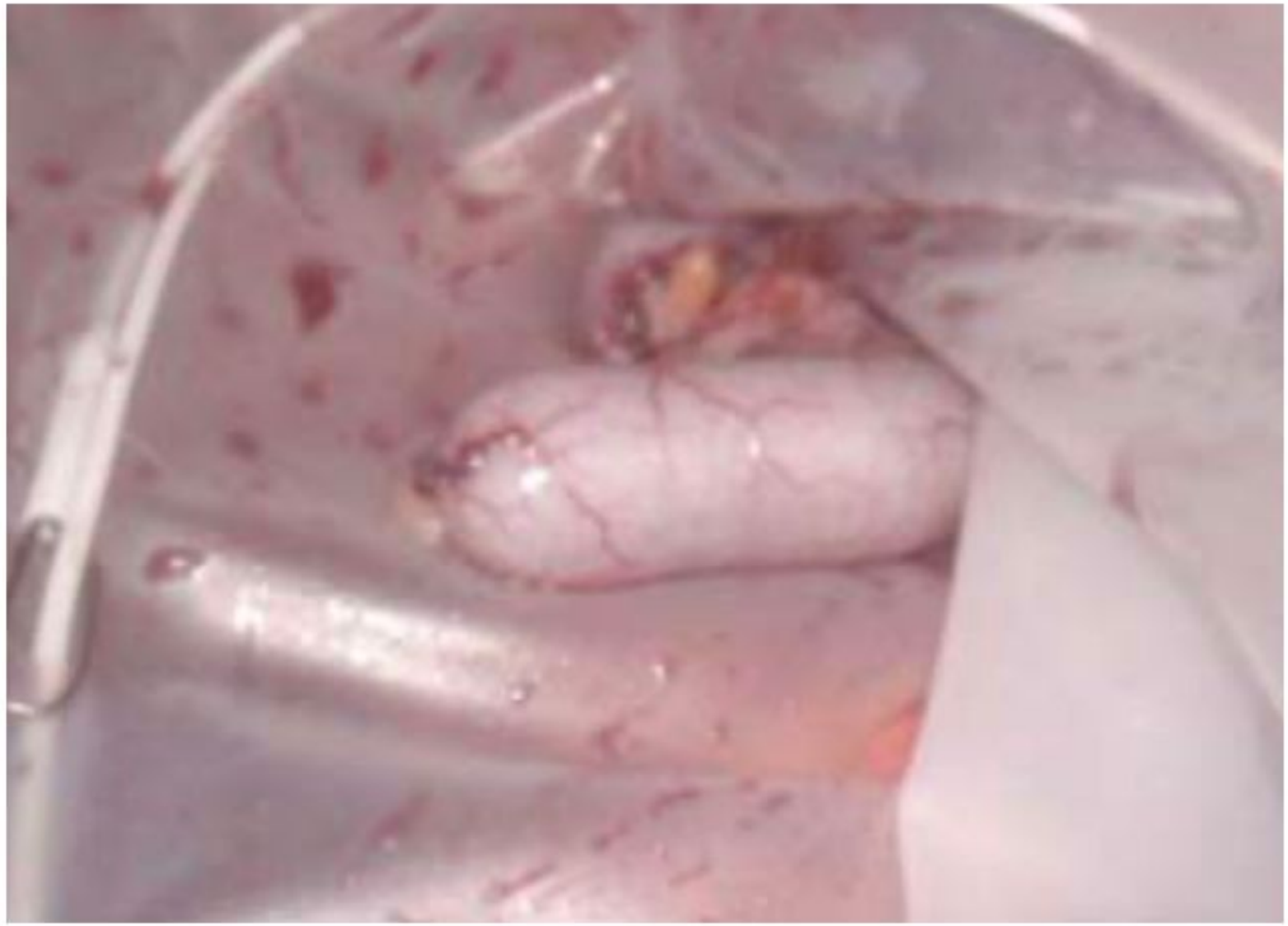


Figure 10. Removal of appendix by endobag.

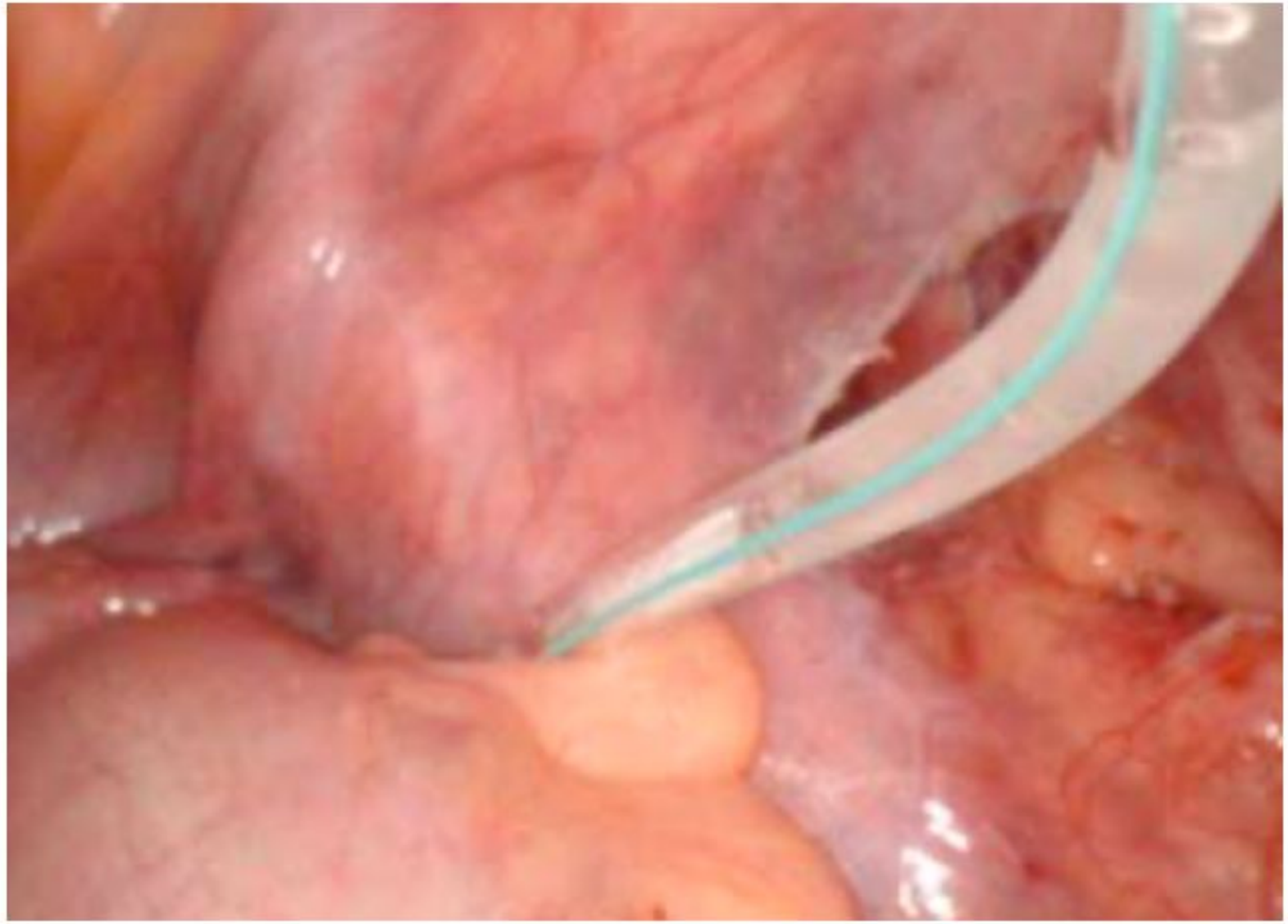


Figure 11. Drain is placed in pouch of Douglas.


2
1
3

Open Appendectomy vs Laparoscopic Appendectomy

Favors Laparoscopy	Favors Open
Diagnosis of other conditions	
Decreased pain and lower narcotic requirement	Shorter operating room time
Reduced length of stay	Lower operating room costs
Fewer wound infections	Fewer intra-abdominal abscesses
Quicker return to usual activities	Lower hospital costs
Lower societal cost	

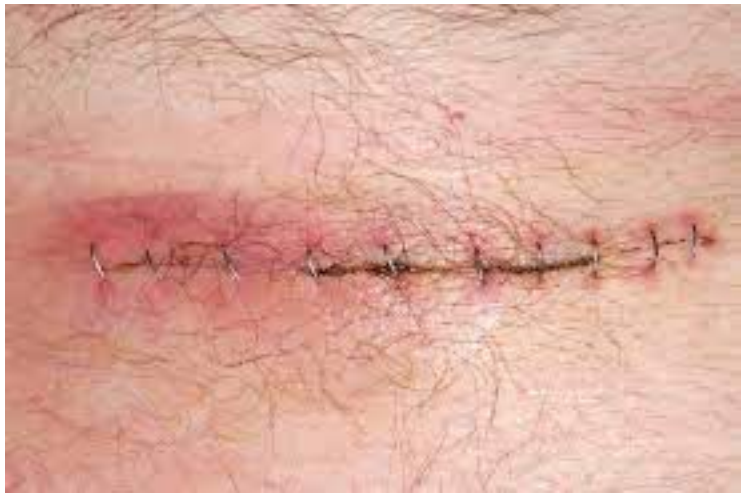
Data from McCall JL, Sharples K, Jadallah F. Systemic review of randomized controlled trials comparing laparoscopic with open appendicectomy: a meta-analysis. *J Am Coll Surg*. 1998; 186:545–553; and Sauerland S, Lefering R, Neugebaur EA. Laparoscopic versus open surgery for suspected appendicitis. *Cochrane Database Syst Rev*. 2004;4:CD001546.

POST-OP MANAGEMENT

- In uncomplicated case, antibiotics should be continued up to 24 hours post-operatively ,oral fluid are started 12hrs after recovery followed by light diet 24hrs later.
- In complicated antibiotics should be continued for anywhere between 3 and 7 days, iv fluids, iv antibiotics and NPO with NG tube drainage until bowel activity recommence and temperature subsides
- An interval appendectomy is generally performed 6-8 weeks after conservative management with antibiotics for special cases, such as perforated appendicitis
- Stiches removed in 7-10days

Post operative Complications

1. Wound infection (Most common)
   - 5-10% of patient
   - 4-5th day
2. Intra- abdominal abscess -8%
3. Hemorrhage
4. Acute intestinal obstruction
5. Generalized peritonitis (Postoperative peritonitis)
6. Respiratory infections
7. UTI
8. Venous thrombosis and embolism
9. Portal pyemia
10. Fecal/ Intestinal fistula

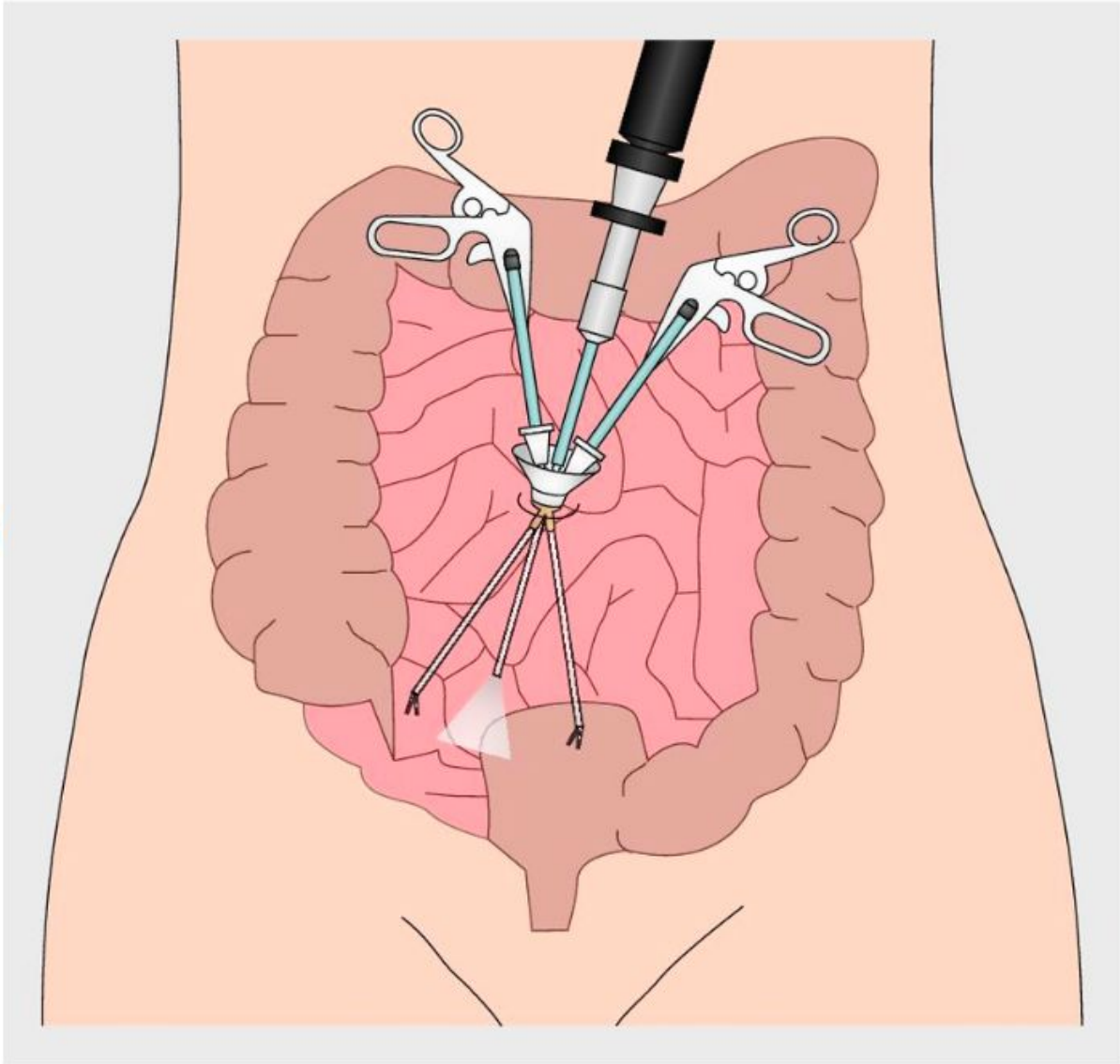


Alternative Methods of Appendectomy

- **Laparoscopic Single-Incision Appendectomy**
- **Natural orifice transluminal endoscopic surgery (NOTES)**

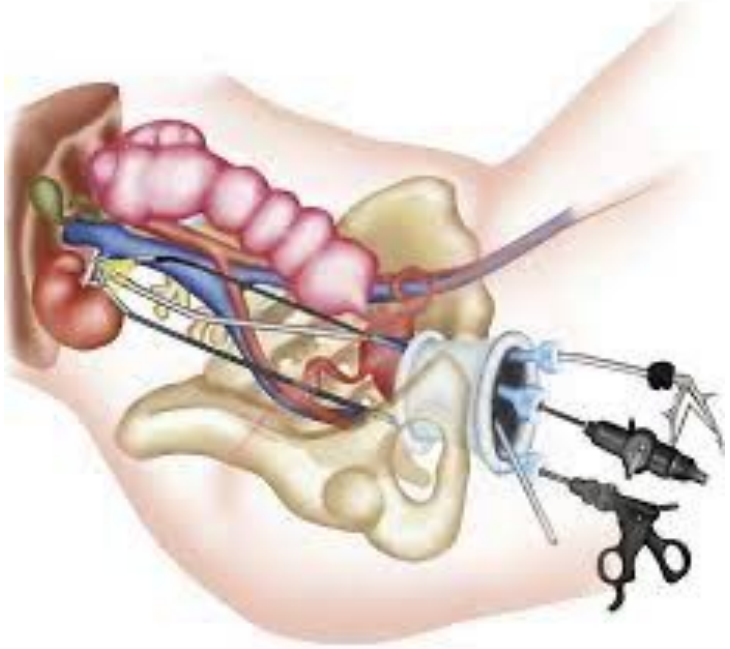
Laparoscopic Single-Incision Appendectomy

- With laparoscopic single-incision appendectomy, the patient is prepared similarly to laparoscopic appendectomy.
- Under general anesthesia, the patient is secured in a supine position with the left arm tucked. The surgeon and assistant stand on the left side facing the appendix and the screen.
- When performing laparoscopic single-incision appendectomy, the surgeon's hands perform the opposite function that they would normally in standard laparoscopic surgery.
- The appendix may be placed in a retrieval bag or removed through the single incision.
- There have been multiple small trials evaluating the efficacy of laparoscopic single-incision appendectomy compared to standard appendectomy; however, there has only been one prospective randomized study (in the pediatric population) and one meta-analysis.
- Although further study is needed, it appears that in laparoscopic appendectomy, laparoscopic single-incision appendectomy conveys no discernible advantage or disadvantage with short-term outcomes. Late outcomes and patient quality- of-life outcomes remain to be investigated.



Natural Orifice Transluminal Endoscopic Surgery

- Natural orifice transluminal endoscopic surgery (NOTES) is a new surgical procedure using flexible endoscopes in the abdominal cavity. In this procedure, access is gained by way of organs that are reached through a natural, already-existing external orifice.
- The hoped-for advantages associated with this method include the reduction of postoperative wound pain, shorter convalescence, avoidance of wound infection and abdominal wall hernias, and the absence of scars.
- The main concern with NOTES has been complications with closure of the enterotomy. To date, there is no reliable method of closure of the gastrotomy site, and there has been significant morbidity reported with this approach.
- Although the transvaginal approach appears to be more promising, in women surveyed on their perception of NOTES, three-quarters were either neutral or unhappy about the prospects of NOTES.



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Thank you for your attention