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Management of Appendicitis

Vishal P. Bhabhor

Abstract

Appendicitis is one of the most common causes of acute abdomen with life time risk between 6 and 8% and it's a most common non obstetric surgical emergency during pregnancy. Appendicitis is claimed to be unknown in the villages of India and China in paper by A. M. Spencer. The reason is simply due to the fact that diagnostic facilities do not exist and cases are not recognized. So diagnosing acute appendicitis accurately and efficiently can reduce morbidity and mortality from perforation and other complications. Surgical intervention is the first choice for appendicitis with medical management being reserved for special situations.

Keywords: diagnosis of appendicitis, appendectomy, appendectomy in pregnancy

1. Introduction

It is widely accepted that the inciting event in most instances of appendicitis is obstruction of the appendiceal lumen. This may be due to lymphoid hyperplasia, inspissated stool (fecolith), or some other foreign body. In this chapter clinical signs, diagnostic tools and surgical approach towards appendicitis is covered.

2. Clinical features

1. Pain: first noticed in periumbalical region with progressive inflammation of appendix, the parietal peritoneum in RIF becomes irritated, producing more intense, constant and localized somatic pain
2. Pyrexia: usually low-grade, and occur within first 24 hours of onset of pain with corresponding increase in the pulse rate
3. Tenderness: seen on right iliac fossa by superficial to deep palpation
4. Rebound tenderness: (Blumberg sign) asking the patient to cough or gentle percussion over the site of maximum tenderness will elicit rebound tenderness
5. Rovsing sign: elicited by pressure over left iliac fossa causing pain over right iliac fossa
6. Psoas sign: stretching of right thigh causing irritation to inflamed appendix over psoas muscle
7. Obturator sign: In supine position with passive rotation of the flexed right hip causing pain

8. Baldwin's sign: A hand is placed over the right flank and patient is asked to raise the right lower limb with knee extended causes pain
9. Ligat's sign: Hyperaesthesia in Sherren's triangle (formed by lines joining the umbilicus, right anterior superior iliac spine and symphysis pubis) is an occasional but inconstant accompaniment of gangrenous appendicitis

3. Differential diagnosis

- Children:
 1. Gastro enteritis
 2. Mesenteric adenitis
 3. Meckel's diverticulitis
 4. Intussusception
 5. Henoch-Schonlein purpura
 6. Right Lobar pneumonia
- Adult:
 1. Regional enteritis
 2. Ureteric colic
 3. Perforated peptic ulcer
 4. Torsion testis
 5. Pancreatitis
 6. Rectus sheath hematoma
- Adult female:
 1. Mittelschmerz
 2. PID
 3. Ectopic pregnancy
 4. Torsion/rupture of ovarian cyst
 5. Endometriosis
- Elderly:
 1. Diverticulitis
 2. Intestinal obstruction

- 3. Colonic carcinoma
- 4. Mesenteric infarction
- 5. Leaking aortic aneurysm

4. Investigations

Despite advances in other diagnostic modalities, appendicitis remains a diagnosis based primarily on history and physical examination.

4.1 Alvarado score

Alvarado scoring system is purely based on history, clinical examination and few laboratory tests and is very easy to apply (Table 1) [1].

Symptoms	Score
Migratory right iliac fossa pain	1
Anorexia	1
Nausea/vomiting	1
Signs	
Tenderness in right iliac fossa	2
Rebound tenderness	1
Elevated temperature	1
Laboratory findings	
Leucocytosis	2
Shift to left of neutrophils	1
Total score	10

Probability of acute appendicitis is decided by score which as following:
Score less than 5: Not sure.
Score between 5 and 6: Compatible.
Score between 6 and 9: Probable.
Score more than 9: Confirmed.

Table 1.
Alvarado scoring for appendicitis.

4.2 Leucocytosis

It is clear that 80–85 percent of patients with acute appendicitis will have a total white blood cell count of over 10000/m³. Neutrophilia of >75 percent will occur in 78 percent of patients. However, the white cell count is raised in 25–70 percent of patients with other causes of acute right iliac fossa pain.

A raised white cell count is highly sensitive for acute appendicitis, it is rendered almost useless by a low specificity and it has little diagnostic value.

4.3 Serum fibrinogen

Fibrinogen is an acute-phase reactant, meaning that elevated fibrinogen levels can be seen the following conditions:

- Inflammation
- Tissue damage/trauma
- Infection
- Cancer

As the acute appendicitis is an acute inflammatory condition serum fibrinogen is useful as novel indicator of ongoing inflammatory process.

4.4 Plain radiograph

However, there is no single sign that is pathognomic of acute appendicitis in a plain film. Brooks et al. described (1965) several signs in a case of acute appendicitis.

- a. Presence of appendicolith.
- b. Sentinel loop—dilated atonic containing fluid level present in right iliac fossa.
- c. Dilated caecum.
- d. Widening/blurring of preperitoneal fat line.
- e. Haziness in right lower part.
- f. Scoliosis concave to right.
- g. Right lower quadrant mass indenting caecum.
- h. Blurring of right psoas outline.
- i. Gas in the appendix.

Plain radiograph has less specificity. It has similar findings and normal findings as well as in other conditions.

Furthermore, irradiation hazard s especially to two groups' most frequently requiring elucidation, namely women of reproductive age and children, as well as the cost and overloading of radiology departments make this investigation of low diagnostic yield unattractive.

4.5 Ultrasound

If the appendix can be seen on ultrasound examination, this is taken to indicate the presence of acute appendicitis and idea about its position [2]. Structure which is blind-ended, immobile, non-compressible and cannot be displaced by ultrasound probe is appendix. The eco density of appendicular lumen is varying and with changed mucosa and thickened wall gives picture of a bull's eye on ultrasound.

There may be presence of fluid or faecolith in the lumen of the appendix confirming the appendicitis. The ultrasound examination will be non-diagnostic in

3–11 percent of cases because of pain, guarding, obesity or overlying gas. Among seven studies in literature, the sensitivity ranges from 75 to 89 percent and the specificity from 86 to 100 percent. Poorer results are also reported for retrocaecal appendices, early appendicitis and perforated appendices.

In the hands of expert ultrasound is highly specific, along with that it has further advantages. Diseases such as mesenteric adenitis, terminal ileitis, ureteric stones and some gynecological disorders can be accurately diagnosed by ultrasound which may not require surgery. In pregnancy ultrasound has major diagnostic role. Need of expertise and special equipment are major disadvantages. Other than this it's difficult to use in obese patients and distended abdomen and low sensitivity in some studies are also disadvantages of the ultrasound.

4.6 CT scanning

Initial studies evaluated sequential (nonhelical) CT scanning in the diagnosis of appendicitis (**Figure 1**) [2].

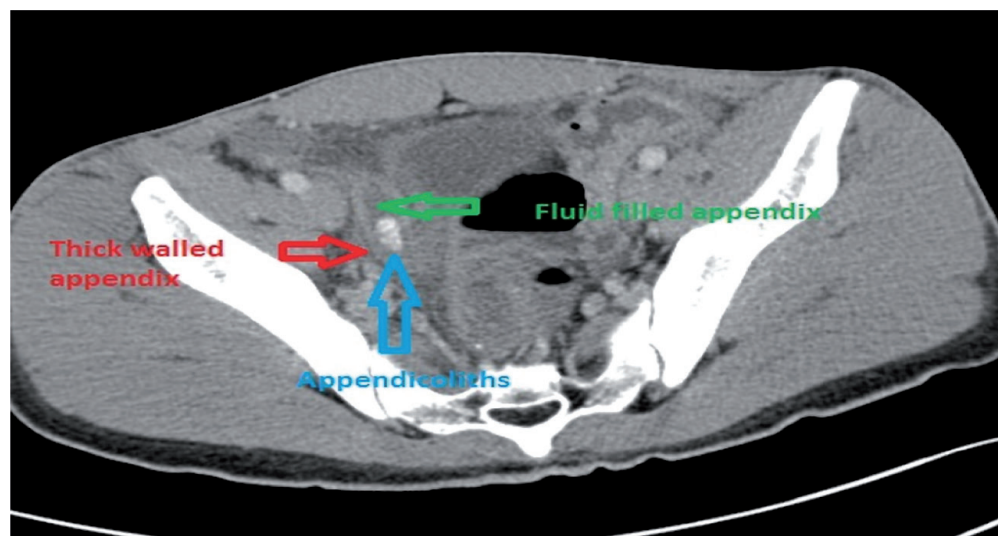


Figure 1.

Showing inflamed appendix arrows (single headed) pointing to abscess (https://www.google.com/url?sa=i&url=https%3A%2F%2Fradiopaedia.org%2Fcases%2Facute-appendicitis-25&psig=AOvVaw2YLkUq9GxMka1g1e4cq3Oo&ust=1626969528328000&source=images&cd=vfe&ved=0CAgQjRxqFwoTCJCyt_zD9PECFQAAAAAdAAAAABAD).

4.7 Diagnostic peritoneal aspiration or lavage

Peritoneum was punctured with fine bore catheter to aspirate fluid which can detect pus or an abnormal number of leucocytes which can be seen in acute appendicitis. Other than appendicitis gynecological infections and mesenteric adenitis may have same results in aspirated fluid examination. Normal findings of aspiration usually rule out all above mentioned conditions.

4.8 Radio isotope scanning

Two types of imaging modalities are used:

1. Radiolabelled white blood cell (Tc^{99m} WBC).
2. Immunoglobulin G (Tc^{99m} IgG).

These techniques rely on the localization of the leukocyte and IgG at the site of appendiceal inflammation, with the use of scintigraphy, the inflamed tissue is observed in the right lower quadrant.

The true potential usefulness of these studies occurs in - patient with persistent symptoms and negative ultrasound and CT studies.

4.9 Diagnostic laparoscopy

Laparoscopy has the attraction of being the only investigation that can view the appendix directly. The criteria used for the diagnosis of acute appendicitis are the identification of an inflamed appendix or the presence of sign of inflammation in the right iliac fossa when no other pathology can be found to account.

Huffman summed up the science of acute appendicitis in laparoscopy:

- Partial or complete visualization of the inflamed appendix.
- Pus in right iliac fossa.
- Omentum adherent to the structure of right iliac fossa.
- Inflammation of pericaecal tissues.

The major disadvantage of laparoscopy is its invasiveness. It requires a general anesthesia (although some perform laparoscopy under local anesthesia) and is in fact an operation that may result in many of the complications of an abdominal procedure.

4.10 Histopathological diagnosis of acute appendicitis

Histopathology is considered the gold standard for confirmation of the diagnosis of acute appendicitis [3]. The histologic criterion for the diagnosis of acute appendicitis is neutrophilic infiltration of the muscularis propria (**Figures 2–10**).



Figure 2.
Microscopy of normal appendix, showing the lumen (low power).

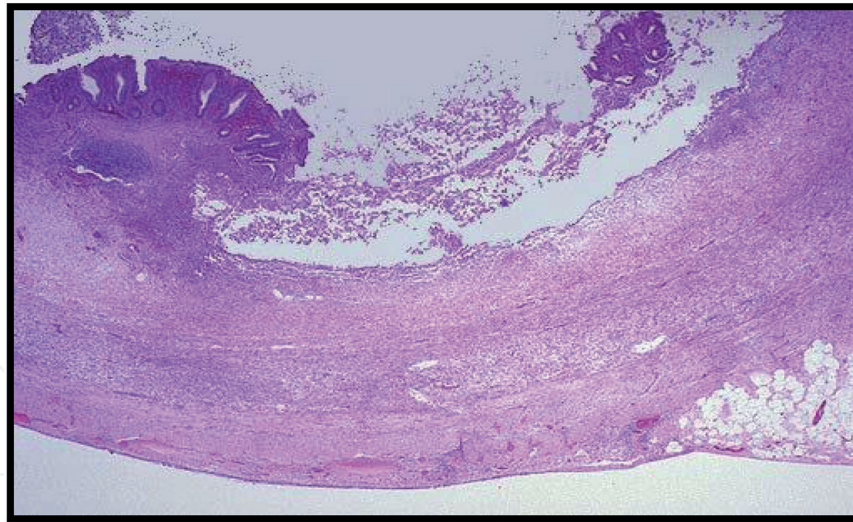


Figure 3.
Microscopy of acute appendicitis is marked by mucosal inflammation and necrosis.

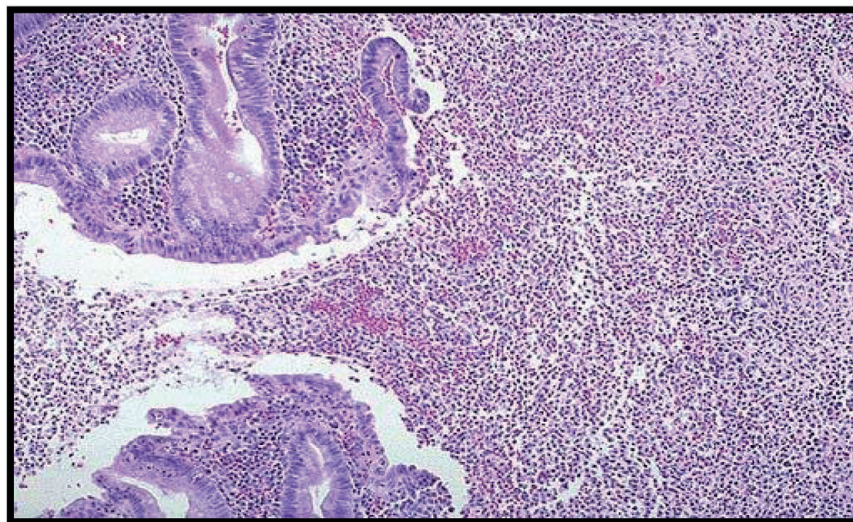


Figure 4.
Acute appendicitis: (Low power) Mucosa shows ulceration and undermining by extensive neutrophilic exudates.

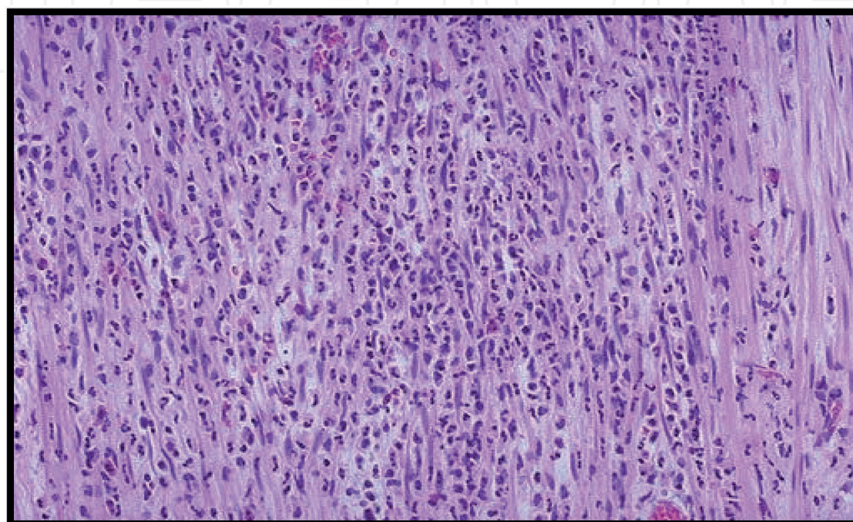


Figure 5.
Acute appendicitis: (High power) Neutrophils extend into and through the wall of appendix.



Figure 6.
Gross specimen: Normal appendix.

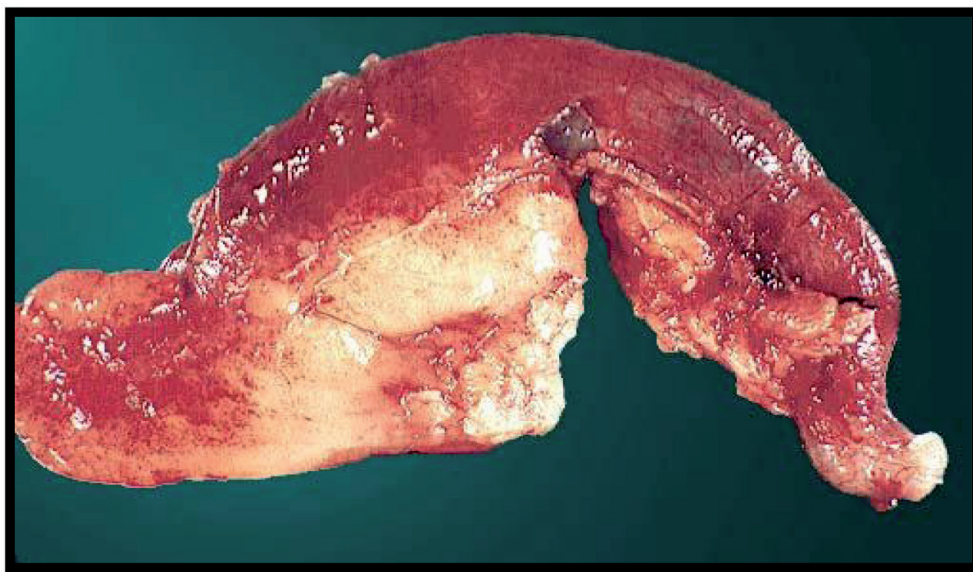


Figure 7.
Gross specimen: Acute appendicitis.



Figure 8.
Gross specimen: Appendix cut open with fecoliths in the lumen.

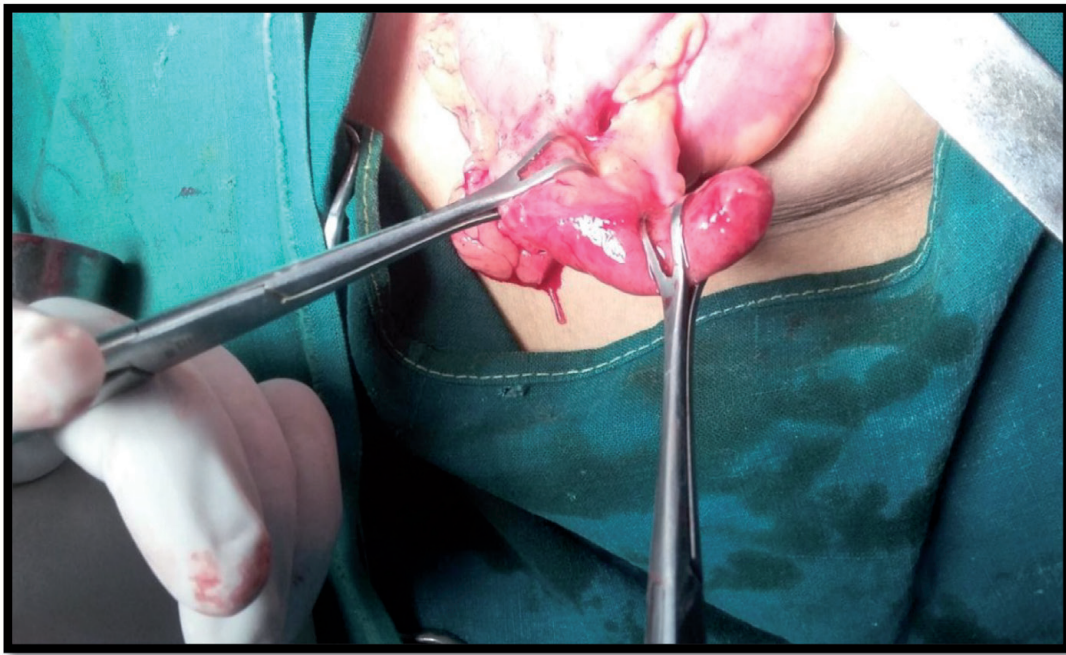


Figure 9.
Gross specimen: Acute appendicitis.

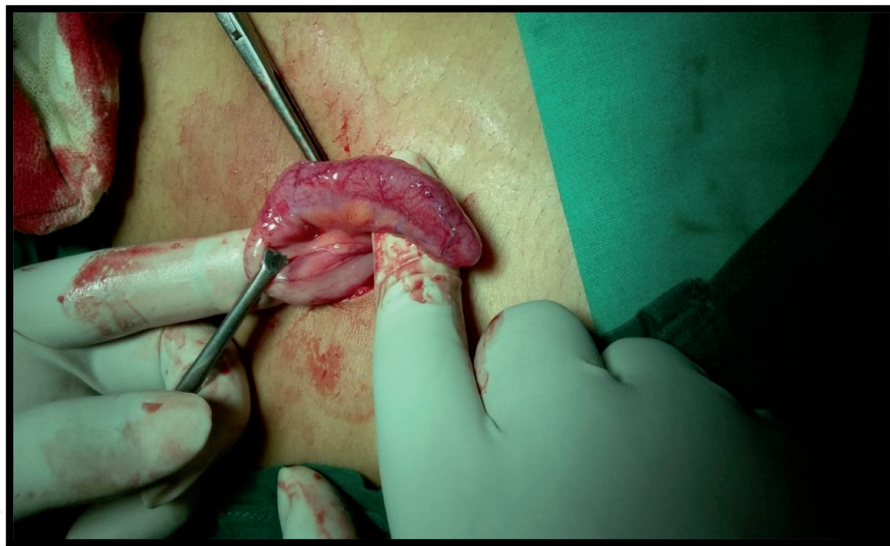


Figure 10.
Gross specimen: Acute appendicitis.

5. Modalities of treatment

- Open appendicectomy
- Laparoscopic appendicectomy
- Conservative management
- Management of complications

6. Appendectomy

6.1 Incisions for appendectomy

- a. McBurneys: oblique, muscle splitting incision.
- b. Lanz: 4–7 cm incision along the lines of Langer, about the level of anterior superior iliac spine.
- c. Rutherford Morison's incision: an oblique muscle cutting incision, which can be extended, obliquely upwards and laterally as necessary. Useful if the appendix is paracaecal or retrocaecal and fixed.
- d. Davis-Rockey: a transverse right lower quadrant skin incision.
- e. Fowler-Weir extension: extension of McBurneys incision via a staged separation of muscles.
- f. Para median: just lateral to the rectus in vertically midline (**Figure 11**).

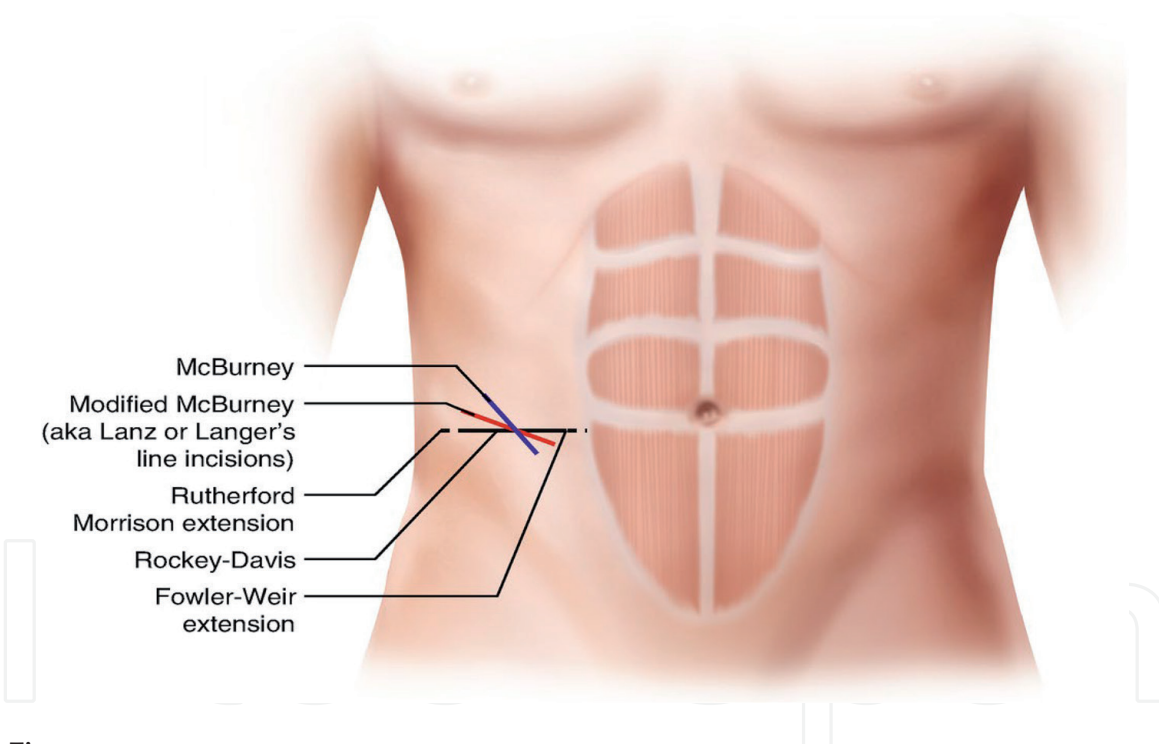


Figure 11.
Incision for appendectomy.

6.2 Procedure of open appendectomy

Abdomen is opened and caecum was identified. Appendix located at illeo caecal junction and mesoappendix dissected and clamped and tied.

Appendix was cut at the base after securing with purse string or Z stitch. Invagination of appendicular stump can be done. When the appendix is retrocaecal and adherent, it is advantageous to do retrograde appendicectomy.

See for Meckel's diverticulum. Put a drain if pus is there or in case of extensive dissection.

The definitive treatment of acute appendicitis is appendectomy and the sooner it is done, the better. There are four exceptions to this excellent rule:

1. The patient is moribund with advanced peritonitis. Conservative supportive treatment can be done in an attempt to get the patient fit for surgery.
2. The attack has already resolved. Interval appendectomy is done later.
3. Circumstances make operation difficult or impossible.
4. Appendicular mass has formed.

6.3 Management of appendicular mass

Ideal is to manage by the Ochsner-Scherren regimen (conservatively). In that regimen patient is treated by starting IV antibiotics and symptomatic treatment.

Patient is allowed orally only when it's tolerated otherwise to start IV fluids at initial part. Stop treating conservatively if:

1. Persistent fever
2. Rising pulse
3. Signs of obstruction
4. Increase in size of abscess

6.4 Laparoscopic appendectomy

As per some studies laparoscopic surgery is comparable or sometimes superior to open surgery in appendectomy. So while going for surgical management of appendicitis laparoscopy is preferred irrespective of clinical condition and diagnostic value [4].

Appendicular stump closure by single endoligature (endoloop) is procedure of choice as tactical modification nowadays. Other alternatives like endostapler, metal clips, bipolar endocoagulation, and polymer clips [5].

All alternative methods have never been assessed in prospective randomized studies but with proper knowledge about them one can do safe and cost-effective procedure [6].

In inflamed appendicular stump one can use endostapler which causes closing and transecting the appendix in one step but it's expensive [7].

Endoclip and endoloop are other methods which are equally cost effective but endoclip is easier to mastered than endoloop. Both offers closing and cutting the appendix before dissecting the mesoappendix. Appendicular base up to 16 mm can be clipped is a limitation of endoclip which is not offered by endoloop [7].

In bipolar coagulation technique there is no need of clip applicators, needle holders or knot pushers required and it is very simple and economical method. But it should be carried out by experienced surgeon [8].

6.5 Advantages (laparoscopic appendectomy)

- Fully exposed peritoneal cavity facilitates diagnosis and treatment of additional pathology especially in females in same sitting.
- Easy to treat subhepatic appendix and appendix in situs inversus.
- Less hospitalization (24 hours) and in uncomplicated cases sometimes as day care surgery.
- Less traumatic access and postoperative pain; early recovery and return to work.

- Less incidence of wound complications.
- Avoids laparotomy and gives good cosmesis.

6.6 Procedure (laparoscopic appendectomy)

Port placement can be done as shown in the figure after creating pneumoperitoneum (**Figure 12**).

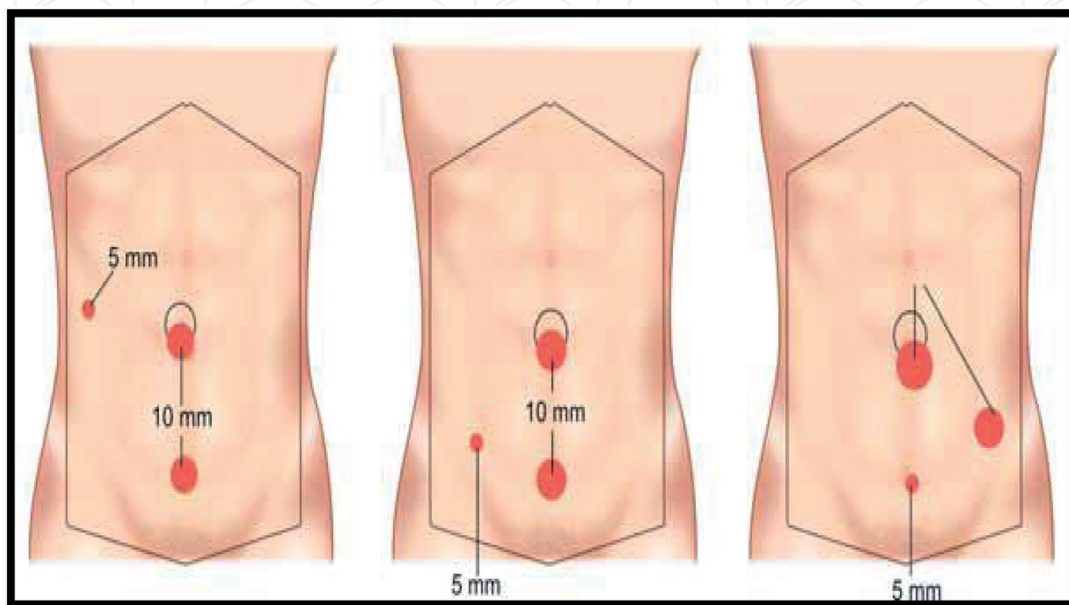


Figure 12.
Port placement.

Appendix was skeletonized and mesoappendix was secured by bipolar coagulation forceps. As described above appendicular base is secured by various different techniques (**Figures 13 and 14**).

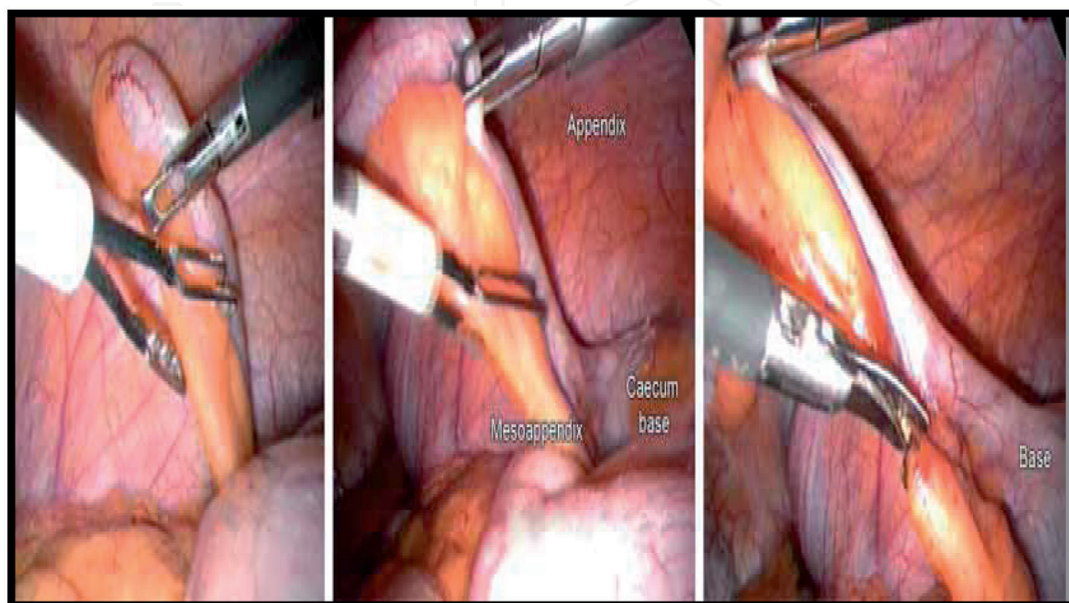


Figure 13.
Securing mesoappendix.

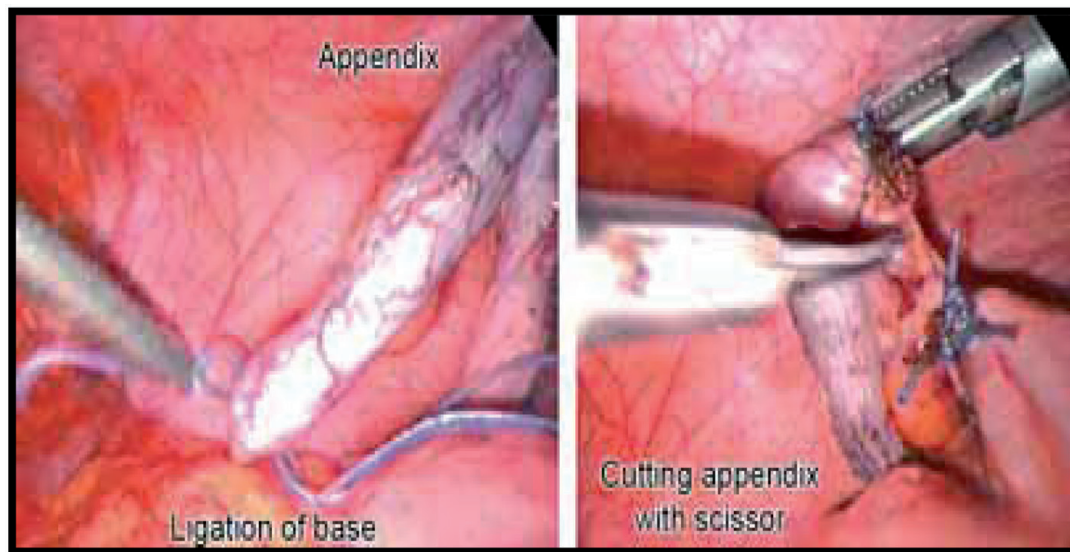


Figure 14.
Removal of Appendix.

Port site infection is prevented by using specimen retrieval bag when appendix is friable or badly infected. After complete examination of pelvic cavity, thorough wash is given and a drain may be kept if needed.

6.7 Complications of appendectomy

1. In 5 to 10% of cases chances of wound infection is there.
2. Perforated pelvic appendicitis may cause pelvic abscess after operation.
3. There may be a brief period of paralytic ileus.
4. Chances of fecal fistula (rare).
5. Gangrenous appendicitis may cause pylephlebitis in rare cases.
6. In women taking oral contraceptive pills can develop venous thrombosis and embolism.
7. Delayed complications:
 - Adhesions and intestinal obstruction.
 - Iliohypogastric nerve injury can cause right sided inguinal hernia.

6.8 Appendectomy in pregnancy

Incidence of appendicitis is same in pregnant and non-pregnant female (1 in every 1400 pregnancies) [9]. Appendicitis is more common during second trimester [9, 10]. Due to longer duration from onset of symptoms to operation perforation is more common during third trimester [10].

Appendectomy is performed in all pregnant having appendicitis. Due to difficulty in diagnosis over one third cases are of negative appendectomy during pregnancy [11, 12]. Due to high risk to the fetus negative appendectomy is accepted as risk reducing surgery in pregnancy when suspected [13].

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