# Laparoscopic Appendicectomy

Prof. Dr. R. K. Mishra

## INTRODUCTION

Appendicitis was first recognized as a disease entity in the 16th century and was called perityphlitis. McBurney first described its clinical findings in 1889. Laparoscopic appendectomy in expert hands is now quite safe and effective and considered as an excellent alternative for patients with acute appendicitis. Acute appendicitis is the most common abdominal surgical emergency in the world, with a lifetime risk of 8.6% in males and 6.9% in females. First successful laparoscopic appendicectomy was performed by Semm in 1982. Although open appendectomy preceded it by almost 100 years, laparoscopic appendectomy has overtaken its open counterpart in popularity. Although laparoscopic appendicectomy can be performed in all groups of patients, surgeons agree that for women of childbearing age, laparoscopic appendectomy is unquestionably the method of choice. Perforation is found in 13–20% of patients who present with acute appendicitis. Perforation rate is higher among men (18% men versus 13% women) and older adults.

## LAPAROSCOPIC ANATOMY

The appendix is derived from a cecal diverticulum of the fetus. The appendix is generally within 1.7 cm of the ileocecal junction. Its length varies from 2 to 20 cm, average 9 cm **(Fig. 1)**. Most of the time when telescope is introduced through umbilicus, appendix is hidden behind the cecum.

The anterior tenia coli of the cecum is an important landmark, which leads to cecum **(Figs. 2 and 3)**. The triangular mesoappendix tethers the appendix posteriorly, which contains appendicular artery and veins. The appendicular artery is a branch of the ileocolic artery.

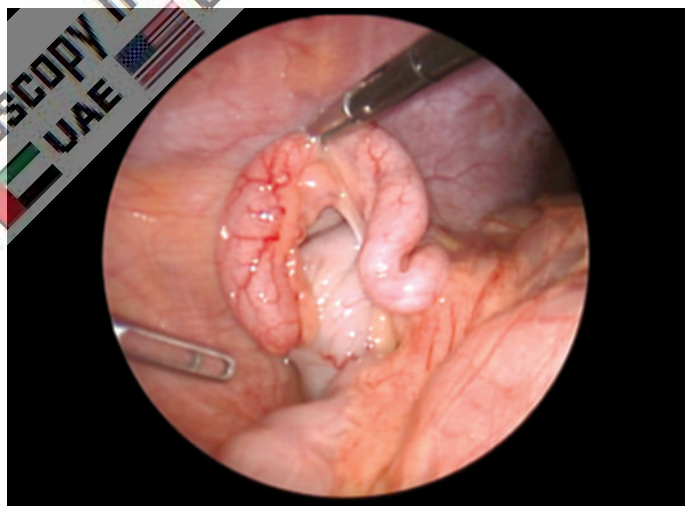
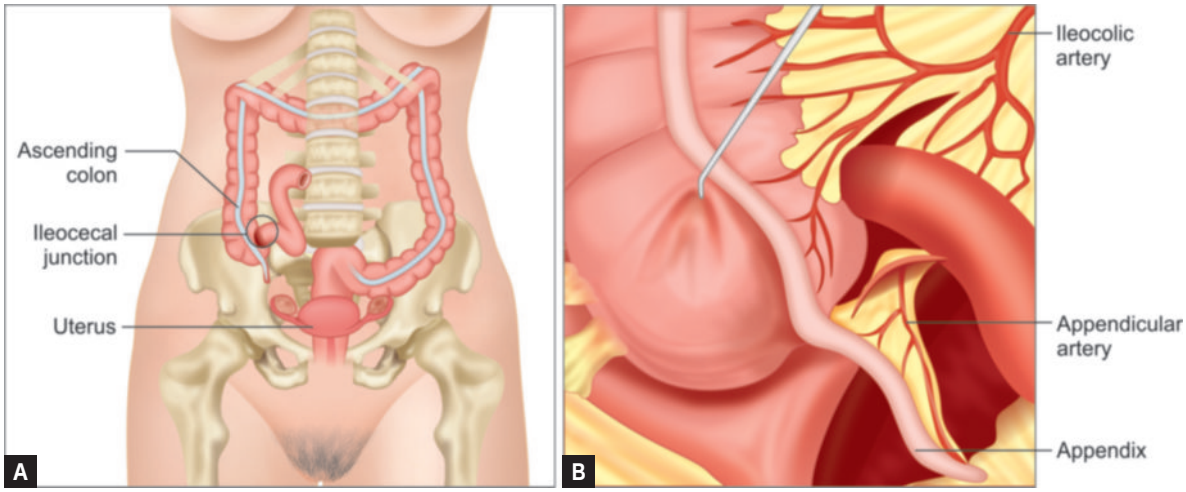


**Fig. 1:** Normal laparoscopic view of appendix.




**Figs. 2A and B:** Anatomic position of appendix.

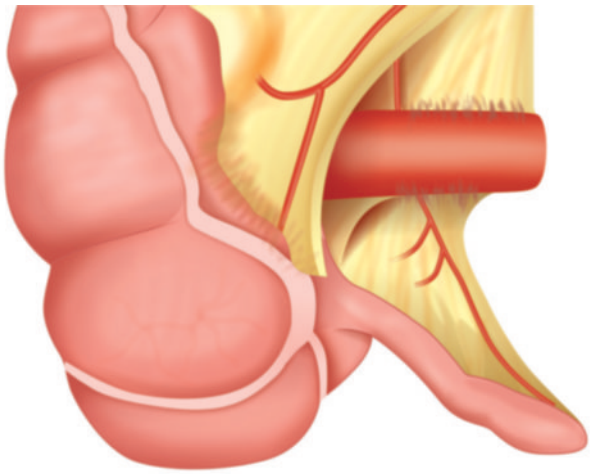


**Fig. 3:** Normal appendix.

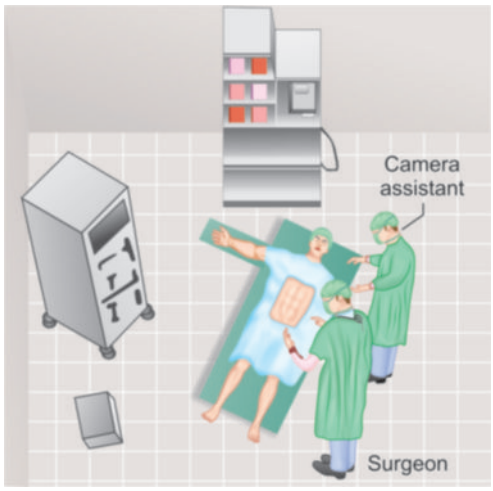



**Fig. 4:** Patient position and setup of operating team.

**TABLE 1:** Indications of laparoscopic and open appendectomy.

| *Laparoscopic appendectomy* | *Open appendectomy* |
|---|---|
| • Female of reproductive age group<br>• Female of premenopausal group<br>• Suspected appendicitis<br>• High working class<br>• Previous lower abdominal surgery<br>• Obese patients<br>• Disease conditions such as cirrhosis of liver and sickle cell disease<br>• Immunocompromised patients | • Complicated appendicitis<br>• COPD or cardiac disease<br>• Generalized peritonitis<br>• Hypercoagulable sites<br>• Stump appendicitis after previous incomplete appendicectomy |

(COPD: chronic obstructive pulmonary disease)

Laparoscopic exposure of the appendix is facilitated by gently pulling the cecum upward.

The base of the appendix must be visualized carefully to avoid leaving a remnant of appendix at the time of laparoscopic appendicectomy. Exposures of retrocecal appendix require mobilization of right colon. The peritoneal reflection is incised, and the cecum is pulled medially to visualize retrocecal appendix.

## Advantage of Laparoscopic Appendectomy

Thorough exposure of the peritoneal cavity is possible.

## Indications

Indications of laparoscopic and open appendectomy are described in **Table 1**.

## Relative Contraindications

- Complicated appendicitis
- Stump appendicitis (develops after previous incomplete appendectomy)
- Poor risk for general anesthesia
- Some cases of previous extensive pelvic surgery.

The general anesthesia and the pneumoperitoneum required as part of the laparoscopic procedure do increase the risk in certain groups of patients. Most surgeons would not recommend laparoscopic appendectomy in those with pre-existing disease conditions. Patients with moderate cardiac diseases and chronic obstructive pulmonary disease (COPD) should not be considered a good candidate for laparoscopy. The laparoscopic appendectomy may also be more difficult in patients who have had previous lower abdominal surgery. The elderly may also be at increased risk for complications with general anesthesia combined with pneumoperitoneum.

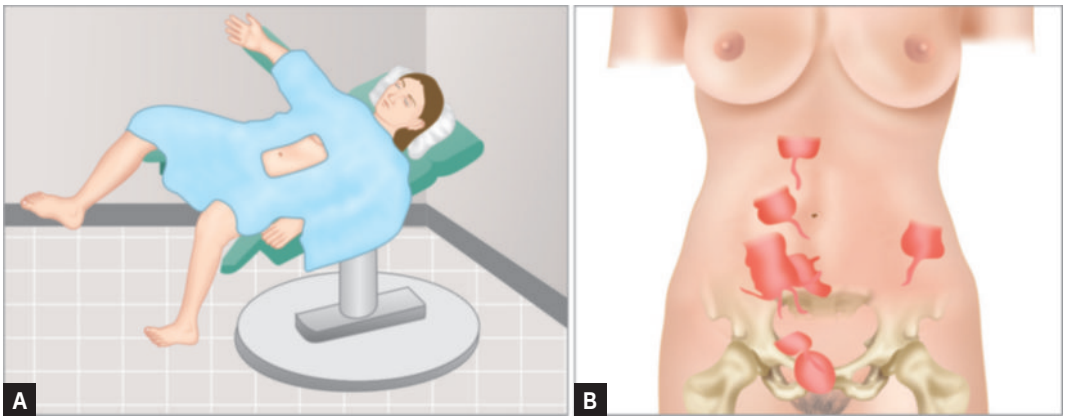
## Patient Position

In the laparoscopic approach, an orogastric tube is typically placed to decompress the stomach. The bladder can be decompressed either with a Foley catheter or by having the patient void immediately prior to entering the operating room. The patient is in supine position, arms tucked at the side. The surgeon stands on the left side of the patient with the camera-holder assistant **(Fig. 4)**. For maintaining coaxial alignment, surgeon should stand near left shoulder and monitor should be placed near right hip facing toward surgeon. In females, the lithotomy position should be preferred because there may be necessity to use uterine manipulator in difficult diagnosis **(Figs. 5A and B)**.

## Port Position

Various port placements have been advocated for laparoscopic appendectomy. These methods share the principle of triangulation of instrument ports to ensure adequate visualization and exposure of the appendix **(Figs. 6A and B)**.

- Total three trocars should be used
- Two 10-mm, umbilical and left lower quadrant (LLQ) trocars
- One 5 mm right upper quadrant (RUQ) trocar
- The RUQ trocar can be moved below the bikini line in females.




**Figs. 5A and B:** (A) Patient position in female; (B) Variation in position of appendix.


**Figs. 6A and B:** (A) Position of surgical team in appendectomy; (B) Port position in appendicectomy.



## Alternative Port and Theater Setup

In beauty conscious females, for cosmetic reason, the baseball diamond concept of port position can be altered from contralateral to ipsilateral port and three ports should be placed in such a way so that the two 5-mm ports will be below bikini line. Access should be performed by 10 mm umbilical port. Once the telescope is inside, one 5-mm port should be placed in left iliac fossa below the bikini line under vision. Second 5-mm port should be placed in right iliac fossa, just mirror image of left port. After fixing all the ports in position, one another 5-mm telescope is introduced through left iliac fossa and surgery should be performed through umbilical port (for right hand) and left iliac fossa port (for left hand) **(Fig. 7)**. In this alternative port position, 60° manipulation angle cannot be achieved and it is ergonomically difficult for surgeon, but patient gets cosmetic benefit.

This alternative port position for laparoscopic appendicectomy should not be performed in case of retrocecal appendix or perforated appendix **(Fig. 5B)**.

Alternative port position in beauty conscious female is shown in **Figure 7**.

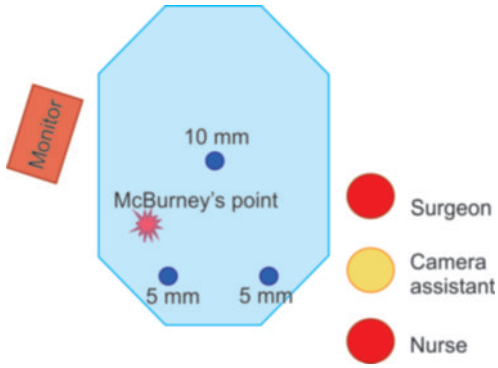



**Fig. 7:** Alternative port position.

## OPERATIVE TECHNIQUES

Pneumoperitoneum is created in the usual fashion. Three ports are used. An atraumatic grasper (Endo Babcock or Dolphin Nose Grasper) is inserted via the RUQ port, if contralateral ports are used, and through the suprapubic port, if ipsilateral port is used. The cecum is retracted upward toward the liver. In most cases, this maneuver will elevate the appendix in the optical field of the telescope.

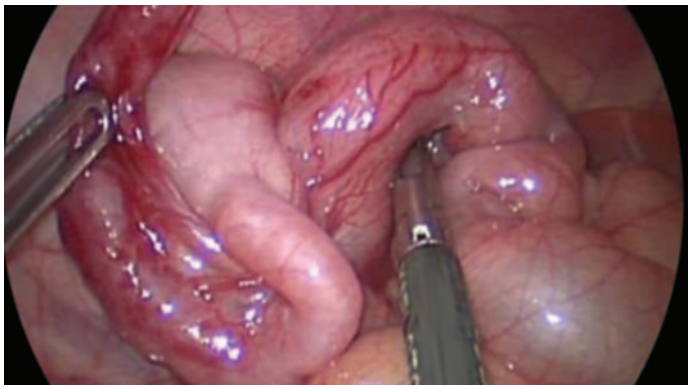
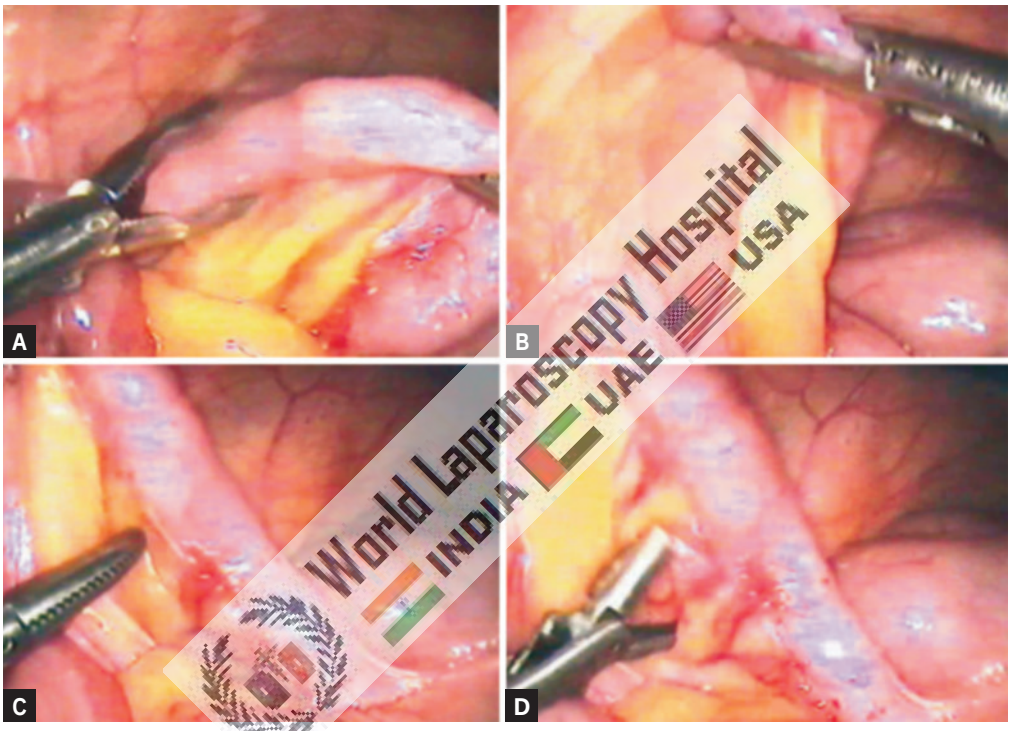


**Fig. 8:** Retraction of appendix.




**Figs. 9A to D:** Retraction of appendix and creation of a window over mesoappendix.

## Retraction of Appendix

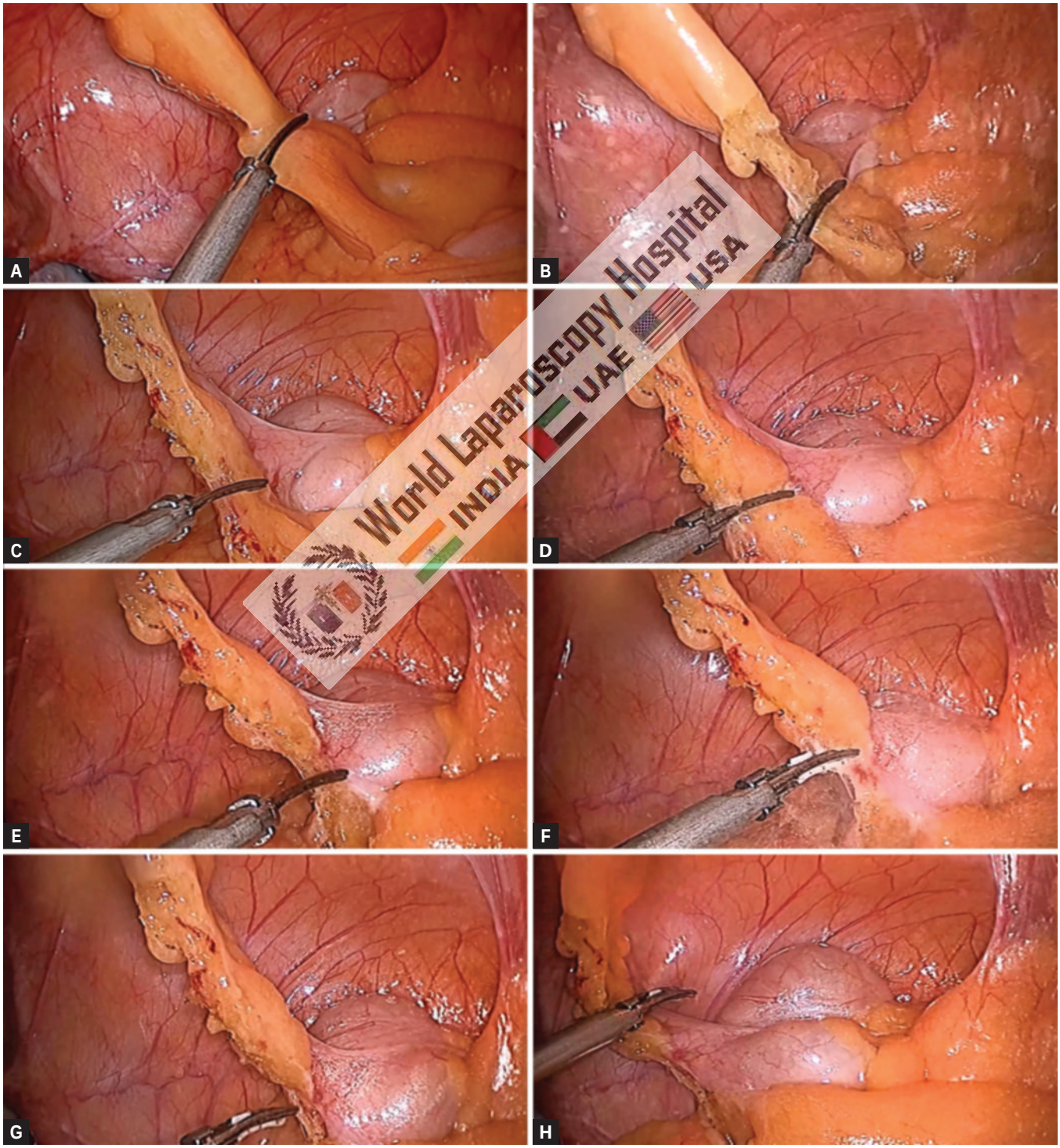
Once the diseased appendix is identified, any adhesions to surrounding structures can be lysed with a combination of blunt and sharp dissection. If a retrocecal appendix is encountered, division of the lateral peritoneal attachments of the cecum to the abdominal wall often improves visualization. The appendix is grasped at its tip with a 5-mm claw grasper via the RUQ trocar. It is held in upward position. After the pelvis is inspected, the appendix is identified, mobilized, and examined properly **(Figs. 8 and 9)**. Periappendiceal or pericecal adhesions are lysed using either bipolar or harmonics and scissors. LLQ grasper is used to create a mesenteric window behind the base of the appendix.

A dolphin nose grasper or Maryland dissector is used to create a mesenteric window under the base of the appendix. The window should be made as close as possible to the base of the appendix and should be approximately 1 cm in size **(Fig. 10)**.

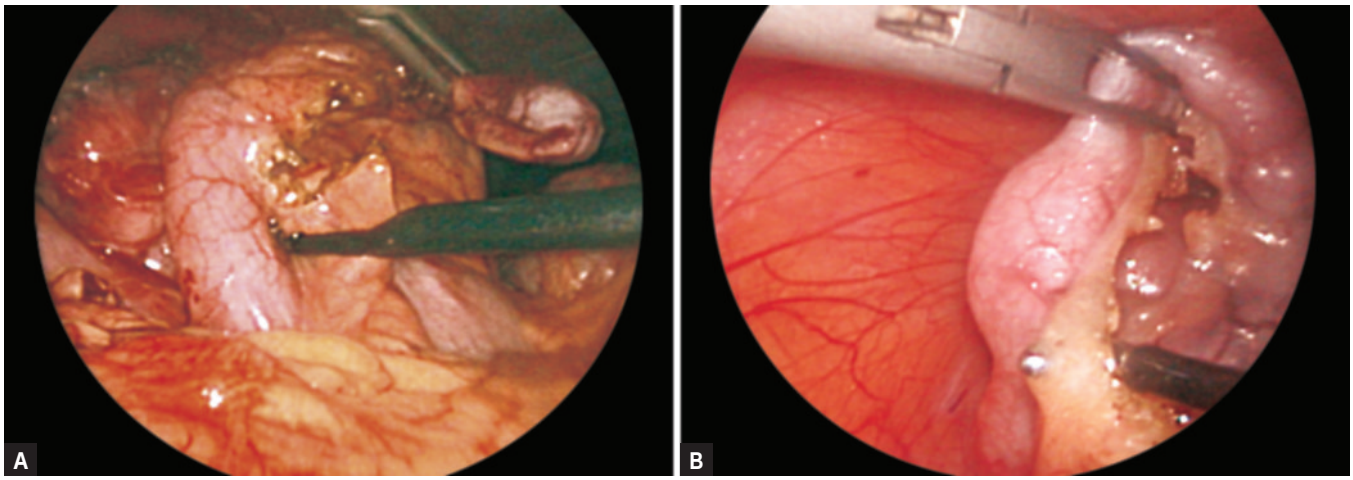
**Fig. 10:** Window in mesoappendix.

The appendiceal artery, or mesoappendix containing it, can be divided sharply between hemostatic clips, with a laparoscopic gastrointestinal anastomosis (GIA) stapler, monopolar cautery, or one of the advanced vessel ligation devices such as ultrasonic scalpel or LigaSure **(Figs. 11 and 12)**.

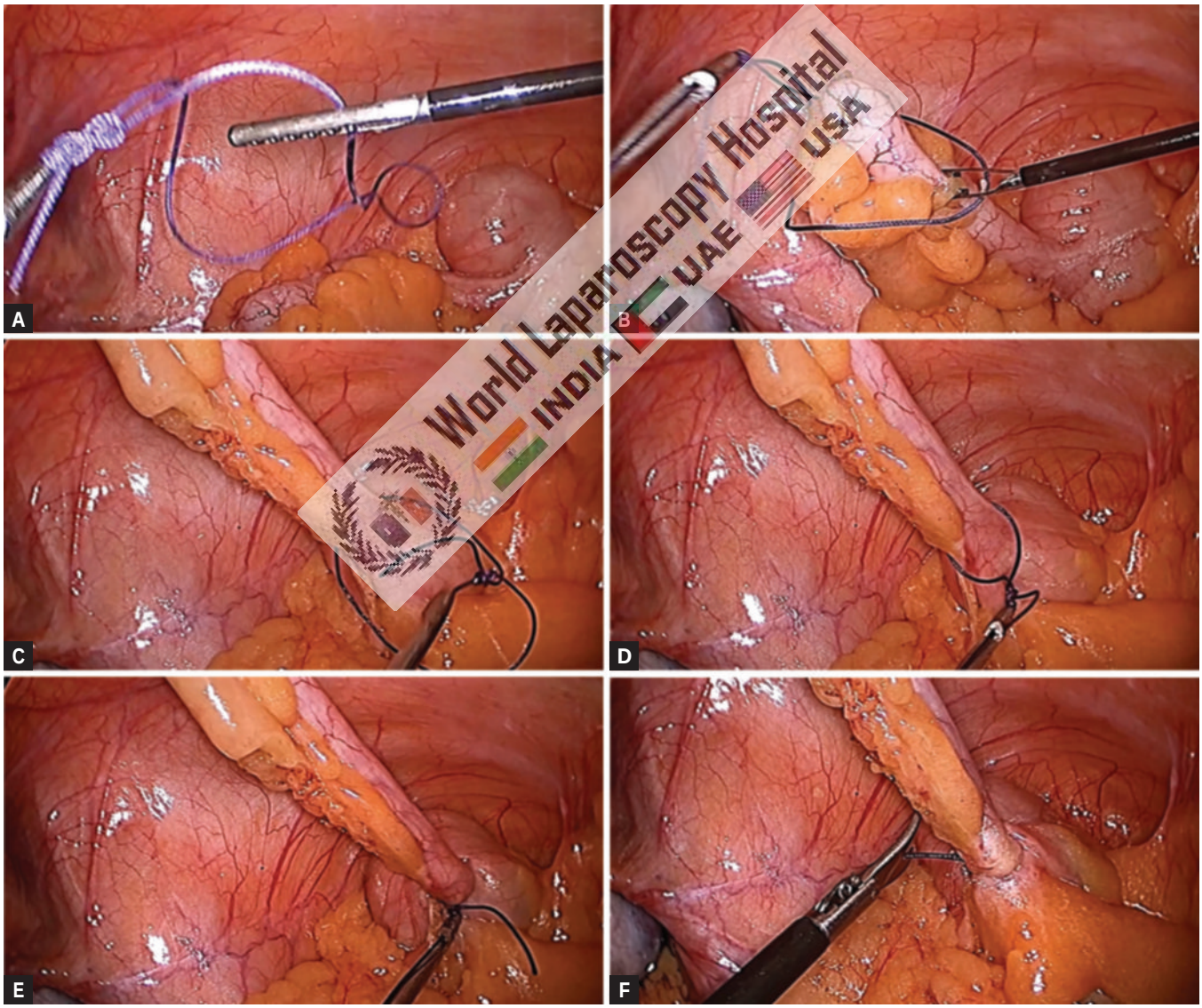
Extracorporeal knotting can be performed (Roeder's, Mishra, Meltzer, or Tayside knot) for mesoappendix as well as appendix. Two endoloop sutures are passed sequentially through one of the 5-mm ports and pushed around the base of appendix on top of each other at a distance of 3–5 mm. A third endoloop suture can be applied 6 mm distal to the second suture so that surgeon will cut between second and third knot **(Figs. 13A to F)**. If harmonic scalpel is used, only one extracorporeal knot can be used at the base of appendix and then it is cut with the harmonic scalpel 6 mm away from the knot. Harmonic will seal the appendicular end preventing any spillage.




**Figs. 11A to H:** Successive dissection of mesoappendix by harmonic scalpel.




**Figs. 12A and B:** Dissection of mesoappendix by monopolar hook.




**Figs. 13A to F:** Tying Roeder's, Meltzer's, or Mishra's knot over appendix.

The Aesculap DS Titanium Ligation Clips can also be used sometimes to secure the proximal or distal portion of the appendix. The luminal portion of the appendiceal stump is sterilized with electrosurgery to prevent spillage and contamination of peritoneal cavity. In case of perforated appendix with peritonitis, Betadine can be applied over the

stump of appendix and thorough suction and irrigation is performed either by normal saline or by Ringer's lactate solution.

After extracting the appendix out of abdominal cavity, surgeon should examine the abdomen for any possible bowel injury or hemorrhage.

### Stapler Appendicectomy

The stapling devices make laparoscopic appendectomy simpler and faster. The Multifire stapler is introduced though a 12-mm port. The appendix may be transacted by inserting an ENDO GIA instrument via the RUQ trocar (blue cartridge, 3.5), closing it around the base of the appendix and firing it. For perforated appendicitis with or without an intra-abdominal abscess, a drain is left in the RLQ and pelvis **(Figs. 14A to C)**. In stapler appendicectomy, the appendix is cleared to its attachment with the cecum, and the appendiceal base is divided using a laparoscopic GIA stapler, taking care not to leave a significant stump. It is sometimes necessary to include part of the cecum within the stapler to ensure that the staples are placed in healthy, uninfected tissue.

Extracorporeal knot (Meltzer, Roeder, or Tayside knot) should be preferred over stapler, depending on the surgeon's expertise.

### Extraction of Appendix

The appendix can be removed from the abdomen with the help of grasping forceps placed through one of the 10-mm ports. However, this may contaminate both the cannula and instrument. Alternatively, an endoloop suture, which was tied last, can be used instead of grasping forceps to pull the appendix out.

Abdomen should be examined for any possible bowel injury or hemorrhage. All the instruments should be removed carefully. The wound should be closed with suture. Use Vicryl for rectus and unabsorbable intradermal or stapler for skin. Adhesive sterile dressing should be applied over the wound.

## POSTOPERATIVE CARE AFTER APPENDECTOMY

Patients may be discharged once they tolerate a regular diet, usually in 2 days. Three to five days of intravenous or oral antibiotics is recommended for perforated appendicitis after appendectomy. Patients with perforated appendicitis often develop an ileus postoperatively regardless of the surgical approach. Thus, diet should only be advanced as the clinical situation warrants.

## RISK FACTORS IN LAPAROSCOPIC APPENDECTOMY

The mortality associated with appendicitis is low but can vary by geographic locations. In developed countries, the mortality rate is between 0.09 and 0.24%. In developing countries, the mortality rate is higher, between 1 and 4%. Overall complication rates of 8.2–31.4%, wound infection rates of 3.3–10.3%, and pelvic abscess rates of 9.4% have been reported following appendectomy.

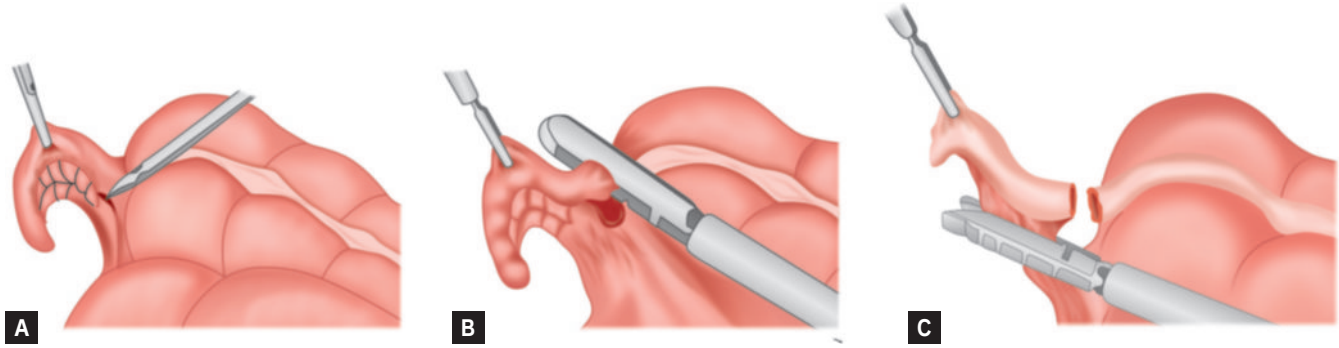
### Missed Diagnosis

There is report also of mucinous cystadenoma of the cecum missed at laparoscopic appendectomy. Less than 1% of all patients with suspected acute appendicitis are found to have an associated malignant process. During conventional appendectomy, through a laparotomy incision, the cecum and the appendix are easily palpated, and an obvious mass can be detected and properly managed at the time of appendectomy. The inability to palpate any mass is an inherent inadequacy of laparoscopic surgery.

### Bleeding

Bleeding may occur from the mesoappendix, omental vessels, or retroperitoneum. Bleeding is usually recognized intraoperatively via adequate exposure, lighting, and suction. It is recognized postoperatively by tachycardia, hypotension, decreased urine output, anemia, or other evidence of hemorrhagic shock.






**Figs. 14A to C:** Stapler appendicectomy.

## Visceral Injury

Risk of accidental burns is higher with monopolar system because electricity seeks the path of least resistance, which may be adjacent bowel. In a bipolar system since the current does not have to travel through the patient, there is little chance of injury to remote viscera. In laparoscopic appendectomy, only bipolar current should be used. Laparoscopists should also routinely explore the rest of the abdomen.

## Wound Infection

Proper tissue retrieval technique is required to prevent wound infection after appendectomy.

If ensues, it is recognized by erythema, fluctuation, and purulent drainage from port sites. The absence of wound infections after laparoscopic appendectomy can be attributed to the practice of placing the appendix in a sterile bag or into the trocar sleeve prior to removal from the abdomen. The regular use of retrieval bag is a very good practice for preventing infection of the wound.

## Incomplete Appendectomy

If surgeon is not experienced, he/she is likely to leave the stump of the appendix too long. There is a report of intra-abdominal abscess formation due to retained fecalith after laparoscopic appendectomy. It is important that the surgeons performing laparoscopic appendectomy should remove fecalith if found, and the stump of appendix should not be big enough to contain any remaining fecalith. Incomplete appendectomy is a result of ligation of the appendix too far from the base.

It may lead to recurrent appendicitis, which presents with symptoms and signs of appendicitis even after laparoscopic appendectomy.

Some surgeons prefer stapling of the appendiceal stump for laparoscopic appendectomy for the treatment of all forms of appendicitis **(Figs. 14 and 15)**. But most of the surgeons now agree that ligation of the appendectomy stump is the best approach **(Figs. 16 to 18)**. There is report of slippage of clip, residual appendicitis followed by abscess formation after using clip for appendiceal stump. The ligation should be performed by using endoloop, an intracorporeal surgeon's knot, or done extracorporeally using a Meltzer's knot or Tayside knot. The security of the knot is essential. It is influenced by the proper port location and experience of the surgeon.

## Leakage of Purulent Exudates

It is usually seen intraoperatively while dissecting appendix. Copious irrigation and suction followed by continued antibiotics can prevent this complication until patient is afebrile with a normal white blood cell count. Retrieval bag should be used to prevent the spillage of infected material from the appendiceal lumen.



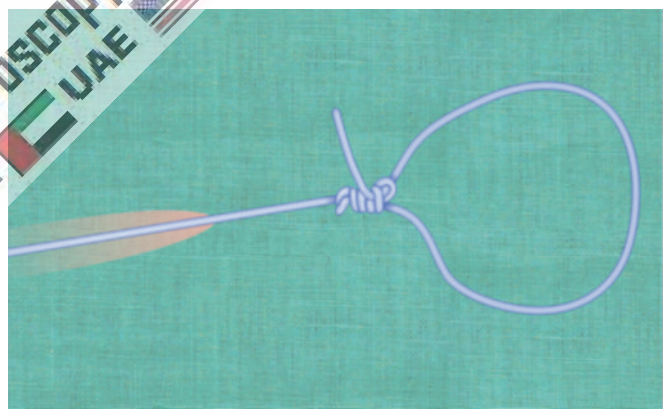


**Fig. 16:** Roeder's knot at the time of appendicectomy.

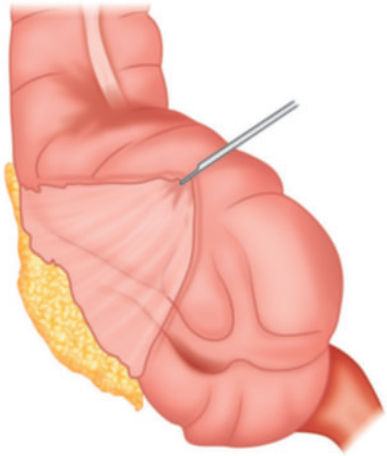


**Fig. 15:** Retrocecal appendix.

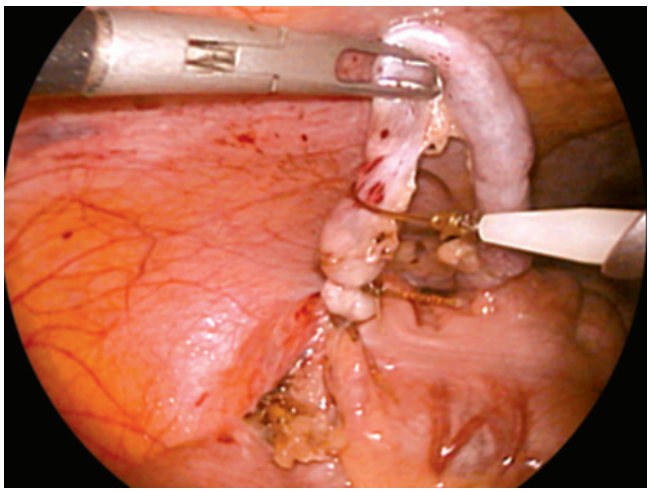
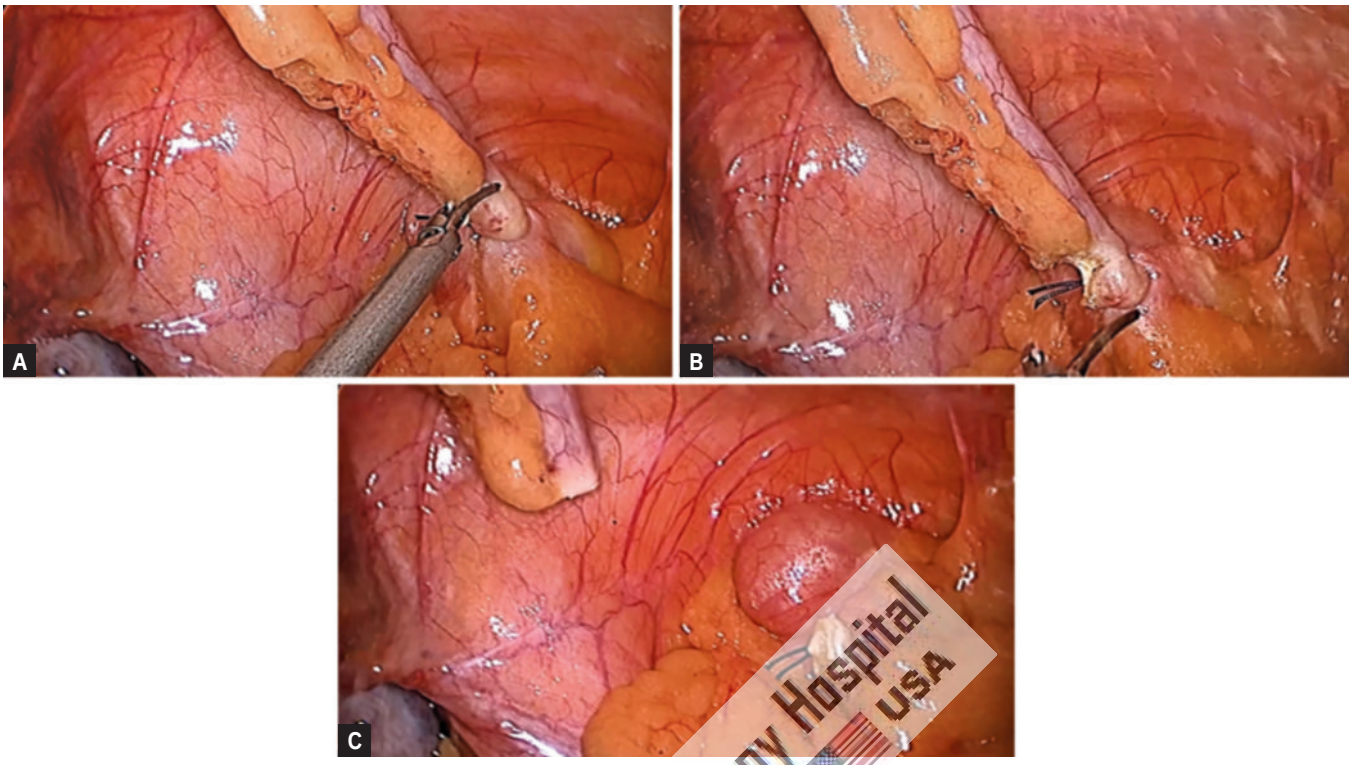


**Fig. 17:** Three Roeder's or Meltzer's knots over appendix.




**Figs. 18A to C:** Amputation of appendix with harmonic scalpel.



## Intra-abdominal Abscess

This postoperative morbidity is recognized by prolonged ileus, sluggish recovery, rising leukocytosis, spiking fevers, tachycardia, and rarely a palpable mass. After confirmation of the intra-abdominal abscess, drainage of pus followed by antibiotic therapy is essential. Rarely, laparotomy may be required.

## Hernia

Trocar site hernia as visible or palpable bulge is sometimes encountered. Possible occult hernia is manifested by pain or symptoms of bowel obstruction.

## Laparoscopic-assisted Appendectomy

It has been described for cases in which the proper endoscopic instruments and sutures are unavailable. The laparoscope facilitates the diagnosis of acute appendicitis and a grasper is passed through an accessory trocar located just over the McBurney's point. The tip of the appendix is grasped and then pulled along with cannula and grasper **(Figs. 19 and 20)**. Once the appendix is exteriorized, the routine appendectomy is performed through this small abdominal incision. This procedure usually takes less time than total laparoscopic appendectomy, but it has more incidence of incomplete appendectomy.

## Perforated Appendix

Perforation of the appendix can cause intraperitoneal dissemination of pus and fecal material and generalized peritonitis. These patients are typically quite ill and may be septic or hemodynamically unstable, thus requiring preoperative resuscitation. The diagnosis is not always appreciated before exploration.

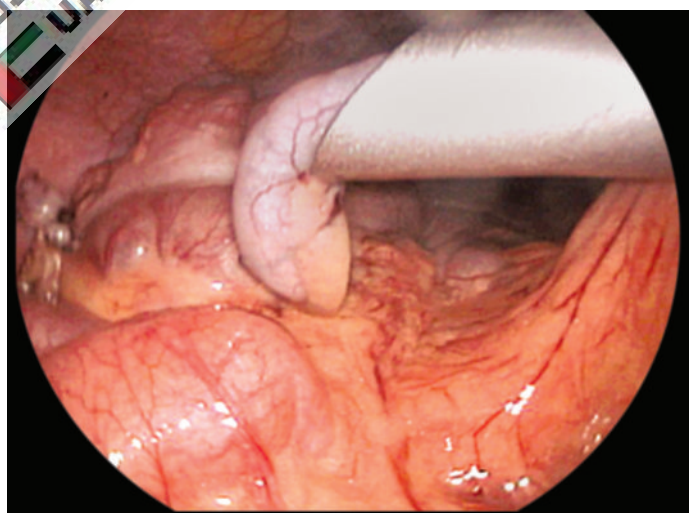


**Fig. 19:** Amputated appendix inside the cannula.

For patients who are septic or unstable, and for those who have perforation of the appendix or generalized peritonitis, emergency appendectomy is required, as well as drainage and irrigation of the peritoneal cavity. Emergency appendectomy in this setting can be accomplished open or laparoscopically; the choice is determined by surgeon preference with consideration of patient condition and local resources.

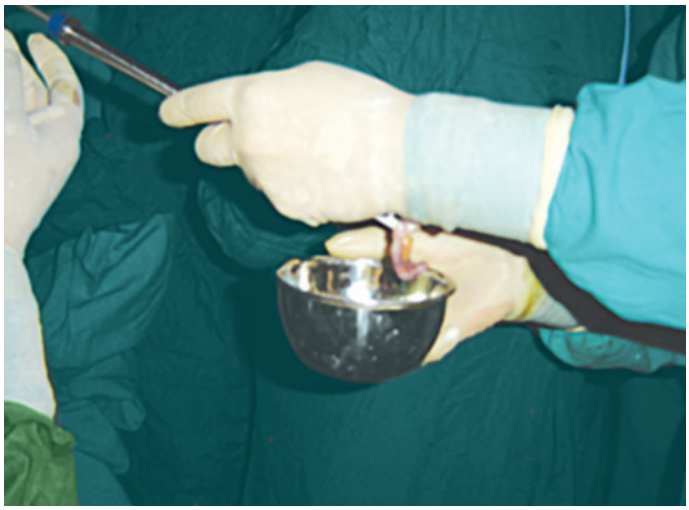


**Fig. 20:** Appendix hidden in cannula is ejected out.

## DISCUSSION

Laparoscopic appendectomy has gained lot of attention around the world. However, the role of laparoscopy for appendectomy, one of the most common indications, remains controversial. Several controlled trials have been conducted, of which some are in favor of laparoscopy, and others not. There is also diversity in the quality of the randomized controlled trials. The main variable in these trials are following parameters:

- Number of patients in trial
- Withdrawal of cases
- Exclusion of cases
- Blinding
- Intention to treat analysis
- Publication biases
- Local practice variation
- Prophylactic antibiotic used
- Follow-up failure.

Without proper attention to the detail of all the parameters, it is very difficult to draw a conclusion. It has been found that there is a hidden competition between laparoscopic surgeons and the surgeons who are still doing conventional surgery, and this competition influences the result of study. One should always think of laparoscopic surgery and open procedures as being complimentary to each other.

A successful outcome requires greater skills from the operator. The results of many comparative studies have shown that outcome of laparoscopic appendectomy was influenced by the experience and technique of the operator. Minimal access surgery requires different skills and technological knowledge. With a clear diagnosis of complicated appendicitis, the skill and experience of the surgeon should be considered for the selection of operating method. Surgeons should perform the procedure with which they are more comfortable.

Laparoscopic appendectomy is equally safe and can provide less postoperative morbidity in experienced hands, as in open appendectomy. Most cases of acute appendicitis can be treated laparoscopically. Laparoscopic appendectomy is a useful method for reducing hospital stay, complications, and early return to normal activity. With better training in minimal access surgery now available, the time has arrived for it to take its place in the surgeon's repertoire. As surgeons gained more experience with the technique, laparoscopic appendectomy became feasible for patients with perforated appendicitis undergoing immediate surgery.

## BIBLIOGRAPHY


1. Addiss DG, Shaffer N, Fowler BS, Tauxe RV. The epidemiology of appendicitis and appendectomy in the United States. Am J Epidemiol. 1990;132:910-25.
2. Alexander F, Magnuson D, DiFiore J, Jirousek K, Secic M. Specialty versus generalist care of children with appendicitis: an outcome comparison. J Pediatr Surg. 2001;36:1510-13.
3. Azzie G, Salloum A, Beasley S, Maoate K. The complication rate and outcomes of laparoscopic appendicectomy in children with perforated appendicitis. Pediatr Endosurgery Innovative Techniques. 2004;8:19-23. [online] Available from: http://www.liebertonline.com/doi/abs/10.1089/109264104773513098. [Last accessed June, 2020].
4. Bamieghbal B, Al-Hindi S, Davies MRQ. Laparoscopic appendectomy with appendix mass in children. Pediatr Endosurgery Innovative Techniques. 2004;8:25-30. [online] Available from: http://www.liebertonline.com/doi/abs/10.1089/109264-104773513106. [Last accessed June, 2020].
5. Beldi G, Muggli K, Helbling C, Schlumpf R. Laparoscopic appendectomy using endoloops: a prospective, randomized clinical trial. Surg Endosc. 2004;18:749-50.
6. Blewett CJ, Krummel TM. Perforated appendicitis: past and future controversies. Semin Pediatr Surg. 1995;4:234-8.
7. Bova R, Meagher A. Appendicitis in HIV-positive patients. Aust N Z J Surg. 1998;68:337.
8. Bratton SL, Haberkern CM, Waldhausen JH. Acute appendicitis risks of complications: age and medical insurance. Pediatrics. 2000;106:75-8.
9. Charfi S, Sellami A, Affes A, Yaïch K, Mzali R, Boudawara TS, et al. Histopathological findings in appendectomy specimens: a study of 24,697 cases. Int J Colorectal Dis. 2014;29:1009.
10. Chen C, Botelho C, Cooper A, Hibberd P, Parsons SK. Current practice patterns in the treatment of perforated appendicitis in children. J Am Coll Surg. 2003;196:212-21.
11. Ciarrocchi A, Amicucci G. Laparoscopic versus open appendectomy in obese patients: a meta-analysis of prospective and retrospective studies. J Minim Access Surg. 2014;10:4-9.
12. David IB, Buck JR, Filler RM. Rational use of antibiotics for perforated appendicitis in childhood. J Pediatr Surg. 1982;17:494-500.
13. Fleming FJ, Kim MJ, Messing S, Gunzler D, Salloum R, Monson JR, et al. Balancing the risk of postoperative surgical infections: a multivariate analysis of factors associated with laparoscopic appendectomy from the NSQIP database. Ann Surg. 2010;252:895-900.
14. Flum DR, Steinberg SD, Sarkis AY, Wallack MK. Appendicitis in patients with acquired immunodeficiency syndrome. J Am Coll Surg 1997;184:481.
15. Guller U, Hervey S, Purves H, Muhlbaier LH, Peterson ED, Eubanks S, et al. Laparoscopic versus open appendectomy:

outcomes comparison based on a large administrative database. Ann Surg. 2004;239:43-52.
16. Harrell AG, Lincourt AE, Novitsky YW, Rosen MJ, Kuwada TS, Kercher KW, et al. Advantages of laparoscopic appendectomy in the elderly. Am Surg. 2006;72:474-80.
17. Heiss K. Victim or player: pediatric surgeons deal with quality improvement and the information age. Semin Pediatr Surg. 2002;11:3-11.
18. Himal HS. Minimally invasive (laparoscopic) surgery. Surgical Endosc. 2002;16:1647-52.
19. Horattas MC, Guyton DP, Wu D. A reappraisal of appendicitis in the elderly. Am J Surg. 1990;160:291.
20. Horwitz JR, Custer MD, May BH, Mehall JR, Lally KP. Should laparoscopic appendectomy be avoided for complicated appendicitis in children? J Pediatr Surg. 1997;32:1601-3.
21. Hui TT, Major KM, Avital I, Hiatt JR, Margulies DR. Outcome of elderly patients with appendicitis: effect of computed tomography and laparoscopy. Arch Surg. 2002;137:995.
22. Ikeda H, Ishimaru Y, Takayasu H, Okamura K, Kisaki Y, Fujino J. Laparoscopic vs open appendectomy in children with uncomplicated and complicated appendicitis. J Pediatr Surg. 2004;39:1680-5.
23. Kanona H, Al Samaraee A, Nice C, Bhattacharya V. Stump appendicitis: a review. Int J Surg. 2012;10:425-8.
24. Kokoska ER, Silen ML, Tracy TF, Dillon PA, Cradock TV, Weber TR. Perforated appendicitis in children: risk factors for the development of complications. Surgery. 1998;124:619-26.
25. Krisher SL, Browne A, Dibbins A, Tkacz N, Curci M. Intra-abdominal abscess after laparoscopic appendectomy for perforated appendicitis. Arch Surg. 2001;136:438-41.
26. Lintula H, Kokki H, Vanamo K, Antila P, Eskelinen M. Laparoscopy in children with complicated appendicitis. J Pediatr Surg. 2002;37:1317-20.
27. Lintula H, Kokki H, Vanamo K, Valtonen H, Mattila M, Eskelinen M. The costs and effects of laparoscopic appendectomy in children. Arch Pediatr Adolesc Med. 2004;158:34-7.
28. Lintula H, Kokki H, Vanamo K. Single-blind randomized clinical trial of laparoscopic vs open appendicectomy in children. Br J Surg. 2001;88:510-4.
29. Lund DP, Murphy EU. Management of perforated appendicitis in children: a decade of aggressive treatment. J Pediatr Surg. 1994;29:1130-4.
30. Martin LC, Puente I, Sosa JL, Bassin A, Breslaw R, McKenney MG, et al. Open vs laparoscopic appendectomy: a prospective randomized comparison. Ann Surg. 1995;222:256-62.
31. Merhoff AM, Merhoff GC, Franklin ME. Laparoscopic vs open appendectomy. Am J Surg. 2000;179:375-8.
32. Moraitis D, Kini SU, Annamaneni RK, Zitsman JL. Laparoscopy in complicated pediatric appendicitis. JSLS. 2004;8:310-13.
33. Nathaniel J, Soper L, Brunt M, Kerbl K. Laparoscopic general surgery. N Eng J Med. 1994;330:409-19.
34. Newman K, Ponsky T, Kittle K, Dyk L, Throop C, Gieseker K, et al. Appendicitis 2000: variability in practice, outcomes, and resource utilization at thirty pediatric hospitals. J Pediatr Surg. 2003;38:372-9.
35. Nguyen NT, Zainabadi K, Mavandadi S, Paya M, Stevens CM, Root J, et al. Trends in the utilization and outcomes of laparoscopic vs open appendectomy. Am J Surg. 2004;188:813-20.
36. Paajanen H, Kettunen J, Kostiainen S. Emergency appendectomies in patients over 80 years. Am Surg. 1994;60:950.
37. Phillips S, Walton JM, Chin I, Farrokhyar F, Fitzgerald P, Cameron B. Ten year experience with pediatric laparoscopic appendectomy: are we getting better? J Pediatr Surg. 2005;40:842-5.
38. Pittman-Waller VA, Myers JG, Stewart RM, Dent DL, Page CP, Gray GA, et al. Appendicitis: why so complicated? Analysis of 5755 consecutive appendectomies. Am Surg. 2000;66:548-54.
39. Reich H. Laparoscopic bowel injury. Surg Laparosc Endosc. 1992;2:74-8.
40. Rymer B, Forsythe RO, Husada G. Mucocoele and mucinous tumours of the appendix: a review of the literature. Int J Surg. 2015;18:132.
41. Schrenk P, Woisetschlager R, Rieger R, Wayand W. Mechanism, management, and prevention of laparoscopic bowel injuries. Gastrointest Endosc. 1996;43:572-4.
42. Siddharthan RV, Byrne RM, Dewey E, Martindale RG, Gilbert EW, Tsikitiset VL, et al. Appendiceal cancer masked as inflammatory appendicitis in the elderly, not an uncommon presentation (Surveillance Epidemiology and End Results (SEER)-Medicare Analysis). J Surg Oncol. 2019;120:736-9.
43. Simpson J, Humes D, Speake W. Appendicitis. Clin Evid BMJ. 20076;2007:0408. [online] Available from: www.clinicalevidence.com/ceweb/conditions/dsd/0408/0408_keymessages.jsp. [Last accessed June, 2020].
44. Tang E, Ortega AE, Anthone GJ, Beart RW Jr. Intra-abdominal abscesses following laparoscopic and open appendectomies. Surg Endosc. 1996;10:327-8.
45. Tannoury J, Abboud B. Treatment options of inflammatory appendiceal masses in adults. World J Gastroenterol. 2013;19:3942.
46. Utpal De. Laparoscopic versus open appendicectomy: an Indian perspective. J Minimal Access Surg. 2005;1:15-20.
47. Vernon AH, Georgeson KE, Harmon CM. Pediatric laparoscopic appendectomy for acute appendicitis. Surg Endosc. 2003;18:75-9.
48. Voyles C, Tucker R. A better understanding of monopolar electrosurgery and laparoscopy. In: Brooks D (Ed). Current Techniques in Laparoscopy. Philadelphia, Pa: Current Medicine; 1994. pp. 1-10.
49. Voyles CR, Tucker RD. Education and engineering solutions for potential problems with laparoscopic monopolar electrosurgery. Am J Surg. 1992;164:57-62.
50. Wagner M, Aronsky D, Tschudi J, Metzger A, Klaiber C. Laparoscopic stapler appendectomy: a prospective study of 267 consecutive cases. Surg Endosc. 1996;10:895-9.
51. Watters JM, Blakslee JM, March RJ, Redmond ML. The influence of age on the severity of peritonitis. Can J Surg. 1996;39:142.
52. Whitney TM, Macho JR, Russell TR, Bossart KJ, Heer FW, Schecter WP. Appendicitis in acquired immunodeficiency syndrome. Am J Surg. 1992;164:467-70.
53. Yong JL, Law WL, Lo CY, Lam CM. A comparative study of routine laparoscopic versus open appendectomy. JSLS. 2006;10:188-92.