

**Comparison Of Endo Clips Versus Suture In Laparoscopic Appendiceal  
Stump Closure**

**by**

**Dr.Aprajita Saha**

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**Under the guidance of**

**DR GIRISH K.K . M.S.(SURG)**

**ASSOCIATE PROFESSOR**

**DEPARTMENT OF GENERAL SURGERY**

**BLDE (DEEMED TO BE UNIVERSITY)**

**SHRI B. M. PATILMEDICAL COLLEGE, HOSPITAL & RESEARCH CENTRE**

**VIJAYAPUR – 586103**

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## LIST OF ABBREVIATIONS

CD4	Cluster of differentiation 4
CMV	Cytomegalo virus
CT	Computed Tomography
USG	Ultrasonography
HIV	Human Immunodeficiency Virus
AIDS	Acquired Immunodeficiency Syndrome
HbsAg	Hepatitis B Surface antigen
HCV	Hepatitis C Virus
ECG	Electrocardiogram
MRI	Magnetic Resonance Imaging
mm	Millimeter
cm	Centimeter
Hg	Mercury
ml	milliliter
HS	Highly significant
NS	Not significant

## **ABSTRACT**

- **AIMS & OBJECTIVES:**

To compare efficacy and safety of metallic endoclips with Roeder's knot for appendiceal stump closure in patients undergoing laparoscopic appendicectomy.

- **METHODS:**

Prospective, comparative study.

90 cases were studied; in each group 45 cases were allocated. After coming to a diagnosis of appendicitis patients were taken up for laparoscopic appendicectomy. Three ports created, one 10mm over umbilicus and two 5mm over both iliac fossae. In 45 patients conventional Roeder's knot was applied at appendiceal stump site and rest 45 titanium (LT 400) clips were applied, three, two at stump at one over specimen end.

- **RESULTS:**

In study group (EC) 57.8% belonged to age group less than 20yrs and 40% in control (S) group. In EC group mean age was 21.56+/-12.48 years while in S group it was 24.04+/-11.580yrs. Males were 57.8 % in EC group where as 55.6% in S group. In EC group 53.3 % presented with complaints since 1-3months while in S group 82.2% within one-month onset. All patients in EC had Right iliac fossa tenderness while in S group 24.4% had guarding with right iliac fossa. In EC group 80% had diagnosis of chronic appendicitis while 75.6% had acute appendicitis in S group. In EC group 26.67% had appendix diameter of 6-7 mm on USG finding while 66.67% in S group

had more than 10mm diameter. There was significant difference in time of surgery, with mean duration of  $57.20 \pm 1.254$  min in EC group while  $66.89 \pm 1.729$  min in S group. There were no significant differences in intraoperative complications, postoperative complications like surgical site complications, pain scale, length of stay, follow up period in both groups. Although clips were costlier than sutures.

#### **CONCLUSION:**

To conclude it can be said that titanium clips are safe to use requiring lesser time of surgery and ideal for beginners.

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# 1.INTRODUCTION

Acute Appendicitis is the most common surgical condition requiring emergency intervention. Incidence of this condition is about 8%. Commonly it presents in the age group between 10-20years<sup>1</sup>. A male preponderance exists, with a male to female ratio of 1.4:1; the overall lifetime risk is 8.6% for males and 6.7% for females in the United States<sup>2</sup>.

The cause for appendicitis is due to obstruction of lumen leading to stasis and bacterial proliferation. Most common cause is fecolith. However other causes include lymphoid hyperplasia, worm infestation, tumours<sup>2</sup>.

The first study on appendicitis was done in 1886 by Fitz following which there have been many papers. Since appendicitis can progress very rapidly to a lot of complications like gangrene, perforation prompt intervention has to be undertaken to reduce morbidity and mortality<sup>2</sup>.

In due course of time the treatment of appendicitis has advanced from open to minimal invasive techniques. At present laparoscopic approach is popularly preferred<sup>1</sup>.

Laparoscopic appendectomy was first performed 39 years ago on 30<sup>th</sup> May 1980 by Dr Semm, a gynaecologist. Also, laparoscopic approach can be done to rule out other diagnoses co existing with appendicitis, in females for pelvic and gynaecological pathologies and obese patients<sup>4</sup>.

Laparoscopy has advantages of reduced surgical site infections, less intra and post-operative analgesia, less hospital stays, early return of bowel functions and good cosmesis<sup>5</sup>. However, its disadvantages may be high cost<sup>6,7</sup>.

The most important step in appendectomy is the closure of the stump as postoperative complications may occur if there is inadequate closure. Complications like faecal fistulas, peritonitis followed by sepsis causes severe morbidity<sup>8</sup>.

In open appendicectomy after closing the stump with suture it can be buried in caecum with purse string sutures to prevent the risk of intra-abdominal infection although later it was proved to be insignificant on the outcome<sup>4</sup>.

There a lot of variations to appendiceal stump closure as newer methods have been introduced like endoloop, double endoloop, ultrasonically activated scalpel, knotting, bipolar coagulation, slipknot tying, metal clip, hem o lock clip and linear endostaplers<sup>1</sup>. It has been seen in studies that use of endoloop require more time and surgical expertise as knots have to be placed and tightened correctly<sup>37</sup>. Also, the use of endoclips is limited as it depends on the diameter of appendix and the severity of inflammation<sup>38</sup>.

In various studies it has been proven that the newer techniques are easier to use, reduces operative time with less learning curve and hence best for beginners, although experienced surgeons prefer knotting to ligate the base due to inflammation or friability<sup>4</sup>.

There a lot of studies comparing these methods but a consensus as to which method is best has not been reached yet. Although in a study by Kazemier et al. it has been proven that there is an advantage of stapling over loop ligatures with respect to infections.

One of the novel techniques for appendiceal stump closure is by titanium clip. It is made of pure titanium, biocompatible, with a high closing force. The clips have parallel ends which helps the tissue adaptation to be good. Also, after closure the tissue gets compressed and hence there is very less axial displacement. As a result of the pyramid shaped inner surface it ensues a strong grip with the underlying tissues and thus prevents slippage<sup>4</sup>.

This study was done to evaluate the safety and ease of use of titanium clips versus conventional knotting for appendiceal stump closure in laparoscopic appendicectomy.

## **2.AIM OF THE STUDY**

- To compare efficacy and safety of metallic endoclips with Roeder's knot for appendiceal stump closure in patients undergoing laparoscopic appendicectomy.

## **OBJECTIVES OF THE STUDY**

- To assess the ease of use and safety of endo clips compared to Roeder's knot in the appendiceal stump closure and to compare
- Operative time
- Intraoperative complications (bleeding due to slippage of clips or incorrect knot placement)
  - Post-operative complications (Surgical site infection)
  - Hospital stay
  - Cost
  - Follow up at 2 months

### **3.RESEARCH HYPOTHESIS:**

- Appendicular stump closure with metallic endoclips is safe and does not increase intra or post-operative complications when compared to conventional knotting technique (Roeder's knot).



## 4. REVIEW OF LITERATURE:

### Historical aspect:

A chronological order in the history of appendix has been enumerated below with the first evidence in the 16<sup>th</sup> century. The following sequence of events is very interesting and important as they signify dedication and inspiration of great pioneers towards mankind.

- ❖ 1530: Greek scholar Erasmus was the first to document a case of appendicitis with abscess formation
- ❖ 1543: Andreas Vesalius demonstrated normal appendix in *De Humani Corporis Fabrica*
- ❖ 1554: First case of perforated appendicitis was diagnosed on autopsy by a French Physician Jean Fernal of a 7year old girl who presented with pain abdomen with loose stools, was given a large quince to reduce her stool frequency
- ❖ 1710: The first person to form the term Vermiform Appendix was by Verneys
- ❖ 1719: A professor of surgery Lorentz Heister from Hermstedt identified appendix to be a site of primary inflammation
- ❖ 1736: First appendectomy done by Claudius Amyand, surgeon at St George's Hospital in London and sergeant surgeon Queen Ann, King George I and King George II<sup>9</sup>.
- ❖ 1742: Leonardo da Vinci was the first to demonstrate the normal anatomy of appendix, named it "orecchio", meaning ear, that is auricular appendage of the caecum.
- ❖ 1812: A case of acute appendicitis was documented by John Parkinson on autopsy of a 5yr boy who died after 48hours of onset of pain abdomen and vomiting. There was presence of fecolith at base with acutely inflamed appendix with normal caecum.

- ❖ 1886: A professor of pathological anatomy, Reginald Fitz coined the term appendicitis, also his famous paper correlated right lower quadrant pain to appendicitis<sup>3</sup>.
- ❖ 1824: Louyer Villermay documented 2 autopsy cases of acute appendicitis<sup>9</sup>.
- ❖ 1827: Francois Melier documented 6 autopsy cases and stressed on the antemortem diagnosis of appendicitis<sup>9</sup>.
- ❖ 1830: A theory of typhlitis and peri typhlitis was formed, that is, inflammation in the surrounding cellular tissue in caecum.
- ❖ 1848: the first surgical treatment of appendicitis or peri typhlitis without abscess was done by Hancock<sup>10</sup>.
- ❖ 1880: Lawson Tait, a pioneer in abdominal surgery performed the first appendicectomy on a girl with gangrenous appendicitis<sup>11</sup>.
- ❖ 1883: first elective appendicectomy by Fergus in Canada<sup>9</sup>. 1884: Samuel Fenwick in London stressed upon the surgical community to operate on a case of perforated appendicitis as soon as it is diagnosed.
- ❖ 1886: Kronlein was the first person to publish on appendicectomy for appendicitis.
- ❖ 1889: The biggest contribution by Charles Mc Burney. He described the Mc Burney's point to be the point of maximum tenderness, at the junction of medial two third and lateral one third of spino-umbilical line<sup>12</sup>.
- ❖ 1890: Conservative management of acute appendicitis by Frederick Treves followed by appendicectomy after infection subsides<sup>13</sup>.
- ❖ Medial extension of grid iron incision by dividing the lateral border of rectus known as Fowler Weir Extension by Harrington, Fowler, Weir.
- ❖ 1902: A surgeon from Chicago, Albert Oschner described the Oschner Shereen regimen for conservative management of appendicular abscess<sup>14</sup>.

- ❖ 1905: Rockey described a transverse skin incision for appendicectomy.
- ❖ 1905: Exact sequence of events that is pain followed by nausea and vomiting with fever and increased localised tenderness for appendicitis by Murphy.
- ❖ 1965: radiological signs of acute appendicitis on plain x ray abdomen demonstrated by Brooke and Killen.
- ❖ 1980: First case of laparoscopic appendicectomy by Dr Semm, a gynaecologist, on May 30<sup>th</sup> <sup>15</sup>.
- ❖ 1986: Alvorado et al developed a scoring system including signs, symptoms and laboratory investigations for management of appendicitis<sup>16</sup>.
- ❖ 1987: Role of ultrasound for diagnosis of appendicitis was given by Jeffrey and his colleagues<sup>17</sup>.
- ❖ 1997: Gupta H et al. documented that for uncertain diagnoses of right lower quadrant or pelvic pain for female/children ultrasound is ideal. Also, he stated that minimum diameter should be 6mm to call it appendicitis with non-compressible tube with tenderness on focal compression<sup>18</sup>.
- ❖ 2004: In a study by Nguyen NT et al the incidence of laparoscopic appendicectomy increased from 20% to 43% from 1999 to 2003 specially in female patients with less severity of symptoms and less likely for perforated appendicitis<sup>19</sup>.

## **EMBRYOLOGY**

The caecum and appendix are formed by enlargement of caecal bud which is a diverticulum that originates from the post arterial segment of midgut loop. Caecum is visible at 5<sup>th</sup> week of

intra uterine life. Appendix is visible at 8<sup>th</sup> week arising from the caecum. The probable inference is that the appendix is a distal part of caecum which is visible as it is unable to keep up with the growth as compared to the proximal part. At birth diameter of colon is 4.5 times that of appendix and at maturity about 8.6 times.

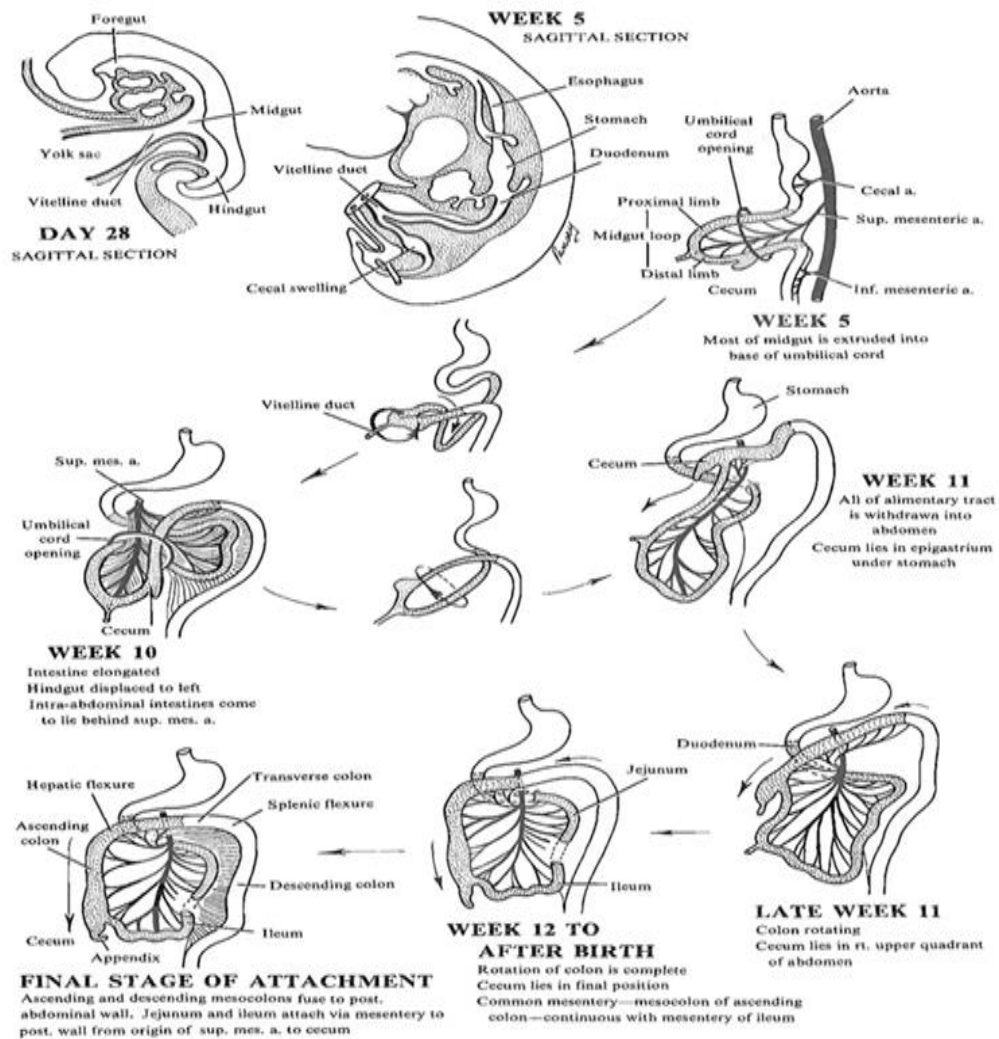


FIGURE 1

In intrauterine life appendix lies at the apex of caecum, but gradually due to increased growth at right terminal haustral it displaces the appendix medially towards the ileo-caecal valve. The taeniae of the longitudinal muscle coating of colon originate at the base of appendix and show the same displacement<sup>20</sup>.

## **ANATOMY**

The appendix is of variable size (5 to 35 cm in length) but averages 9 cm in length in adults. Its base can be reliably identified by defining the area of convergence of the taeniae at the tip of the cecum and then elevating the appendiceal base to define the course and position of the tip of the appendix, which is variable in location. Knowledge of these anatomic variations is important to the surgeon because the variable position of the appendiceal tip may account for differences in clinical presentation and in the location of the associated abdominal discomfort. The appendicular orifice is guarded by a semilunar fold of mucous membrane called valve of Gerlach<sup>21</sup>.

### **VARIOUS POSITIONS OF APPENDIX (DESCRIBED BY TREVES)**

Retrocaecal (74%)- at 12 o clock position, lies behind caecum

Pelvic (21%)- at 4 o clock position, dips into pelvis

Sub-caecal (1.5%)- at 6 o clock position

Preileal (1%)- at 1 o clock position

Paracolic (2%)- at 11 o clock position

Postileal (0.5%)- at 2 o clock position

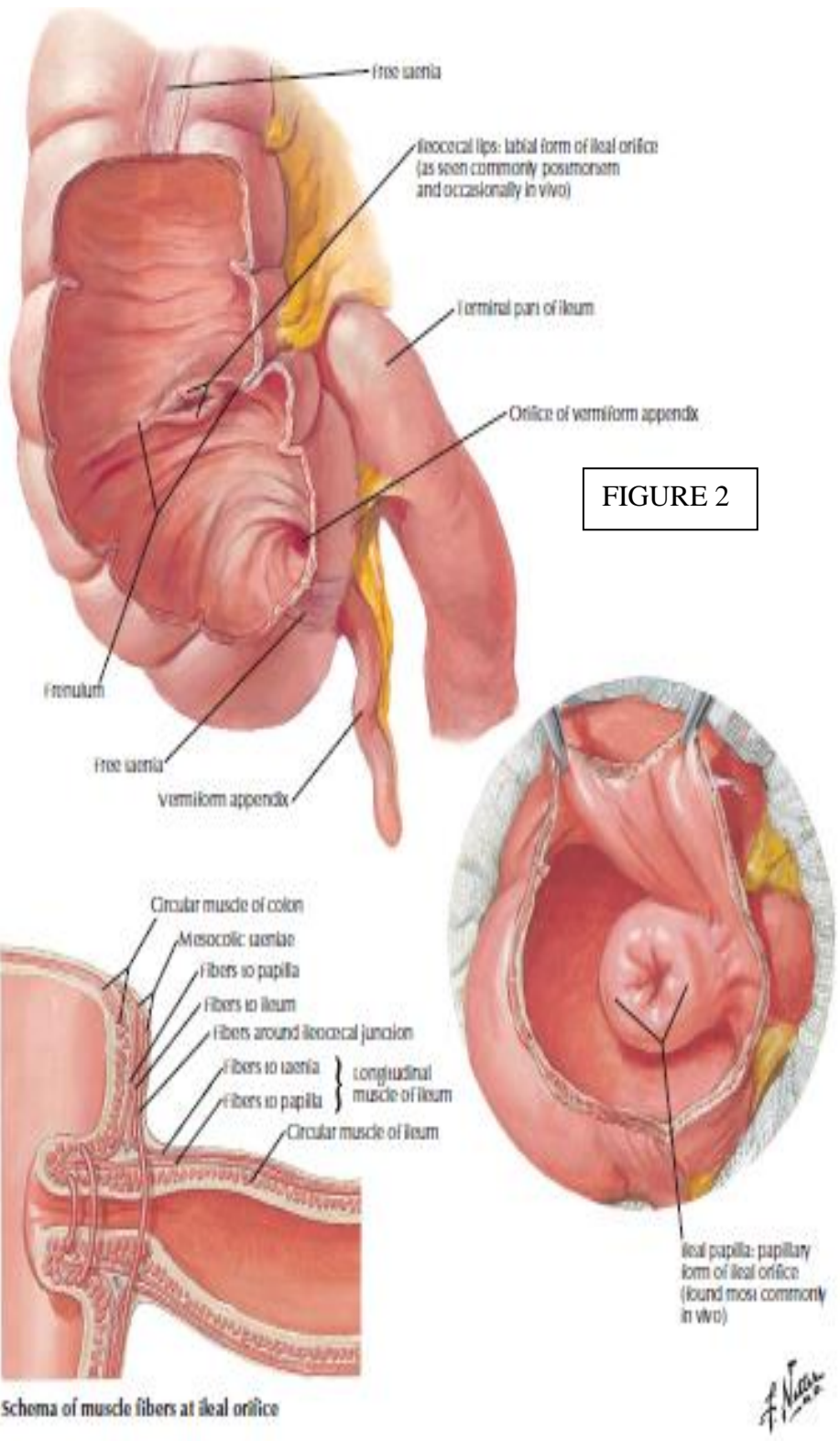


FIGURE 2

FIGURE 3

FIGURE 4

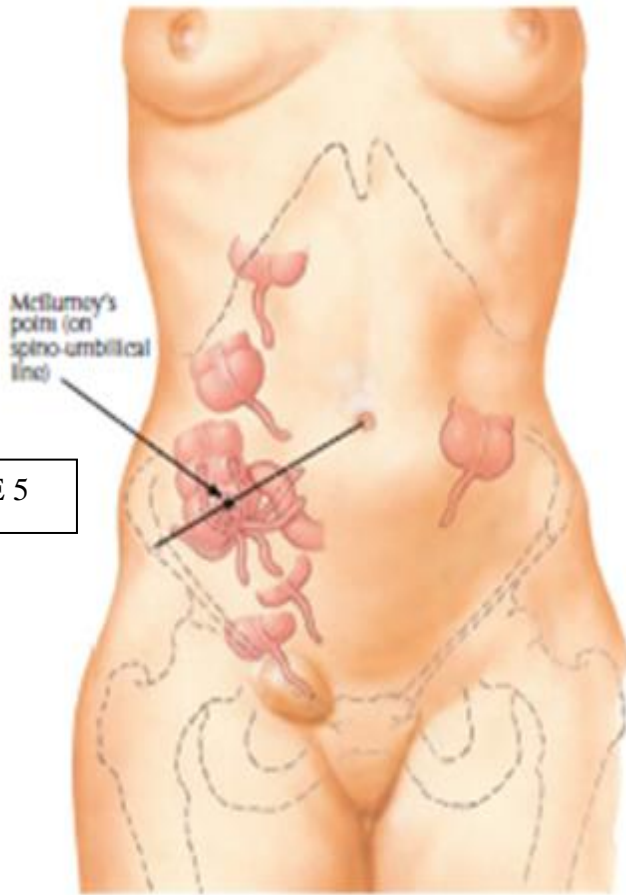


FIGURE 5

Variations in position of appendix

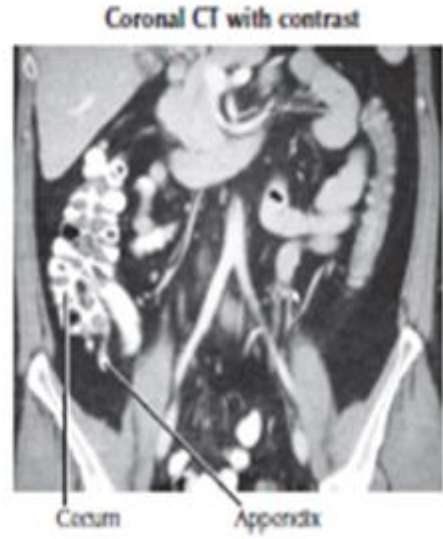


FIGURE 6

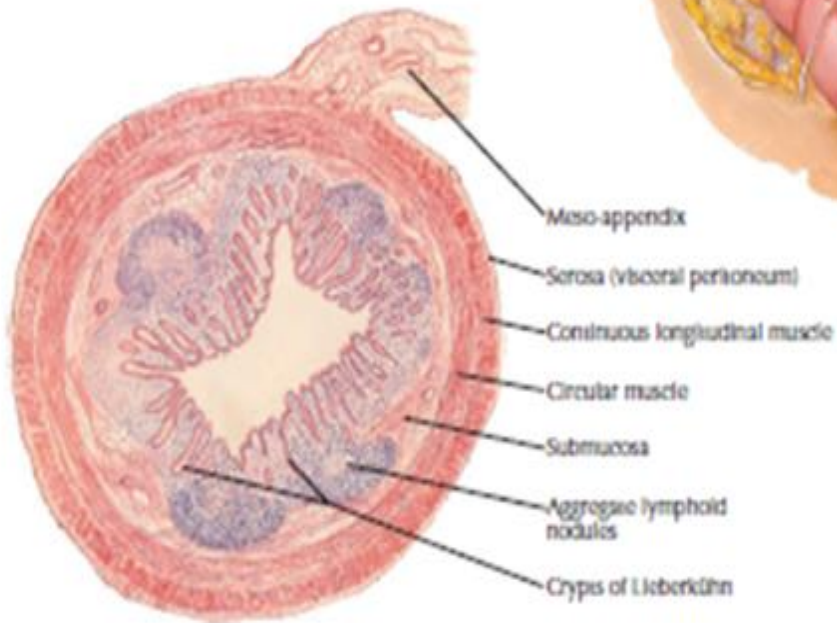
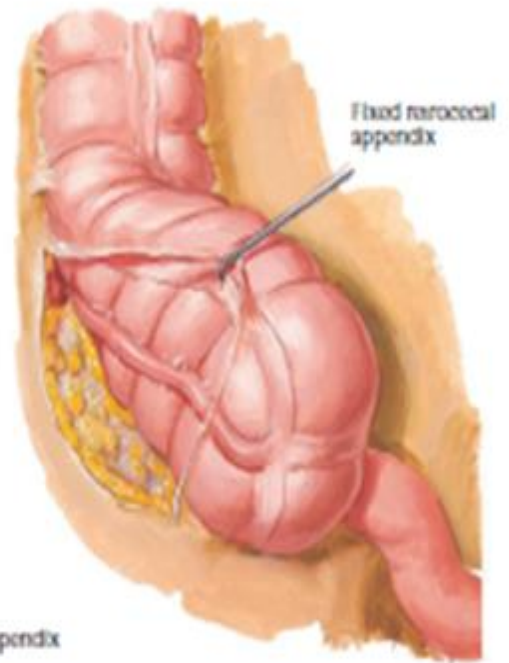


FIGURE 7

FIGURE 8

*F. Netter*

## ARTERIAL SUPPLY

The appendicular artery is a branch of the lower division of the ileocolic artery, branch of superior mesenteric artery, passes posterior to the distal end of ileum to enter the mesoappendix near to the base. A recurrent branch from the artery anastomoses with a branch of posterior caecal artery. Appendicular artery is an end artery hence inflammation will cause thrombosis which further leads to gangrene and perforation. There may be presence of an accessory artery of Seshachalam at times<sup>23</sup>.

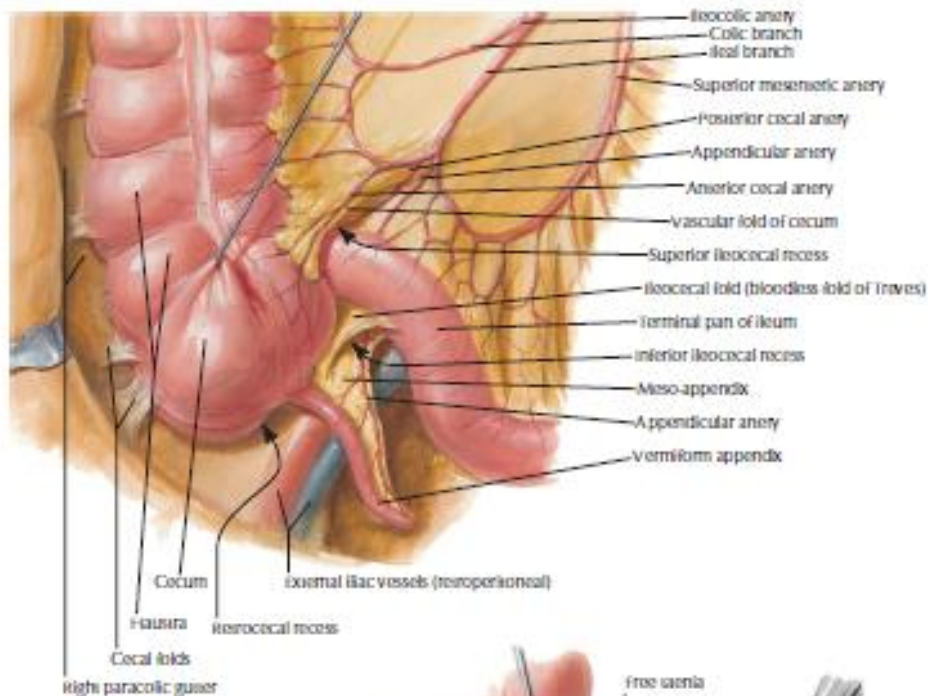


FIGURE 9

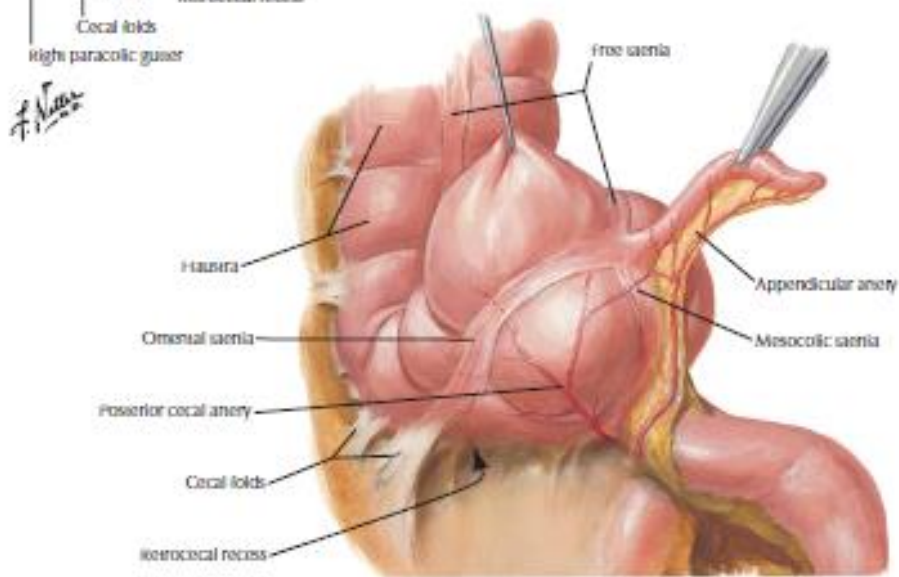


FIGURE 10



## VENOUS DRAINAGE

By appendicular vein which follows the artery along the free border of mesoappendix, joins the ileocolic vein which drains into inferior mesenteric vein, finally into portal vein<sup>23</sup>.

## LYMPHATIC DRAINAGE

Lymphatic vessels drain from the lymphatic follicles and by piercing the muscle coat to the nodes in mesoappendix and finally into paracolic nodes along ileocolic artery and finally to group of superior mesenteric lymph nodes<sup>23</sup>.

## NERVE SUPPLY

Sympathetic supply from thoracic segments 9 and 10 through coeliac plexus.

Parasympathetic supply from vagus nerve. Hence referred pain is felt around umbilicus (T9-10)<sup>23</sup>.

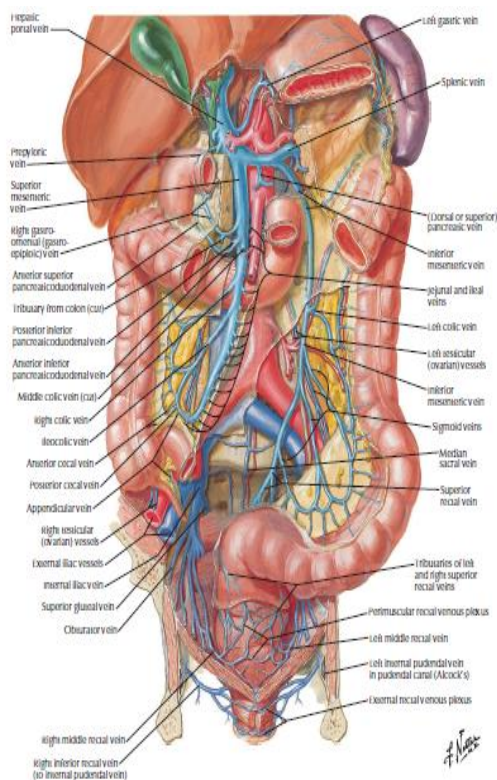


FIGURE 11

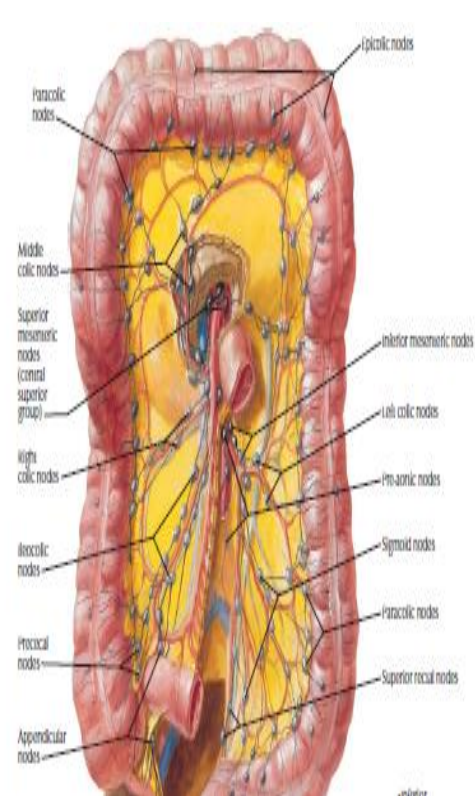


FIGURE 12

## **SURFACE MARKING**

The base of appendix corresponds to Mc Burney's point, which is at junction of medial two third and lateral one third of a line joining anterior superior iliac spine to umbilicus<sup>12</sup>.

## **NORMAL HISTOLOGY**

The mucosa has lining epithelium with numerous goblet cells, underlying lamina propria with intestinal glands which are not well developed shorter and lesser in number. Crypts are present but lesser in number, base of which is formed by argentaffin cells (Kulchitsky cells), which is a source of carcinoid tumours. Abundant lymphatic tissue which is diffusely scattered in lamina propria, in submucosa and may also extend to the mucosa. Also, there is a layer of muscularis mucosa<sup>24</sup>. Submucosa has abundant blood supply. Muscularis externa has 2 layers of muscle-inner circular and outer longitudinal. In between these two layers lie the myenteric plexus that is parasympathetic ganglia. Outermost layer is of serosa under which is seen adipose cells.

## **PATHOLOGIC APPEARANCE IN APPENDICITIS**

**MORPHOLOGY:** In early acute appendicitis there is congestion of sub-serosal vessels which leads to accumulation of neutrophilic infiltrate in all layers. Due to inflammatory reaction the normal glistening appearance of the serosa is turned into dull, granular erythematous surface<sup>25</sup>. In early stages appendix is oedematous and serosa shows hyperemia<sup>25</sup>. Diagnosis of acute appendicitis is made by neutrophilic infiltration of muscularis propria and with presence of superficial ulcerations. Although these are not specific markers. There may be presence of added fibrinopurulent reaction in severe cases. With progression of inflammation there may be focal abscesses within the wall leading to acute suppurative appendicitis. It

progresses to vascular compromise leading to areas of ulceration, necrosis due to thrombosis of end artery causing gangrenous appendicitis and perforation.

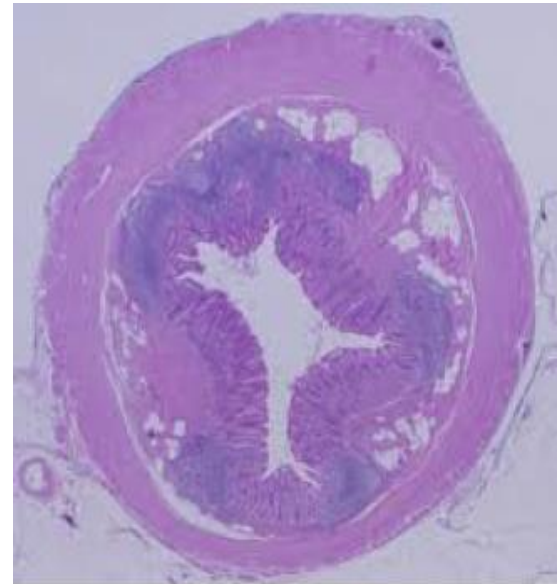
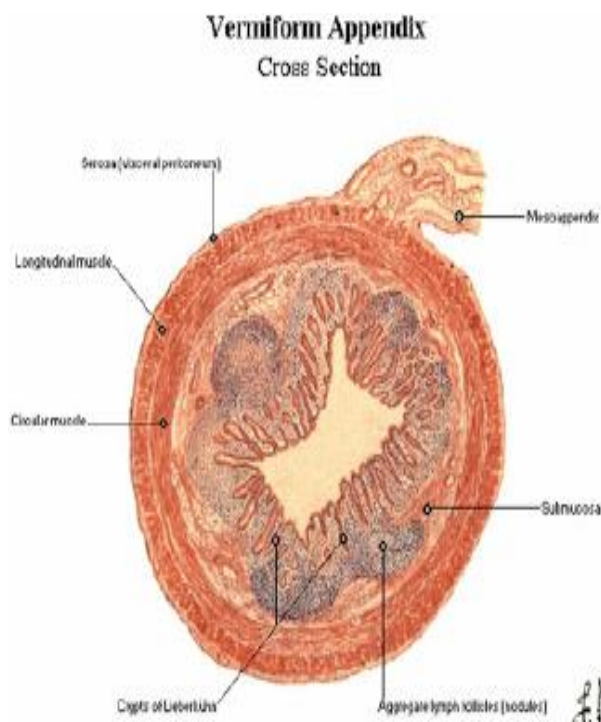


FIGURE 13: NORMAL HISTOLOGY

FIGURE 14: ACUTE APPENDICITIS

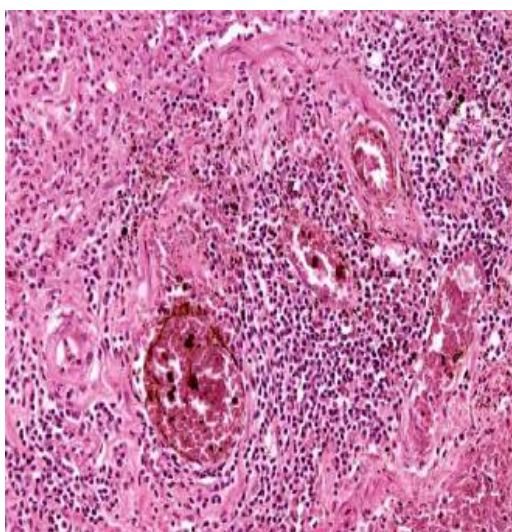


FIGURE 15: SUPPURATIVE APPENDICITIS

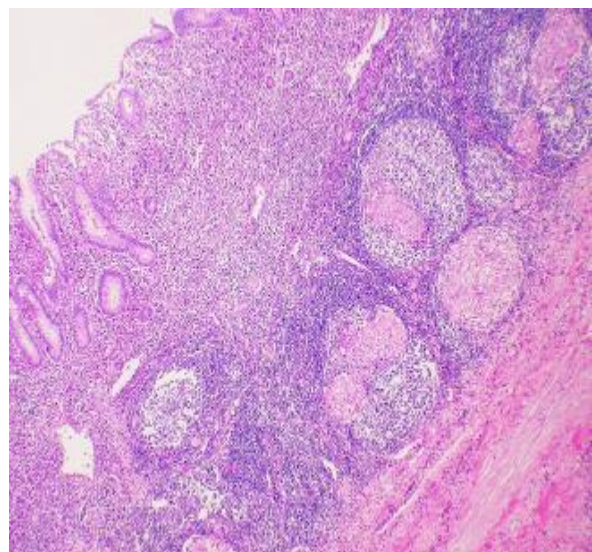


FIGURE 16: CHRONIC APPENDICITIS

## **FUNCTIONS**

In mammals particularly herbivores, caecum and appendix are large and are important for cellulose digestion by symbiotic bacteria. The lymphoid follicles are a centre for B cell lymphocyte maturation. Appendix has very important immunological role in synthesis of immunoglobulins, specially immunoglobulin A<sup>10</sup>.

## **PATHOGENESIS OF APPENDICITIS**

The spread of infection from appendicular lumen to peritoneum occurs due to:

- ✓ Perforation.
- ✓ Transmigration of bacteria through the wall.

## **TYPES OF APPENDICITIS:**

### **1)ACUTE NON-OBSTRUCTIVE APPENDICITIS:**

In this type there is no luminal obstruction but there is mucosal inflammation followed by secondary infection. Its sequelae are resolution, fibrosis, recurrent appendicitis or obstructive appendicitis<sup>26</sup>.

Rapid progression of inflammation occurs if it reaches the submucosa. Appendix becomes turgid with haemorrhages into the mucosa. Finally, obstructive appendicitis occurs once the bacteria translocates from submucosa to muscularis propria. As appendicular artery is an end artery, inflammation may lead to its thrombosis which causes necrosis and gangrene starting at the tip of appendix. Lymphoid hyperplasia has also been seen to cause obstructive appendicitis.

This type usually progresses slowly for protective barriers to form, and if at all progresses it causes localised peritonitis. Also, sometimes the inflammation does not pass beyond the mucosa i.e. catarrhal inflammation. Due to chronic fibrosis the tip appears shrunken, which is a classical ultrasound finding in recurrent appendicitis.

## **2)OBSTRUCTIVE APPENDICITIS**

Commonest cause is fecolith, being 40% in acute appendicitis,65% in gangrenous (without perforation) appendicitis and more than 90% in perforated cases<sup>10</sup>.

Other causes include lymphoid hyperplasia, foreign bodies like seeds, worm infestation like pinworm or roundworm.

Following obstruction there occurs a cycle of events. Due to obstruction that is closed loop obstruction the normal mucosal secretions accumulate causing stasis which in turn causes distension. The normal mucosal capacity is 0.1ml, accumulation of 0.5ml of fluid increases the luminal pressure to 60cm of water. As a consequence of this distension the stretch receptors that are present in visceral peritoneum get activated. At this time the patients complain of vague and dull aching type of pain in the umbilical region. Due to stasis of secretions it causes bacterial proliferation. As a result of stretch receptors, it leads to nausea and vomiting. Further progression of distension leads to firstly venous congestion and venous obstruction but arterial flow is still intact. The inflammatory process then involves the parietal peritoneum which causes shift of pain to the right iliac fossa (migratory pain). As the distension further increases arterial supply is compromised due to thrombosis causing ellipsoidal infarcts at antimesenteric border. Since it is an end artery it will finally lead to necrosis causing gangrenous appendicitis which further progresses into rupture into the peritoneal cavity causing peritonitis.

The infection is usually polymicrobial with presence of both gram negative and anaerobes. Common isolates include *Escherichia coli*, *Bacteroides fragilis*, enterococci, *Pseudomonas aeruginosa*, and others. The following table shows the bacteriae commonly isolated and their incidence<sup>21</sup>.

TYPE OF BACTERIA	PATIENTS (%)
<b>Anaerobic</b>	
<i>Bacteroides fragilis</i>	80
<i>Bacteroides thetaiotaomicron</i>	61
<i>Bilophila wadsworthia</i>	55
<i>Peptostreptococcus</i> spp.	46
<b>Aerobic</b>	
<i>Escherichia coli</i>	77
Viridans streptococcus	43
Group D streptococcus	27
<i>Pseudomonas aeruginosa</i>	18

FIGURE 17: INCIDENCE OF BACTERIAE ISOLATED FROM APPENDIX

After several hours of perforation, it is body's reaction to seal off the perforation and confine the inflammation to the periappendiceal area. The greater omentum tries to seal off the perforation and prevents spread to the rest of the peritoneal cavity. An inflammatory mass formed of matted intestines and omentum is formed as a result (appendicular mass) with little or no pus. It may cause further suppuration leading to appendicular abscess.

It is even more catastrophic if there is a rupture of the appendicular abscess leading to generalised peritonitis.

There may be ascending septic thrombophlebitis of portal venous system(pyelothrombophlebitis) which is very grave. Pyogenic abscesses may be formed in the liver due to septic emboli.

Obstructive appendicitis with resolution of infection leads to distension of appendix with mucous collection known as mucocoele.

### **3)RECURRENT APPENDICITIS**

Recurrent attacks of non-obstructive appendicitis lead to fibrosis and adhesions causing recurrent appendicitis.

### **4)SUBACUTE APPENDICITIS**

Milder form of acute appendicitis.

### **5)STUMP APPENDICITIS**

Infection of the left-out stump if a long stump is left behind after appendicectomy.

## **CLINICAL DIAGNOSIS**

Based on both history and clinical examination.

### **1)HISTORY**

a) Anorexia-The first symptom to appear in a patient with acute appendicitis is anorexia (more than 95%)<sup>10</sup>.

b) Pain abdomen-The classical type of pain in appendicitis varies with the course of the disease. Initially due to distension of the mucosa, stretch of the receptors in visceral peritoneum leads to a diffuse, vague, dull aching type of pain at periumbilical region. Gradually with the course of inflammatory process the pain localises and changes to sharp constant pain at the right iliac region. It happens within 12-24hrs of onset of symptoms.

c) Nausea, vomiting-Usually present in younger age group<sup>10</sup>.The intensity of nausea or vomiting depends on the amount of distension of inflamed appendix and reflex nervous susceptibility of patient. These symptoms start after onset of abdominal pain, in case where they start first other differential diagnoses have to be considered like gastroenteritis<sup>9</sup>.

d) Fever-Usually associated with low grade fever without chills (that is up to 103F). If there are complaints of high-grade fever with chills then appendicular perforation or abscess should be suspected.

### **MURPHY'S TRIAD- pain abdomen, fever, vomiting**

e) Constipation-If patients presents with paralytic ileus then there can be complaints of constipation and absent bowel sounds

f) Diarrhoea-It is usually seen in pelvic or post ileal appendicitis when the inflamed appendix irritates the rectum with infected exudates.

g) Urinary complaints-If the inflamed appendix irritates the bladder the patient may present with increased frequency of micturition.

## **2)PHYSICAL EXAMINATION**

On general examination patient may have a toxic look with fever, if more than 101F suggests perforation or abscess, tachycardia (PR >90bpm), hypotension (systolic bp <100mm Hg).

Per Abdominally-tenderness will be present at the right iliac fossa, with rebound tenderness at the Mc Burney's point. Due to peritoneal inflammation patient will have guarding and rigidity. In case of an appendicular mass there will be presence of a mass, well localised with regular borders, not mobile, not moving with respiration, tender soft to firm consistency will be palpable.



Per rectal examination-there may be tenderness on right side either due to pelvic appendicitis or pelvic abscess.

### **SPECIFIC SIGNS OF APPENDICITIS:**

**1)MC BURNEY'S SIGN**-On deep palpation at the Mc Burney's point, there is presence of tenderness.

**2)BLUMBERG'S SIGN (REBOUND TENDERNESS)**-On release of pressure over the Mc Burney's point, the patient winces or cries in pain. This suggest inflammation of the parietal peritoneum due to appendicitis. If there is guarding then there is no need of this test. This test indicates peritoneal inflammation due to an inflamed organ underneath<sup>27</sup>.

**3)COPE'S/PSOAS SIGN**-This test has two parts: Cope's Psoas and Cope's Obturator tests

**COPE PSOAS TEST**-This test is positive in retrocaecal appendicitis. Inflamed appendix comes in contact with psoas muscle causing its inflammation and hence spasm. So, patient keeps the hip in flexed position. In this test we passively hyperextend the hip on supine position, there will aggravation of pain, indicates a positive test.

**COPE OBTURATOR TEST**-This test is positive in pelvic appendicitis. Inflamed appendix irritates the obturator internus muscle which goes into spasm, so on internal rotation of the hip joint there is exaggerated pain.

**4)POINTING SIGN**-On asking about the progression and radiation of pain, the patient points that the pain initially was at the umbilicus and then has shifted to the right lower quadrant at present. This migration of pain is called as Volkovich Kocher's sign.

**5)ROVSING'S SIGN**-On deep palpation of left iliac fossa, patient complaints of pain in the right iliac fossa. This is due to shift of coils of small intestine from left to right where there is localised peritonitis.

**6)HYPERESTHESIA IN SHEREEN'S TRIANGLE**-Shereen's triangle is a triangle formed by three points-umbilicus, right anterior superior iliac spine, symphysis pubis. Hyperesthesia is checked by gently lifting a fold of skin in this triangle or by simply scratching the abdominal wall. Presence of hyperesthesia suggests gangrenous appendicitis. Loss of this hyperesthesia in course of gangrenous appendicitis suggests rupture.

## **UNUSUAL PRESENTATIONS WITH RESPECT TO VARIOUS ANATOMICAL POSITIONS OF APPENDIX:**

### **A) RETROCAECAL APPENDICITIS-**

Usually it is silent appendix as signs of rigidity and tenderness are absent as the caecum which is distended with gas prevents the pressure exerted by the hand to reach the inflamed appendix. On deep palpation, tenderness and rigidity of quadratus lumborum may be present. There may be flexion of the hip joint due to spasm because of irritation by inflamed appendix. If there is no flexion, hyperextension of the hip will cause pain abdomen.

### **B) PELVIC APPENDICITIS-**

Per abdomen signs of rigidity and Mc Burney's point tenderness is usually absent. Patient will have complaints of diarrhoea and urinary frequency due to irritation of rectum and urinary bladder. Per rectal examination shows tenderness at rectovesical pouch or pouch of Douglas.

### **C) PREILEAL AND POSTILEAL APPENDICITIS-**

Due to constant irritation of ileum there are complaints of nausea vomiting and diarrhoea. Tenderness is not present over the Mc Burney's point but at an area just medial to the umbilicus.

### **D) SUBHEPATIC APPENDICITIS-**

Usually misdiagnosed as acute cholecystitis or peptic ulcer disease. Happens in case of retrocaecal appendix reaching the subhepatic position.

### **SPECIAL FEATURES ACCORDING TO AGE**

- **INFANTS-** usually rare in age below 36 months as patient is unable to give proper history as result of which there is a delay of surgical intervention, thus it may cause perforation and post-operative morbidity is higher than older children, also generalised peritonitis develops very fast due to undeveloped greater omentum, unable to localise the infective foci.
- **CHILDREN-** they usually present with multiple episodes of anorexia, vomiting, diarrhoea
- **YOUNG-** women of age group 20-30 years, if they present with pain and discomfort over lower abdomen, associated with ovulation (mittelschmerz), diseases of ovary, ruptured ectopic gestation, salpingitis, PID are commonly mis diagnosed as appendicitis. Proper history and clinical examination help us to come to a conclusion.
- **PREGNANCY-** appendicitis is most common extra uterine acute abdominal condition in pregnancy. The clinical evaluation is complicated due to anatomical

changes in the appendix during pregnancy. It should be suspected in a pregnant woman if there is new onset of the pain on the right side (as only 50 % of them have migration of pain to right iliac fossa). Raised total count will not be diagnostic as there is physiological leucocytosis of pregnancy<sup>29</sup>.

Ultrasonography and MRI are useful in diagnosis, the risk of fetal loss after appendicectomy is 4% and risk of premature labour is 7%. Accuracy of diagnosis helps in improving the incidence of fetal loss.

- **ELDERLY-** classical symptoms of pain, nausea, anorexia may be less pronounced. Tenderness in the right iliac fossa, rigidity are not well appreciated due to lax abdomen. Sometimes it may be wrongly mis diagnosed as sub-acute intestinal obstruction. Due to reduced blood supply, risk of perforation at an early stage is common.
- **APPENDICITIS DUE TO PARASITIC INFECTIONS-** appendicular luminal obstruction may happen due to parasites blocking it or due to local inflammation. Enterobius vermicularis is the most common parasite isolated.
- **APPENDICITIS WITH HIRSCHPRUNG'S DISEASE-** Large bowel obstruction in neonates can occur due to imperforate anus, meconium plug, Hirschprung's disease etc. As a result, caecum and appendix may over distend leading to perforation. Treatment includes, addressing the primary disease with appendicectomy.
- **APPENDICITIS WITH AIDS/ HIV-** incidence is 0.5 % (general population 0.1 - 0.2%). Symptoms are similar but absolute leucocytosis is absent due to already low total counts. However, if the baseline leukocyte count is available in HIV patients, we can see relative leucocytosis. Appendicular rupture is more common (43%) due to late presentation (> 24hrs) and low CD4 count.

The differential diagnosis of right iliac fossa pain in HIV patients include opportunistic infections like, cytomegalo virus (CMV), Kaposi Sarcoma, Tuberculosis, Lymphoma and other causes of infectious colitis (30). CMV causes vasculitis in the submucosa which leads to thrombosis. This finally causes mucosal ischaemia leading to ulceration, bowel gangrene and perforation.

Also, spontaneous peritonitis may be caused by opportunistic organisms like mycobacterium avium, intracellular complex, myco bacterium tuberculosis. Cryptococcus neoformans and Strongyloides, Kaposi Sarcoma and Non Hodgkins Lymphoma may also present with right lower quadrant pain and mass. Viral and Bacterial Colitis also occur commonly.

In an HIV patient, thorough history and physical examination is crucial and immediate appendicectomy is indicated. If there is complains of diarrhoea, colonoscopy should be considered. Post-operative morbidity and length of hospital stay are increased in the patients with perforated appendicitis.

## **COMPLICATIONS OF APPENDICITIS**

1. APPENDICULAR RUPTURE- seen commonly in patients who are conservatively treated. Pathology continues leading to gangrenous appendix followed by rupture and thus peritonitis. Low immunity is also a cause for the rupture, seen in extremes of age groups.
2. APPENDICULAR MASS (PHLEGMON)- If patient doesn't present in the initial stages of disease, it progresses leading to adhesion of the omentum and coils of intestine around the inflamed appendix to form a mass. This is a natural defence

mechanism of the body to prevent generalised peritonitis even if there is perforation of the appendix. Commonly mass develops after third day of onset of acute appendicitis. It presents as a tender mass in the right iliac fossa, well localised with patients having fever and features of toxicity. Mass is treated by Oschner Sherrin's Regime- which is conservative management followed by interval appendicectomy. If patients do not respond to conservative treatment, it may turn into appendicular abscess.

3. APPENDICULAR ABSCESS- It happens due to suppuration in already formed appendicular mass. Usually occurs in retrocaecal and pelvic region. Patients usually present at 8- 10 days with a tender mass in the right iliac fossa with localised rigidity with indistinct lower margin. Patients will also have signs of fever, toxicity. USG is done to confirm.
4. GENERALISED PERITONITIS AND SEPSIS

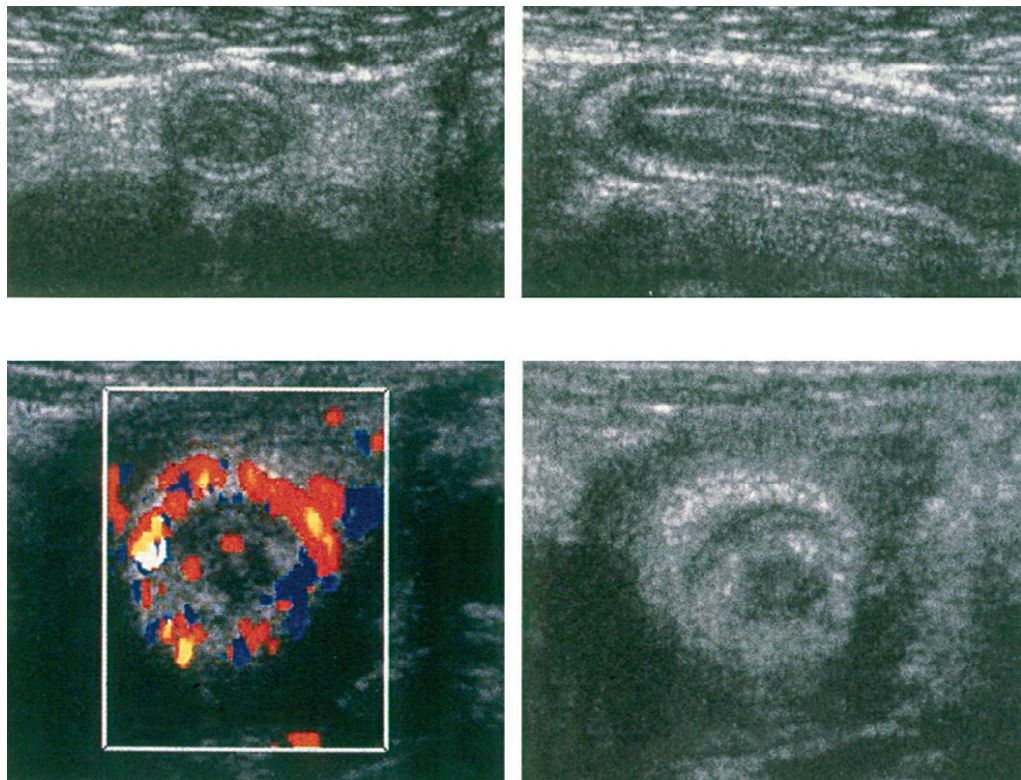
## DIFFERENTIAL DIAGNOSIS OF APPENDICITIS

CHILDREN	ADULT	ADULT FEMALE	ELDERLY
Gastroenteritis	Regional enteritis	Mittelschmerz	Diverticulitis
Mesenteric adenitis	Ureteric colic	pelvic inflammatory disease	Intestinal obstruction
Meckel's Diverticulitis	perforated peptic ulcer	Pyelonephritis	Colonic carcinoma
Intussusception	Torsion of testis	Ectopic pregnancy	torsion appendix epiploicae
Henoch-Schonlein purpura	Pancreatitis	Torsion/rupture of ovarian cyst	Mesenteric infarction
Lobar pneumonia	Rectus sheath haematomas	Endometriosis	Leaking aortic aneurysm

## INVESTIGATIONS

- A. Haemoglobin
- B. Total and differential counts- mild leucocytosis 10000- 18000 cells/ cubic mm. is associated with uncomplicated appendicitis with left shift. Counts more than 18000 is associated with complicated appendicitis.
- C. Random and fasting blood sugars (in diabetics)
- D. Erythrocyte Sedimentation Rate- elevated levels found in perforation and abscess
- E. Coagulation Profile
- F. Renal function tests
- G. HIV/ HBsAg
- H. Complete urine analysis
- I. ECG and Chest X ray

- J. Erect X ray Abdomen – which may show a fecolith, ureteric calculus, increased soft tissue density in the right lower quadrant, distended small bowel loops.
- K. Ultrasonography- first study performed in a case of acute abdominal pain due to lower cost, accessibility, lack of ionising radiations and ability to detect gynaecological diseases<sup>31</sup>. There are disadvantages to USG, that it is operator dependent, also USG cannot penetrate through gas, so it may not be able to visualise appendix if there is gas such as retrocaecal or deep pelvic appendicitis<sup>32</sup>.  
Ultrasound Diagnostic criteria; tender, non-compressible blind ending loop more than 6 mm diameter or mass or abscess seen, Probe tenderness, in the right iliac fossa.
- L. CT- it has a sensitivity of 87-100 % and specificity of 90-95 %. It is indicated in Alvarado scores of 5 and above. On scan, appendix appears dilated > 6mm with wall thickening. Fecolith may be visualised, surrounding fat stranding and



FIGURES 18,19,20,21-USG PICTURE OF APPENDICITIS



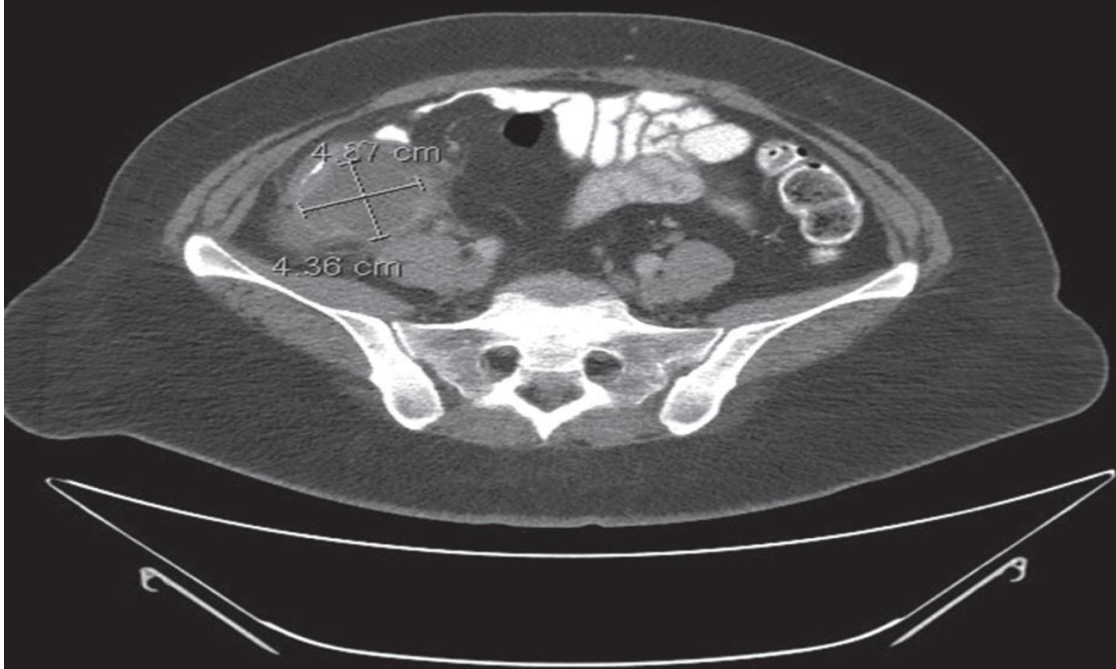


FIGURE 22: CT PICTURE OF AN APPENDICULAR ABSCESS

inflammation can be present. It rules out other intrabdominal and pelvic pathologies. Disadvantages; long term risks of radiation exposure with paediatric population at greater risk. For this reason, CT has been used judiciously in paediatric patients.

M. MRI- Sensitivity of 98- 100 %, specificity of 92.4 – 93.8 %. Useful in pregnant and paediatric population. Disadvantages include, longer duration, breath holds for certain sequences, need for sedation in the paediatric patients.

Features suggestive of Appendicitis are- Hyper intense thickened wall, Hyper intense Peri appendiceal tissue, dilated appendix (6 mm) which can be associated with free fluid in the pelvis<sup>31</sup>.

**ALVORADO SCORING SYSTEM:**

Following investigations this scoring is done so as to plan the further treatment.

It has 3 symptoms, 3 signs and 2 investigations.

<b>MIGRATING PAIN</b>	<b>1</b>
<b>ANOREXIA</b>	<b>1</b>
<b>NAUSEA, VOMITING</b>	<b>1</b>
<b>TENDERNESS AT RIGHT ILIAC FOSSA</b>	<b>2</b>
<b>REBOUND TENDERNESS</b>	<b>1</b>
<b>ELEVATED TEMPERATURE</b>	<b>1</b>
<b>LEUCOCYTOSIS (&gt;10,000)</b>	<b>2</b>
<b>SHIFT TO LEFT WITH NEUTROPHILIA</b>	<b>1</b>
<b>TOTAL</b>	<b>10</b>

**SCORE <5 NOT SURE**

**5-6 COMPATIBLE**

**6-8 PROBABLE**

**>9 CONSTANT**

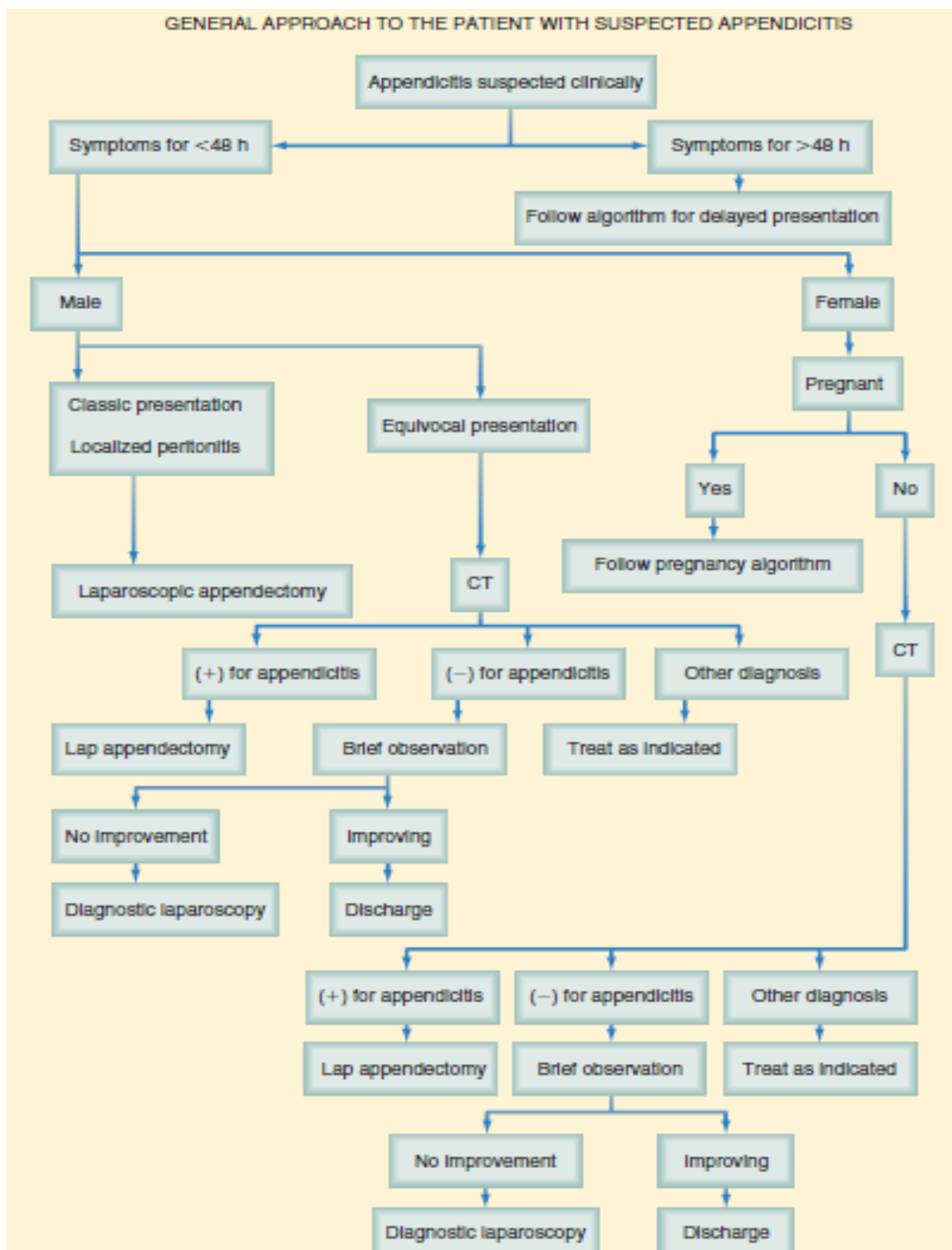


FIGURE 23: APPROACH TO A PATIENT WITH APPENDICITIS

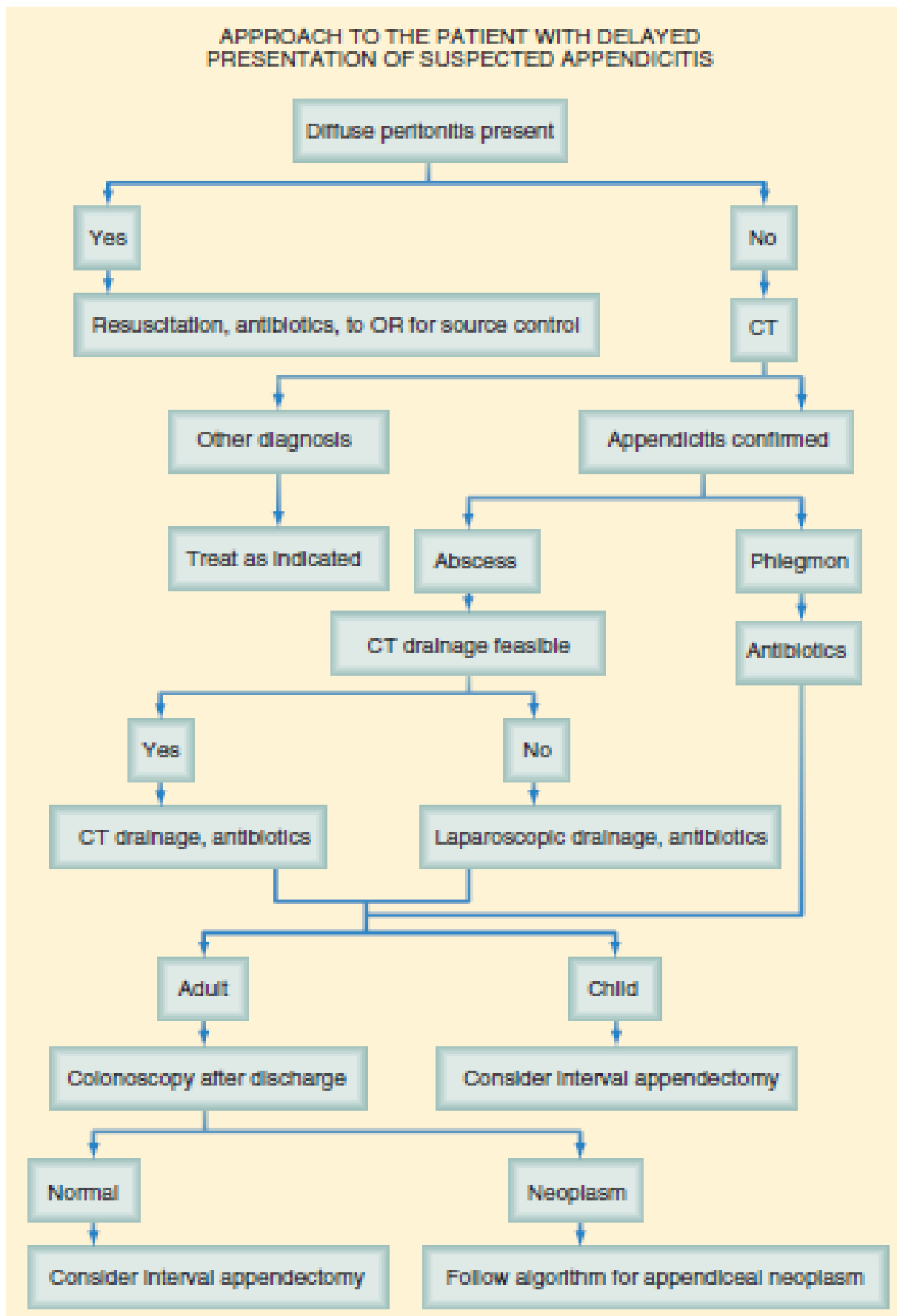


FIGURE 24: APPROACH TO DELAYED PRESENTATION OF APPENDICITIS

## TREATMENT

- **NON-OPERATIVE:** Appendicectomy is one of the first abdominal operation done. Treves pursued early conservative management of appendicitis even before the advent of antibiotics. Coldrey presented a retrospective study of a series of 471 patients whom he treated with antibiotics, out of which 57 failed thus requiring surgical intervention in the form of appendicectomy. Based on the high rate of failure of antibiotic treatment, surgical treatment is preferred over conservative management.
- **OPERATIVE:** Appendicectomy is the most common surgical emergency and should be done as an immediate procedure. The definitive treatment of acute appendicitis is appendicectomy in the 1<sup>st</sup> two days of attack on an emergency basis before perforation or mass appears. If there is evidence of mass or abscess that is onset more than 48hrs, surgery may be delayed although there is no absolute rules regarding the same. Patients with peritonitis and rupture have to be taken for surgery immediately.

## PROGNOSIS

- Simple uncomplicated appendicitis has a mortality rate of 0.2%. Irrespective of the course of disease the overall mortality is 1%. The average length of hospital stay in uncomplicated appendicitis is about 5-6 days whereas in gangrenous or complicated is 14-15 days.
- Higher antibiotics, improved surgical methods, early diagnosis through advanced imaging helps to reduce the mortality and morbidity of the disease.

## **PREOPERATIVE PREPARATIONS**

Patient should be shifted to OT immediately without any delay.

Requisites include nil per oral, intravenous fluids to correct dehydration and electrolyte imbalance, intravenous antibiotics and analgesics, preparation of parts for surgery.

## **OPERATION**

After patient is anaesthetised the abdomen is palpated again to look for any mass palpable. The various incisions used for appendicectomy are as follows:

- ✓ **Grid iron incision:** this incision is applied at right angles to the spinoumbilical line at the junction of medial two third and lateral one third.
- ✓ **Fowler Weir incision:** Extension of the grid iron incision by dividing the anterior rectus sheath in line with the incision<sup>33</sup>.
- ✓ **Rutherford Morrison's muscle cutting incision:** By cutting the internal oblique and transverse abdominis both medially and laterally grid iron incision can be converted into this type<sup>33</sup>.
- ✓ **Lanz's transverse incision:** It is a transverse skin incision in the line of skin crease with centre of Mc Burney's point<sup>21</sup>.
- ✓ **Battle's pararectal incision:** in 1895 Battle enumerated an incision in the right semilunar plane of variable length, including the rectus medially.
- ✓ **Right lower paramedian incision:** A straight vertical incision of about 2.5cm length, 1.25-2.5cm lateral to the midline on the right side.

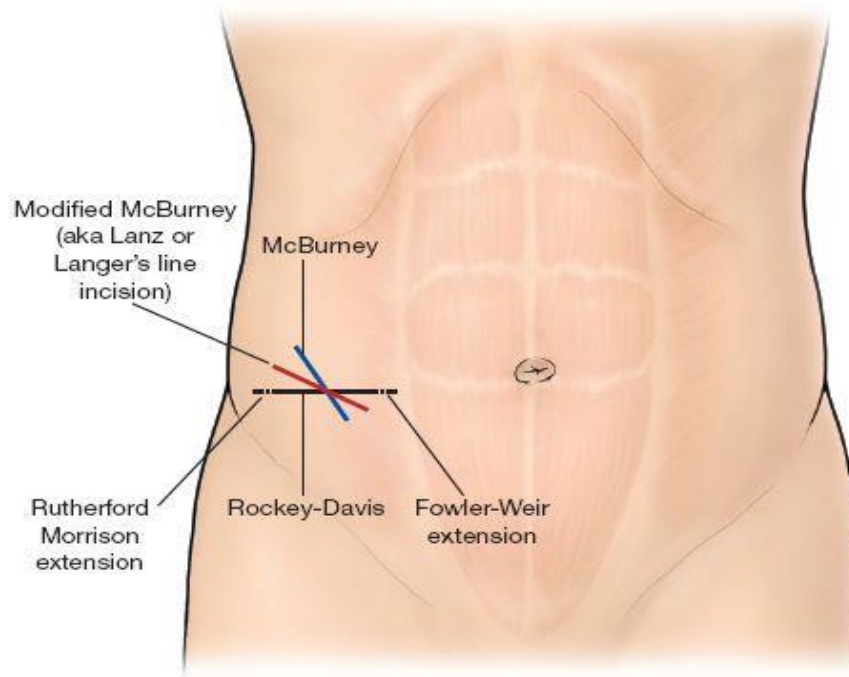


FIGURE 25: VARIOUS INCISIONS FOR OPEN APPENDICECTOMY

## ISOLATION OF APPENDIX

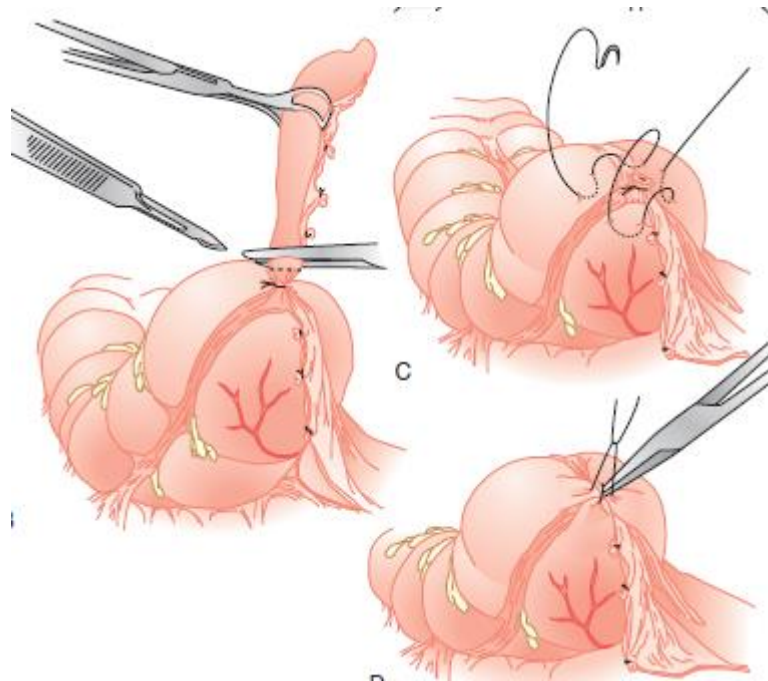
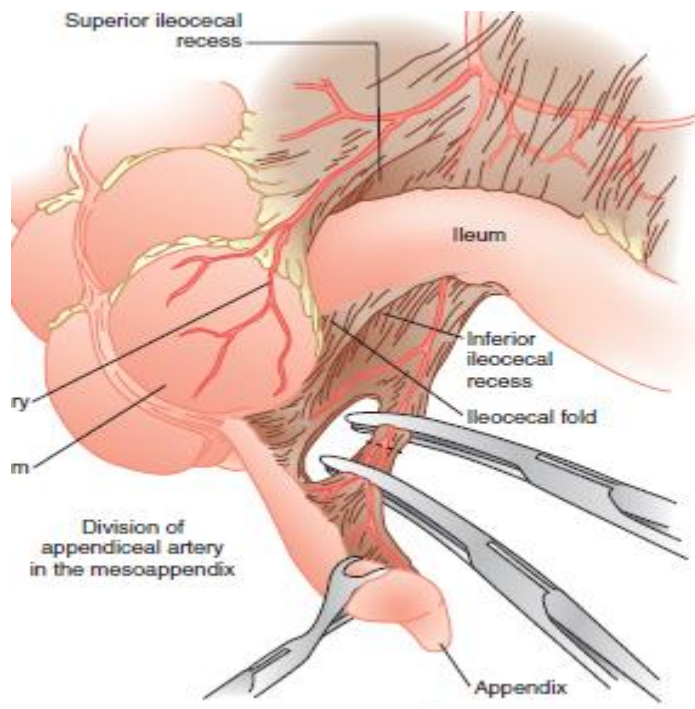
On entering the peritoneal cavity by tracing the anterior taenia coli appendix is identified. Another method is to identify fold of Treves, the only antimesenteric epiploic appendage which signifies the junction of caecum and ileum

## DIVISION OF MESOAPPENDIX

The mesoappendix is pierced at the base with a mosquito forceps and the appendicular artery is ligated through this hole. The mesoappendix is divided in close proximity to the appendix.

## REMOVAL OF APPENDIX

Appendix base is crushed with the help of a Kocher's forceps, it causes mucosal and muscular layers to occlude the lumen but peritoneal layer remains unaffected. Base is transfixed with suture. Appendix is cut in flush with this artery forceps<sup>34</sup>.



FIGURES 26,27: STEPS OF APPENDICECTOMY



## LAPAROSCOPIC APPENDICECTOMY

It is more commonly used nowadays than open technique. Advantages include better visualisation of abdomen and pelvis, faster recovery, less hospital stay, less wound infections, reduced pain and analgesic use, cosmetically better scar. However, disadvantages include cost factor, and contraindicated in cardiac and pulmonary disease. Also, the operating surgeon should have sufficient expertise and skills for performing laparoscopy. Diagnostic laparoscopy can be beneficial in undiagnosed pain abdomen.



FIGURE 28: NORMAL LAPAROSCOPIC VIEW OF APPENDIX

### **Essential requirements for laparoscopy:**

For visualisation-light source, telescope, video camera system, beam splitter, monitor.

For exposure and manipulation- insufflator, puncture instruments, grasping and dissecting instruments, occlusion and ligation instruments, electro surgical unit, wound closure instruments, irrigation and suction instruments, laparotomy instruments.

## **PROCEDURE**

After giving general anaesthesia patient is kept supine. First port access can be done by two techniques, first method where first pneumoperitoneum is created using a Veress needle and then 10mm trocar is introduced and second by direct puncture in which directly 10 mm trocar is introduced without pneumo-peritoneum. For safe Veress needle insertion we should check for the stylet and needle patency by aspirating to rule out blood, bile or air. If there is no aspirate saline is injected and there should be free flow. The Veress is connected to an insufflator and gas pressure is maintained at 12mm Hg and 10mm flow rate. If the value is greater than this it means that the patient is not given GA properly and is contracting abdominal muscles.

After insufflation with carbon dioxide, a 10 mm port is created just below the umbilicus and under vision through the 10mm umbilical port two more ports are created, both 5mm, one at the hypogastrium, care should be taken not to injure the bladder, and second one at the right or left iliac fossa. Depending on surgeon's preference 5mm ports can be also created at right and left iliac fossae. The angulation between the instruments should be between 60-90 degrees. Also, the instruments should be adequately far from each other to form an equilateral triangle. Surgeon and assistant stand on the left side, with monitor over the right side. The surgeon operates the two dissecting instruments while the assistant holds the telescope. The appendix is identified, adhesions are released from the base with electro cautery.

If there is retrocaecal appendix, then peritoneal attachments to the abdominal wall on the lateral side should be divided for better visualisation. Injury to the iliac vessels and ureter are avoided.

Appendix is held with a Babcock's forceps and retracted anteriorly. A window is created in the mesoappendix and appendicular artery is ligated with help of cautery. Appendix base is closed with suture or clips. This is followed by cutting the appendix in flush and appendix is removed with endobag through umbilical port. Port closure of 10mm is done in 2 layers, whereas others in single layer.

## **POST OPERATIVE MANAGEMENT**

Patient is kept nil orally till bowel sounds appear or patient has passed flatus, intravenous fluids with electrolyte correction till oral feeds started, iv antibiotics, iv analgesics, TPR/BP 4<sup>th</sup> hourly, if peritoneal drainage is used it should be removed after 24-48hrs, regular dressings, suture removal from 7<sup>th</sup> -10<sup>th</sup> postoperative day. Care is same for open and laparoscopic techniques.

## **POSTOPERATIVE COMPLICATIONS**

**Early-** haemorrhage, diffuse peritonitis, pulmonary complications, retention of urine, neurogenic ileus.

### **Intermediate-**

secondary or residual abscess (pelvic, paracaecal, perinephric, subdiaphragmatic), wound infection, pyelophlebitis, femoral or iliac vein thrombosis, phlebitis and pulmonary embolism.

**Late-** incisional hernia, right sided indirect inguinal hernia, intestinal obstruction.

Wound infection is commonly seen in complicated appendicitis. Cardiovascular and pulmonary complications most commonly are seen in older age group.

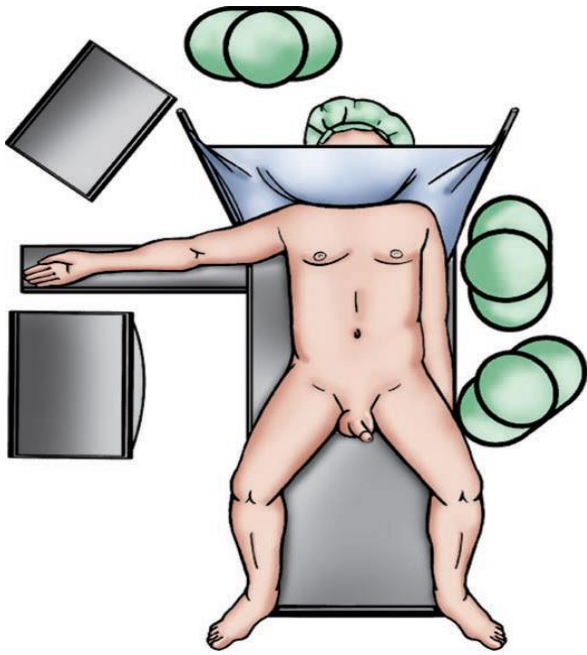


FIGURE 29

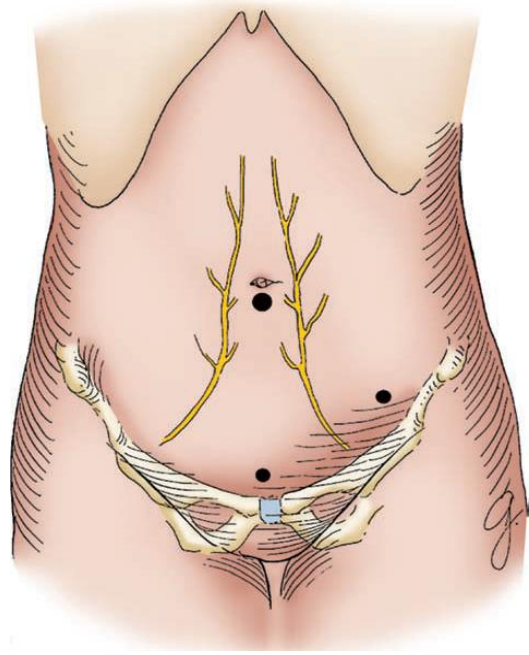


FIGURE 31: PORT PLACEMENT

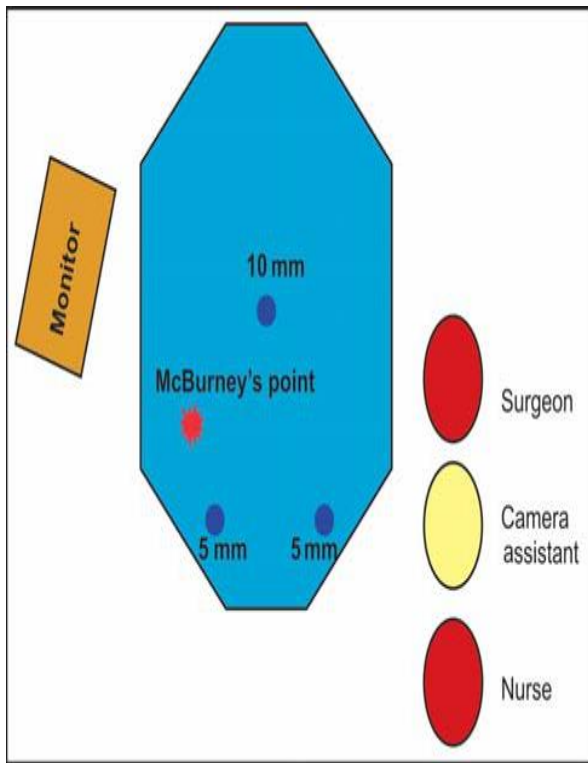
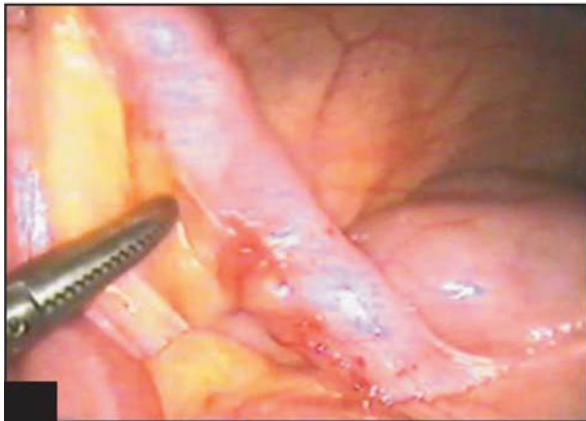
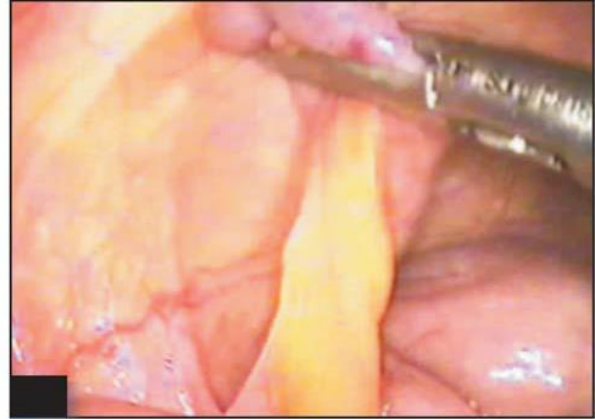


FIGURE 29,30- SURGEON, ASSISTANT AND MONITOR POSITIONS



FIGURE 32: CREATION OF PNEUMOPERITONEUM WITH VERESS NEEDLE



FIGURES 33,34,35,36: STEPS OF LAPAROSCOPIC APPENDICECTOMY

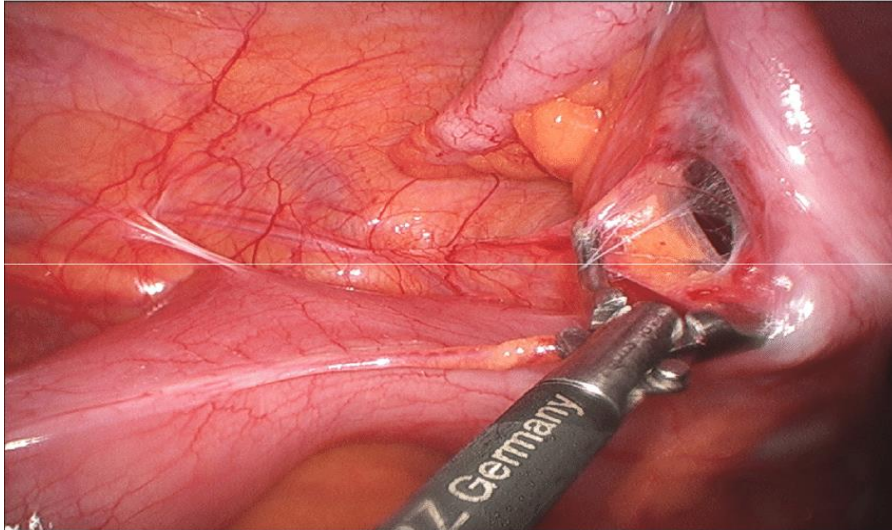
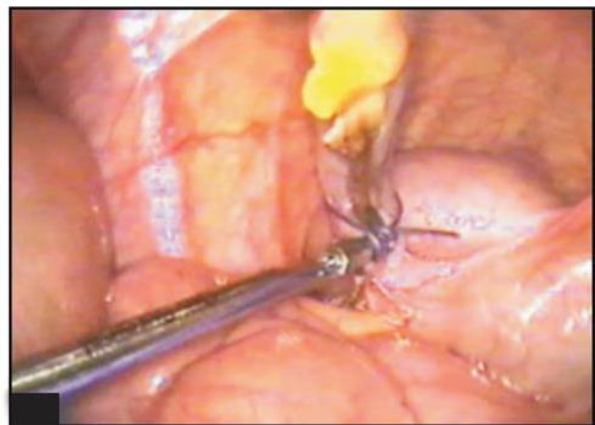
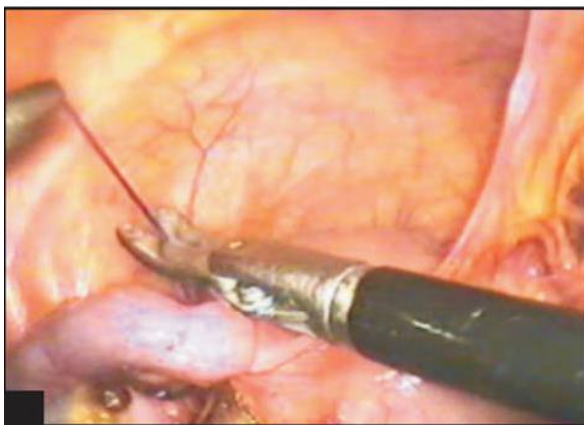
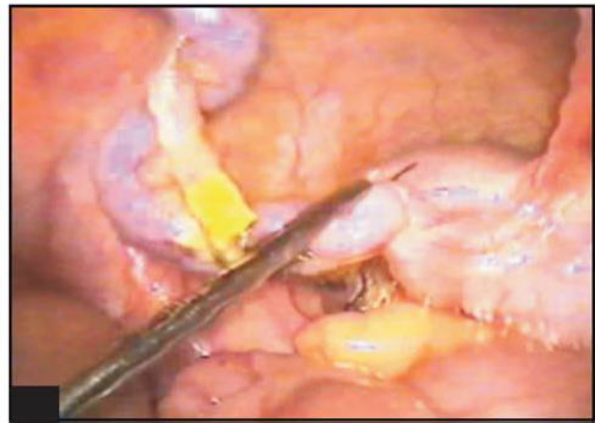
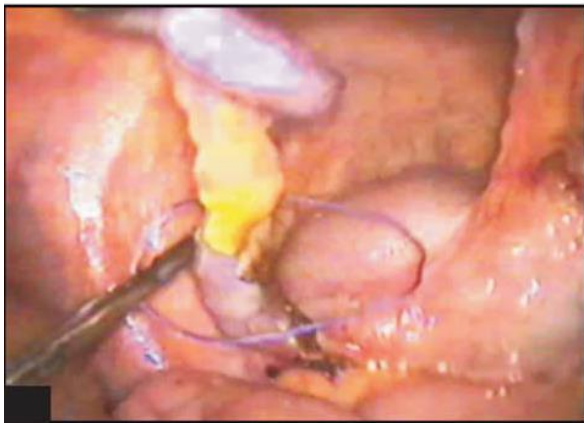
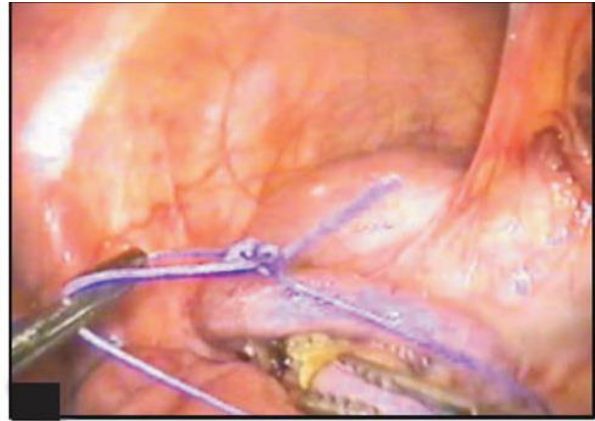
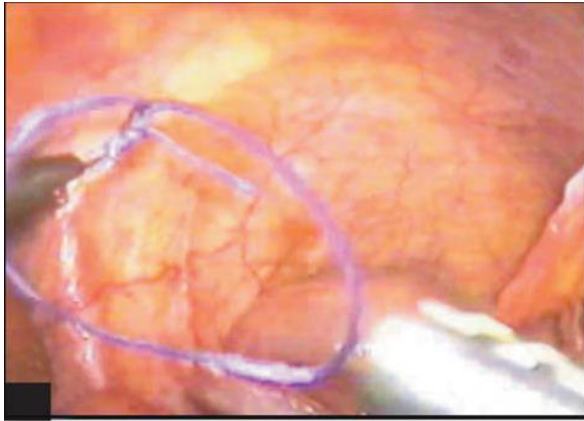


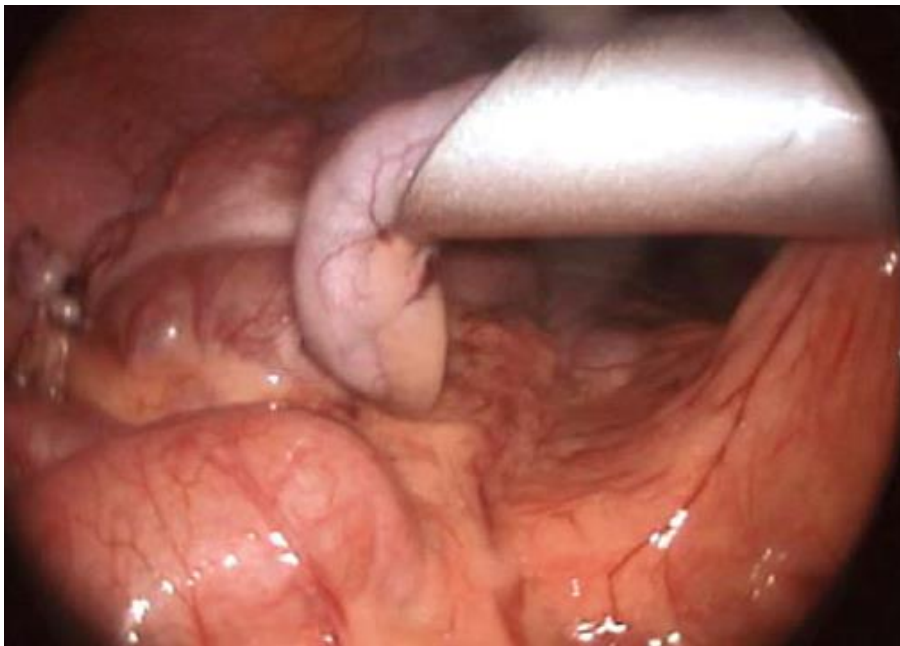
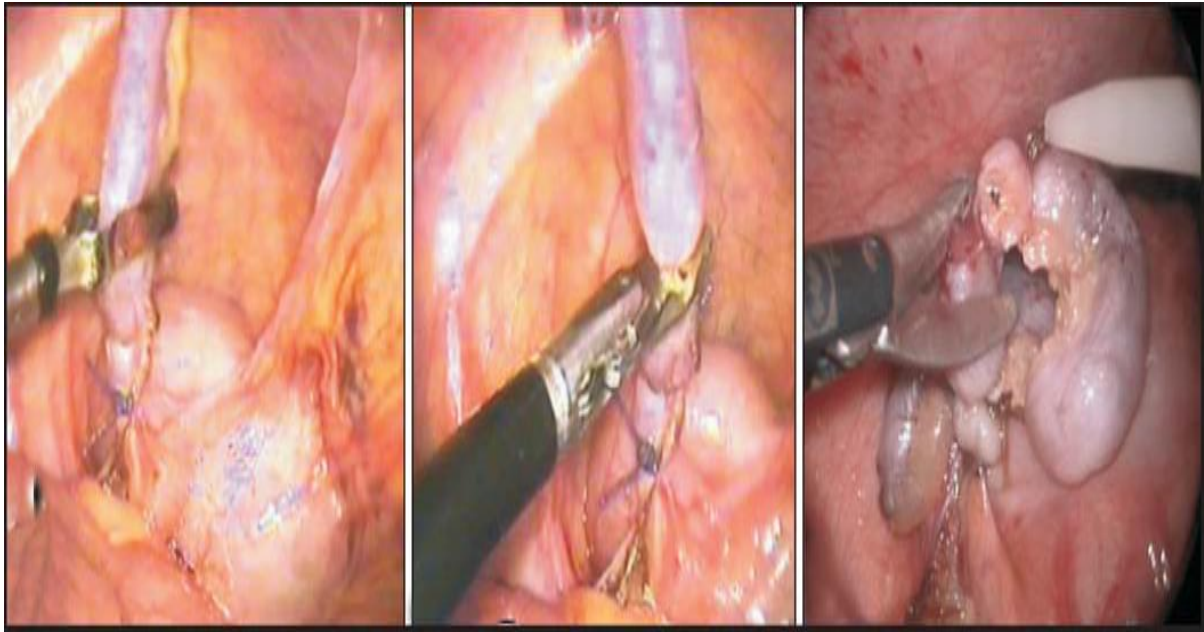
FIGURE 37: CREATING WINDOW IN MESOAPPENDIX



FIGURE 38: DISSECTION BY MONOPOLAR



FIGURES 39,40,41,42,43,44: APPLYING ROEDER'S KNOT OVER APPENDIX



FIGURES 45,46,47,48: DELIVERING THE APPENDIX OUT



## ADVANTAGES OF LAPAROSCOPIC APPENDICECTOMY

Laparoscopic appendectomy	Open appendectomy
Female of reproductive age group	Complicated appendicitis
Female of pre-menopausal group	COPD or cardiac disease
Suspected appendicitis	Generalized peritonitis
High working class	
Previous lower abdominal surgery	
Obese patients	Hypercoagulable sites
Disease conditions like cirrhosis of liver and sickle cell disease	Stump appendicitis after previous incomplete appendicectomy
Immune-compromised patients	

## NOVEL TECHNIQUES FOR APPENDICEAL STUMP CLOSURE

Various new techniques have been tried for the closure of appendix base during appendicectomy. Some of these are endoloop, double endoloop, ultrasonically activated scalpel, instrument-assisted knotting, bipolar coagulation, slipknot tying, metal clip, Hem-o-lock clip, and linear endostaplers. Results of all these methods are comparable<sup>1</sup>.

- ❖ **Titanium clip** application is also a new method for stump closure. Titanium has been proven biocompatible element. Its advantages are that it has a force of contact which is high closing and continuous. Also, it has been seen that the tissue adapts good to the implant. It has 2 stems which are parallel to each other. Following its application over the base the base is crushed between the stems, thus preventing slippage. There is a pyramid shaped indentation on the inner surface which helps to increase the surface area of contact between the tissues. As a result, it helps in a good clasp. Also, the implant end ensures that there is no slipping<sup>1</sup>.



FIGURES 49,50: TITANIUM DOUBLE SHANKED CLIPS

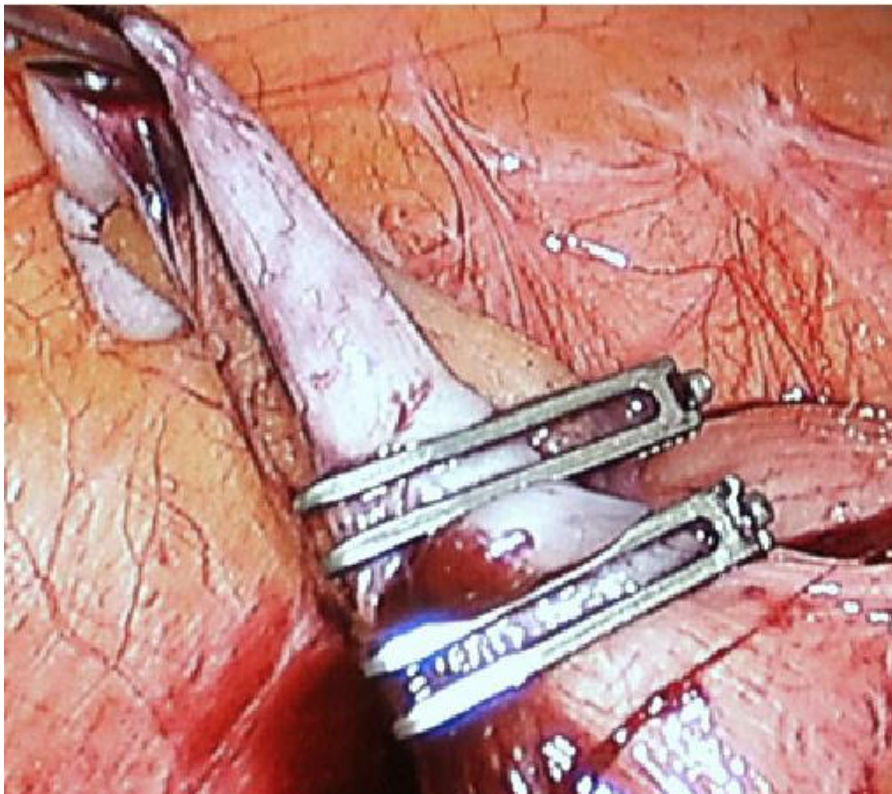


FIGURE 51: TITANIUM CLIPS APPLIED OVER APPENDIX BASE

## Haem o lock clips

These are non-absorbable polymer structures which can be used for sealing of vessels, ureters, bile ducts. These can be used as an alternative novel technique for closure of the appendicular stump. Although they are costly but are considered safe and requiring lesser time of laparoscopy. They have less risk of slippage from the base. Due to presence of the locking device the clips sit at the base securely thus assuring the surgeon towards slippage. The clips should be applied at 90 degrees to the base of appendix<sup>35</sup>.

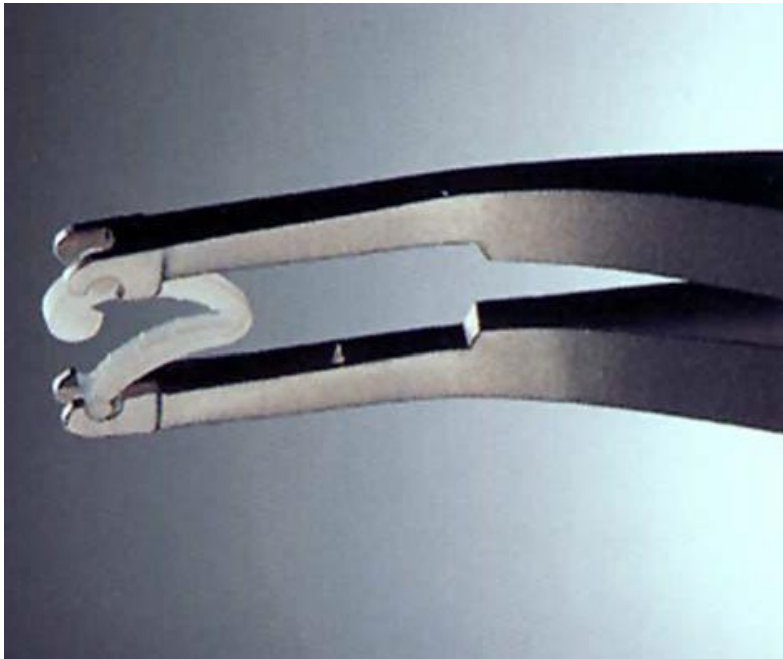
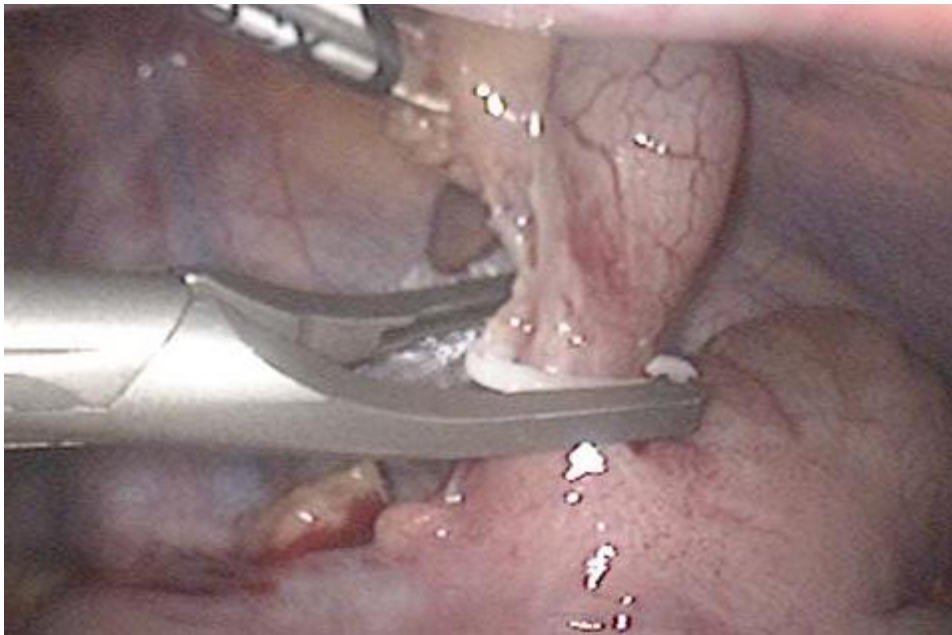


FIGURE 52: HAEM O  
LOCK CLIPS WITH



FIGURES 53,54: HAEM O LOCK CLIPS AT THE APPENDIX BASE

## ENDOSTAPLERS

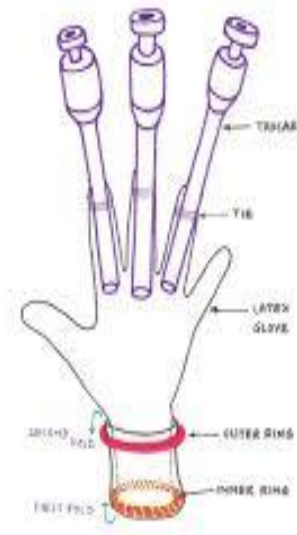
Another alternative for stump closure is use of endostaplers. Main advantage is that it is fast and easy. Also, it has ability to seal and transect tissue at once. Its main disadvantage is its price. It can tangentially transect the wall of caecum. It can be used when base is thickened.



FIGURE 55: ENDOSTAPLERS FOR APPENDIX BASE

## SINGLE INCISION LAPAROSCOPIC SURGERY(SILS)

Current advancement in the field of minimal access surgery includes the use of one incision for performing surgeries. Advantages include early healing, less scars, fewer surgical site complications, better cosmetic results. Although it has been seen that the time required for surgery is longer. Over the years SILS has been used for cholecystectomy, appendicectomy, bariatric surgeries, hernia repair, fundoplication, nephrectomy. For SILS, 30 mm umbilical incision is made followed by insertion of a SILS port with a shoehorn technique. 5 mm trocars introduced through the device. Rest of the procedure for appendicectomy remains same. Closure can be done in two layers<sup>36</sup>.



FIGURES 56,57,58: SILS PORT, SILS PORT WITH GLOVE

FIGURE 59: SILS PORT INSERTED AT UMBILICUS

## STUDIES

Our study is to compare efficacy and safety of novel method that is metallic endoclips for appendiceal stump closure in patients undergoing laparoscopic appendicectomy. For a detailed study we need to review with other studies.

A study done by Nikhil Dikshit and Abhijit S Gogate done in Jawaharlal Nehru medical college, Belgaum, Department of surgery showing the comparison between metallic endoclips and Roeder's Knot for appendix stump closure in 2016 included 30 patients in study group that is titanium clips application group and 30 in control that is Roeder's knotting. The study group required less duration of surgery(45-60min) in comparison to control group(61-75min). Also, the study group patients had lesser duration of hospital stay and hence early return to daily activities. Other parameters like intra-operative, postoperative complications and follow up period were insignificant as compared to both groups<sup>1</sup>.

Another study by Alexander Rickert and colleagues done in 2011 which included 104 patients for application of titanium clips for base of appendix in laparoscopic appendicectomy. Here in 4 patients clips could not be placed due to adhesions and inflammation extending till the caecum. Also, one patient had developed intraabdominal abscess which had to be drained under guidance, although second surgery was not required. Other parameters like hospital stay, operative time, complication rate were similar to other methods of stump closure. The study had proven that application of titanium clips were safe, easy and with less learning curve making it easier to learn for young surgeons<sup>38</sup>.

M Nadeem and coworkers had done a study in 2016 comparing extra corporeal knotting with titanium clips for appendicular base in laparoscopic appendicectomy for acute appendicitis without complications. In this study total 68 patients were included and divided into two groups randomly,32 in Roeder's knotting group and 36 in metallic clips group. The mean



duration of surgery was significantly less in endoclips group (42.1+/-7.4) than in Roeder's knotting (48.3+/-8.4) with p value of 0.002. However, with respect to cost factor endoclips group had higher cost. With respect to complication and hospital stay there was no much statistical significance. Hence, they concluded that titanium clip use for appendix base is safe and requires less time of surgery and is good for beginners<sup>4</sup>.

Marcin Strzalka and coworkers had done a study in 2016 comparing three methods for closure of appendix base-titanium clips, staplers and invaginating sutures. Total no of patients included were 307. It was concluded that these newer methods were efficacious and safe. Among these titanium endoclips were seen to have short duration of stay, operative time with least complications. The maximum duration of surgery and hospital stay was seen in invaginating sutures group<sup>39</sup>.

A study done by Carlos et al in 2013 using titanium clips for appendix base for laparoscopic appendicectomy in complicated appendicitis showed that the necrosis of base is a very significant parameter for predicting complications post-surgery. Although in this study it has been reported that metallic clips for complicated appendicitis is safe and efficacious<sup>40</sup>.

## **5.MATERIALS AND METHODS**

### **SOURCE OF DATA:**

All patients coming to in Surgery Department admitted for laparoscopic appendicectomy.

### **METHOD OF COLLECTION OF DATA:**

All patients admitted in Surgery Department during duration of Nov 2017 – July 2019 with 45 patients in each group, of a total of 90 patients.

- The patients will be divided into two groups- The first group will include patients undergoing Endoclip closure (EC) and the second group will include patients undergoing suturing(S)
- Patients will be allotted to either of the group to ensure that the two groups are adequately matched with respect to age, sex ratio and mean body mass index.

### **INCLUSION CRITERIA**

Patients diagnosed with appendicitis and willing for LA

- Clinically diagnosed as acute/chronic appendicitis
- Patients aged between 18 and 60 years.

### **EXCLUSION CRITERIA**

- complicated appendicitis (perforated/gangrenous appendicitis or if base is more than 10mm
- Bleeding disorders
- Pregnancy
- Patients not fit for general anesthesia.

## **SAMPLING**

- Prospective, comparative study.

## **STATISTICAL ANALYSIS:**

- Data will be expressed as mean, median and standard deviation.
- Diagrams.
- Chi square test and T test will be used to compare the results between 2 groups.

## **SAMPLE SIZE COLLECTION**

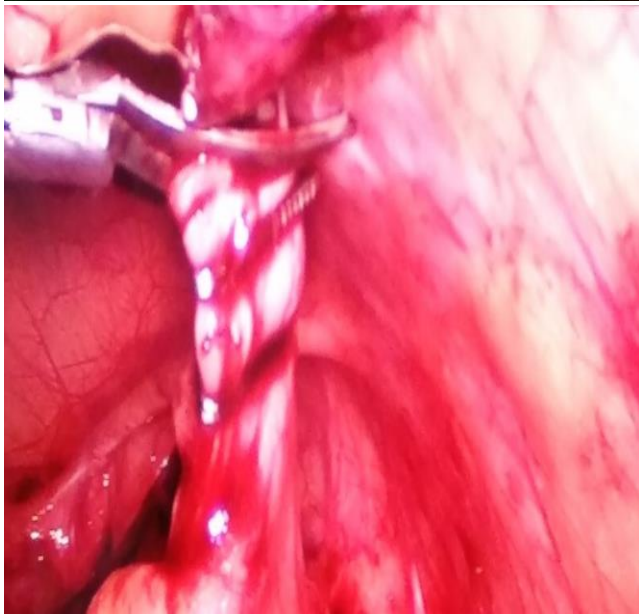
- A study by M Nadeem et al titled Comparison of extracorporeal knot tying and metallic endoclips in laparoscopic stump closure in uncomplicated acute appendicitis, the minimum sample size per group is 45 With 95% power and 5% level of significance.
- By using the formula:
- $$n = \frac{(z_{\alpha} + z_{\beta})^2 \cdot 2 \cdot SD^2}{MD^2}$$
- Where Z= Z statistic at a level of significance
- MD= Anticipated mean difference
- SD= Anticipated Standard deviation

## **METHOD OF PORT PLACEMENT:**

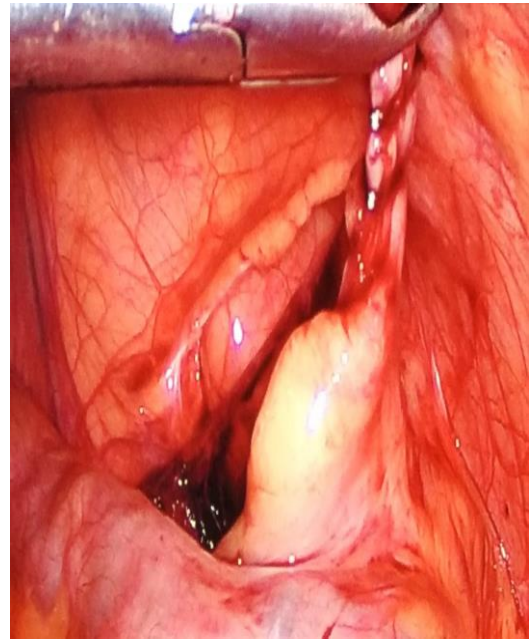
- For Roeder's knot: two 5 mm ports are placed over right iliac region and hypogastric region with one 10mm port over umbilical
- For Endoclip 10mm ports are placed over umbilical and hypogastrium and one 5mm port over right iliac region.

## **METHOD OF STUMP CLOSURE:**

- Roeder's knot: 2 knots 5 mm apart at base of appendix
- Endoclip: 3 clips are applied.
- Endoclip closure group will undergo appendicular stump closure by endoclips.
- The patients will be explained in details about both the operative procedures and complications.
- The following information will be included in the data sheet: age, sex, duration of symptoms before admission, clinical presentation, use of preoperative antibiotics, intraoperative bleeding and spillage, postoperative parenteral analgesia, duration of post-op stay and complications.
- Routine post op care is followed
- Operative findings and time will be noted from skin incision to skin closure.
- Total number of days in hospital will be noted.
- First follow up will be done on 7<sup>th</sup>-10<sup>th</sup> post op day for suture removal and wound assessment followed by a subsequent follow up at 2 months.



FIGURES 60,61,62,63: TITANIUM CLIPS USED IN THIS STUDY FOR APPENDIX BASE



FIGURES 64,64,66,67: TITANIUM CLIPS USED IN THIS STUDY FOR APPENDIX BASE

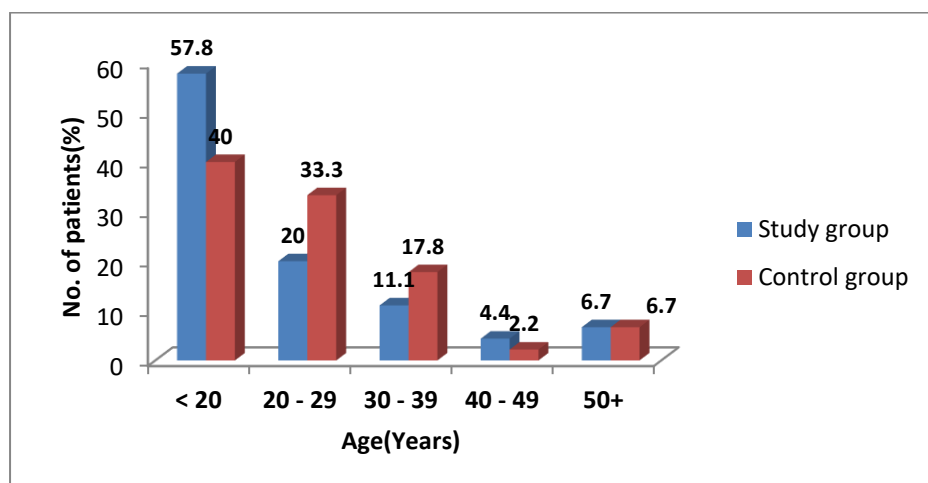
## 6.RESULTS

**TABLE 1: AGE DISTRIBUTION IN STUDY AND CONTROL GROUPS**

Age (Years)	Study		Control	
	No. of patients	percentage	No. of patients	percentage
< 20	26	57.8	18	40.0
20 - 29	9	20.0	15	33.3
30 - 39	5	11.1	8	17.8
40 - 49	2	4.4	1	2.2
>50	3	6.7	3	6.7
Total	45	100.0	45	100.0

The aforementioned table shows age distribution of two groups study with titanium clips and control with Roeder's knotting. There were 26 patients in the age group of less than 20 years in study group corresponding to 57.8 %, while in control it is 18 that is 40% in the same age group. In the age group of 20-29 years there are 9 patients that is 20% in study group whereas 15 in control group which is 33.3%. In 30-39 years, it is 5(11.1%) in study group and 8(17.8%) in control group. In 40-49 years, group it is 2 (4.4%) in study and 1(2.2%) in control. It is similar that is 3(6.7%) in both groups for age more than 50 years.

**FIGURE 68: AGE DISTRIBUTION IN STUDY AND CONTROL GROUPS**



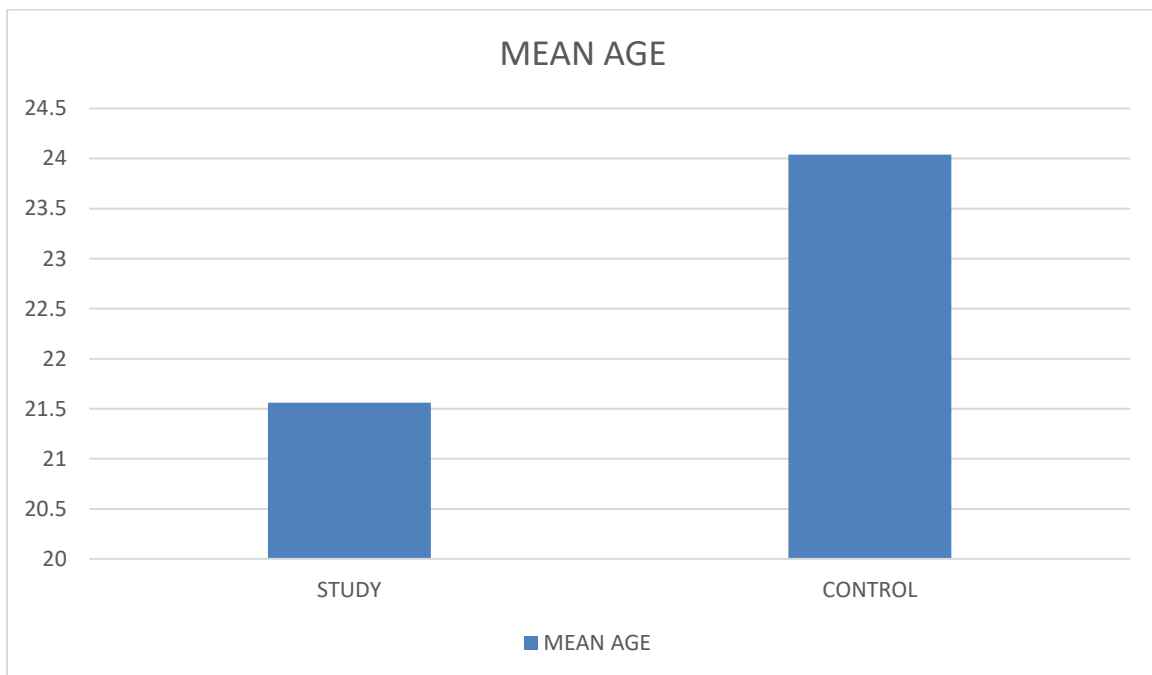
**TABLE 2: MEAN AGE IN STUDY AND CONTROL GROUPS**

Variables	Study Group		Control Group		Mann whitney U test/ Independent t t test	P value
	Mean (Median)	±SD	Mean (Median)	±SD		
Age (Years)	21.56(16)	12.48	24.04(23)	11.580	U=833.500	P=0.147 NS

**NS: Not significant HS: Highly significant**

Mean age was 21.56+/-12.48 with median of 16 in the study group. In the control group it was found to be 24.02+/-11.580 mean and 23 median.

**FIGURE 69: MEAN AGE BETWEEN STUDY AND CONTROL GROUPS**



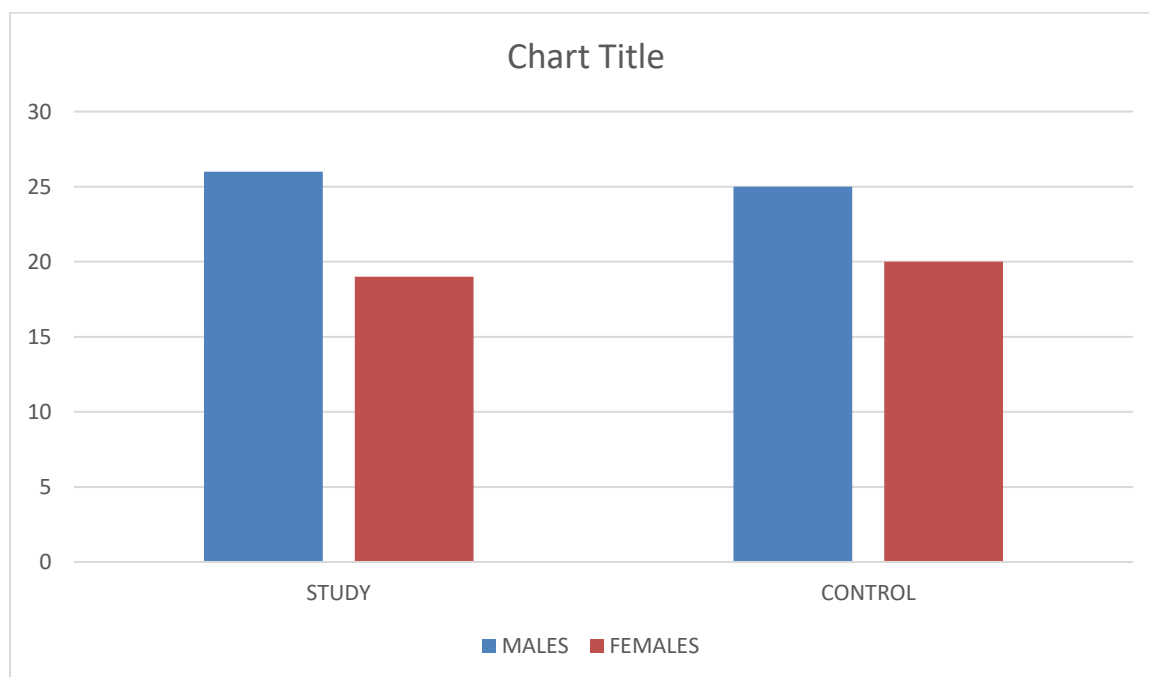


**TABLE 3: GENDER DISTRIBUTION IN STUDY AND CONTROL GROUP**

Gender	Study		Control		Chi square test	P value
	No. of patients	percentage	No. of patients	percentage		
Female	19	42.2	20	44.4	X <sup>2</sup> =0.0452	P=0.8315 NS
Male	26	57.8	25	55.6		
Total	45	100.0	45	100.0		

Among 45 patients, 26(57.8%) were males and rest females in study group. In control group 25(55.6%) were males.

**FIGURE 70: GENDER DISTRIBUTION IN STUDY AND CONTROL GROUP**

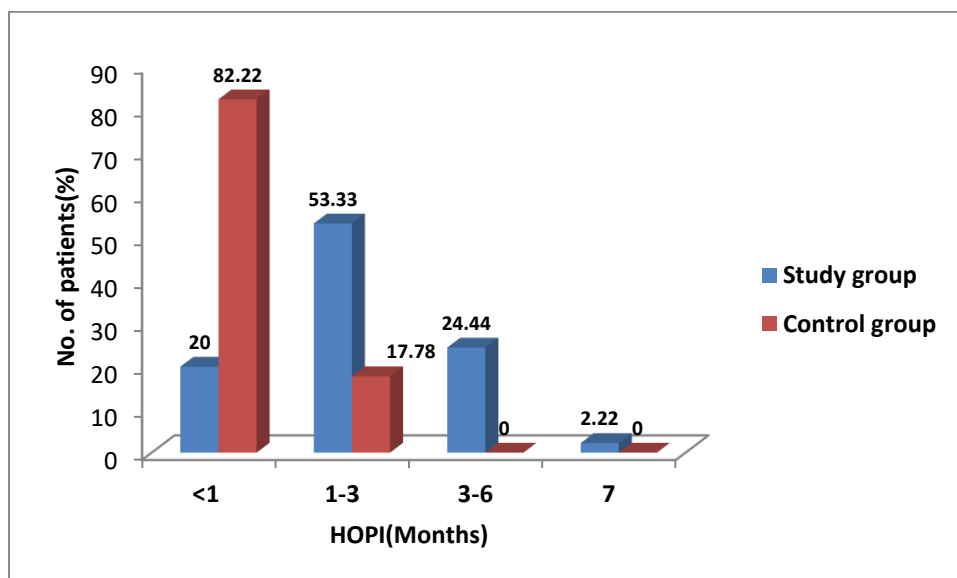


**TABLE 4: DISTRIBUTION OF PRESENTING COMPLAINTS**

PRESENTING COMPLAINTS (Months)	Study		Control		Chi square test	P value
	No. of patients	percentage	No. of patients	percentage		
<1	9	20	37	82.22	X <sup>2</sup> =37.503	P<0.0001 HS
1-3	24	53.33	8	17.78		
3-6	11	24.44	0	0		
>6	1	2.22	0	0		
Total	45	100	45	100		

9 patients (20%) in study group and 37(82.22%) in control group had complaint of pain abdomen within one-month duration. Between 1-3 months there were 24 patients (53.33%) in study and 8(17.78%) in control group. Between 3-6 months there were 11 (24.44%) in study and 0 in control group. Only 1 patient (2.22%) with symptom of pain abdomen in study group of more than 6 months duration. P value was found to be <0.0001 which was highly significant.

**FIGURE 71: DISTRIBUTION OF PRESENTING COMPLAINT (PAIN ABDOMEN)**

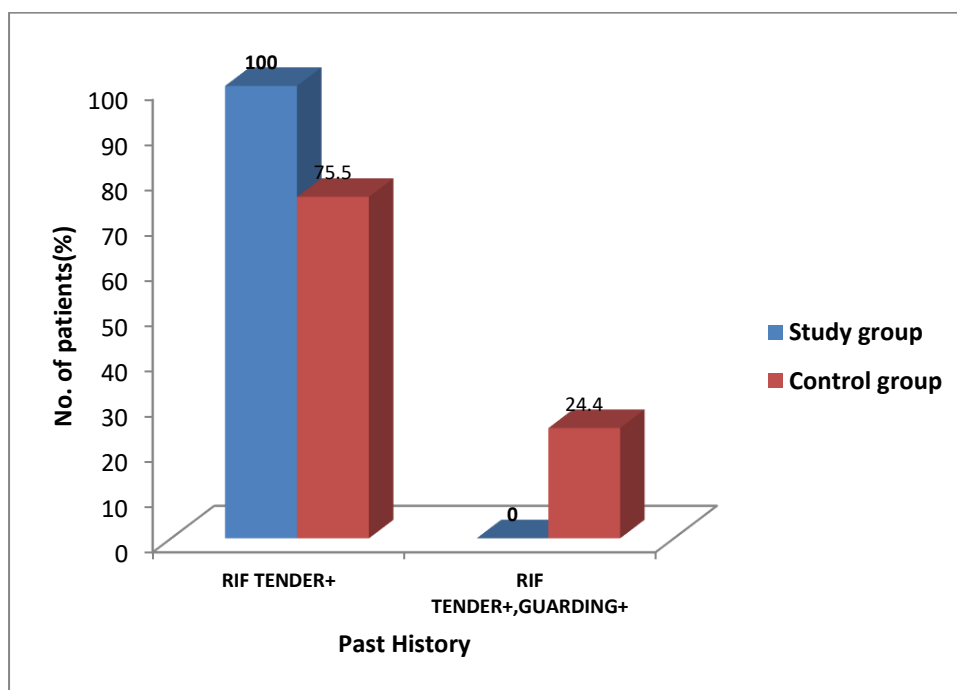


**TABLE 5: DISTRIBUTION OF PER ABDOMEN FINDINGS WITH RESPECT TO STUDY AND CONTROLS**

P/A	Study		Control		Chi square test	P value
	No. of patients	percentage	No. of patients	percentage		
RIF TENDER+	45	100.0	34	75.6	X <sup>2</sup> =12.532	P=0.0004 HS
RIF TENDER+, GUARDING+	0	0	11	24.4		
Total	45	100.0	45	100.0		

All patients in study group had only right iliac fossa tenderness. In control group 34 (75.6%) had only right iliac fossa tenderness, whereas 11 (24.4%) had both guarding and right iliac fossa tenderness. P value was found to be less than 0.0001 which is significant.

**FIGURE 72: DISTRIBUTION OF PER ABDOMEN FINDINGS WITH RESPECT TO STUDY AND CONTROLS**



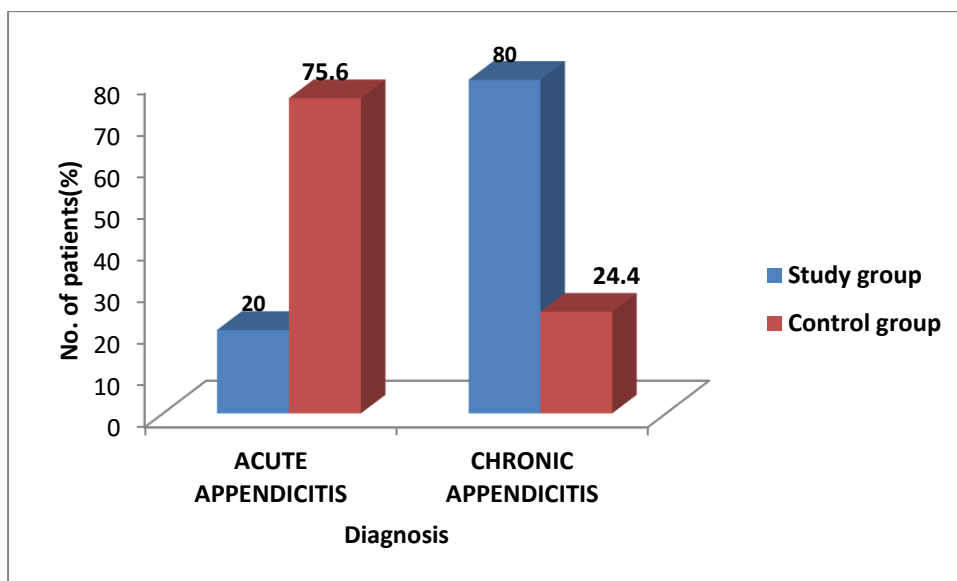
**TABLE 6: DISTRIBUTION OF DIAGNOSES**

DIAGNOSIS	Study		Control		Chi square test	P value
	No. of patients	percentage	No. of patients	percentage		
ACUTE APPENDICITIS	9	20.0	34	75.6	X <sup>2</sup> =27.833	P<0001 HS
CHRONIC APPENDICITIS	36	80.0	11	24.4		
Total	45	100.0	45	100.0		

HS: Highly significant

Diagnosis of acute appendicitis was made in 9 patients (20%) in study while 34(75.6%) in control group. Chronic appendicitis was seen in 36(80%) in study and 11(24.4%) in control group. P value was found to be highly significant.

**FIGURE 73: DISTRIBUTION OF DIAGNOSES**

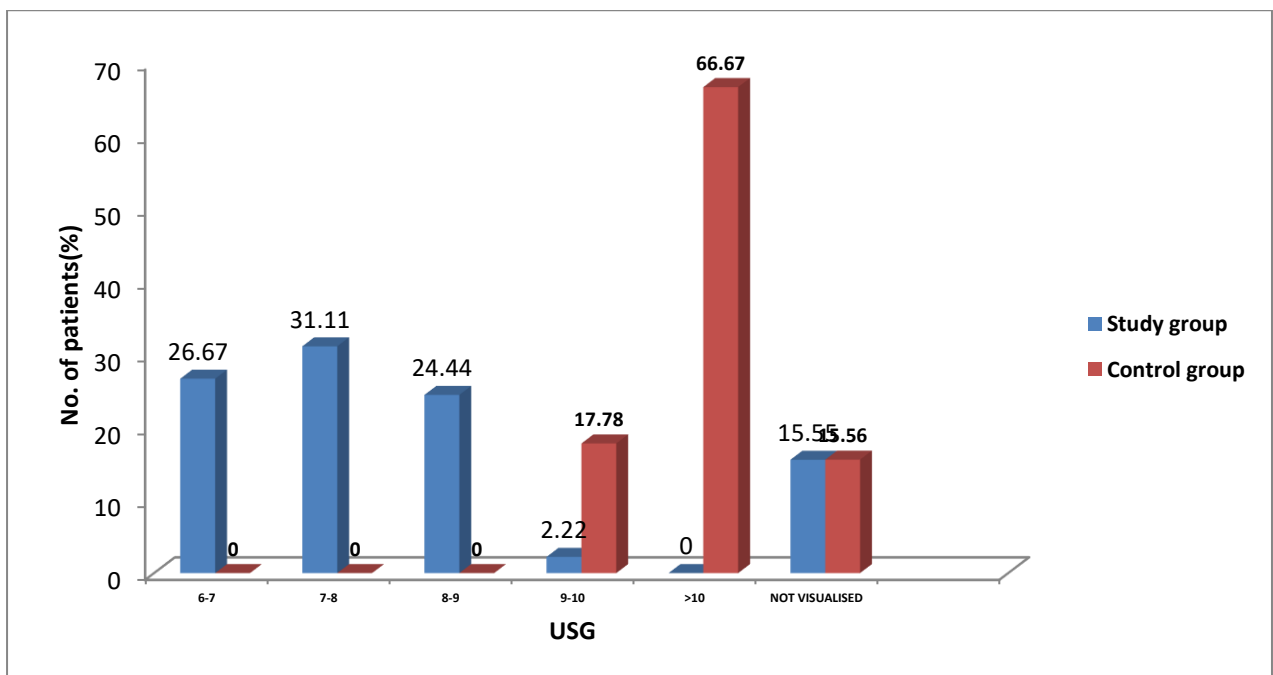


**TABLE 7: APPENDICULAR BASE DILATATION ON USG FINDINGS**

USG	Study		Control		Chi square test	P value
	No. of patients	percentage	No. of patients	percentage		
6-7	12	26.67	0	0	X <sup>2</sup> =60.442	P<0001 HS
7-8	14	31.11	0	0		
8-9	11	24.44	0	0		
9-10	1	2.22	8	17.78		
>10	0	0	30	66.67		
NOT VISUALISED	7	15.55	7	15.56		
Total	45	100.0	45	100.0		

In study group base of size 6-7mm was seen in 12 (26.67%) patients, 7-8mm in 14 (31.11%), 8-9 mm in 11 (24.44%), only 1 patient (2.22%) with 9-10 mm and none with more than 10 mm. In control group no patients were seen with base of size 6-7mm,7-8mm and 8-9 mm. However, 8 patients (17.78%) with 9-10mm and 30 (66.67%) were seen. Both groups had 7 patients each in whom appendix could not be visualised on ultrasound abdomen.

**FIGURE 74: APPENDICULAR BASE DILATATION ON USG FINDINGS**



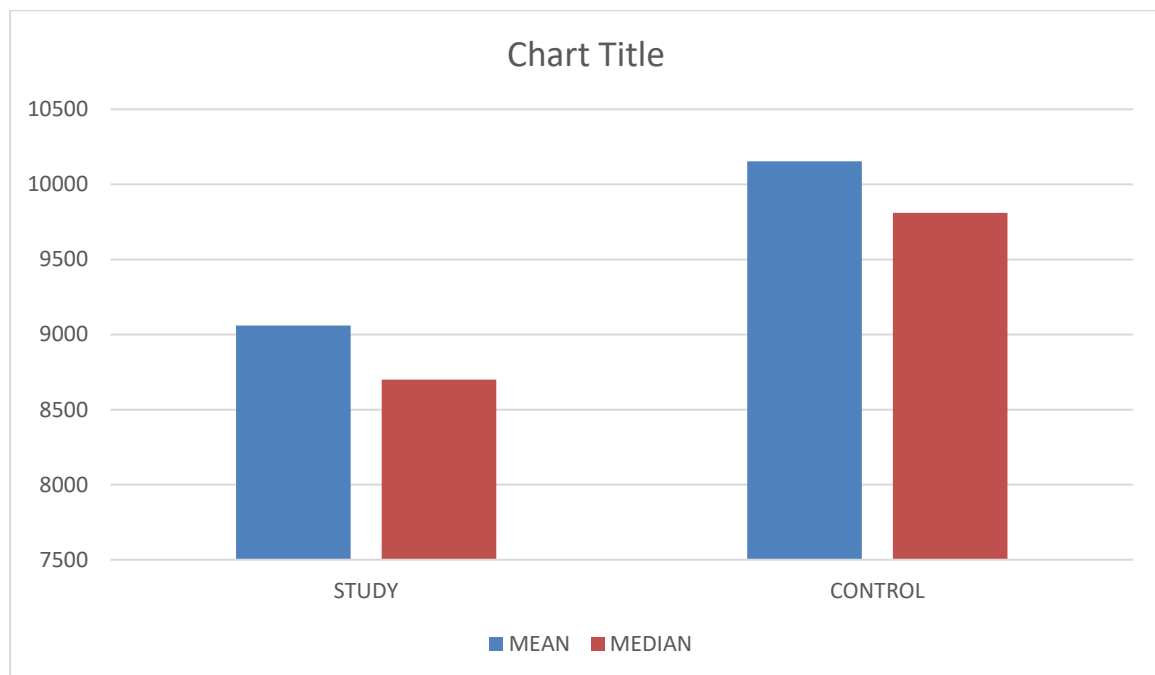
**TABLE 8: MEAN, MEDIAN AND SD OF TOTAL COUNTS IN STUDY AND CONTROL GROUPS**

Variables	Study Group		Control Group		Mann whitney U test/ Independent t t test	P value
	Mean (Median)	±SD	Mean (Median)	±SD		
TC	9059.56(8700)	2063.67	10154.22(9810)	2213.97	U=691.0	P=0.009 HS

**NS: Not significant HS: Highly significant**

Mean of total counts in study groups was 9059.56 with a median of 8700 and standard deviation of 2063.67. In control group mean was found to be 10154.22, median of 9810 and standard deviation of 2213.97. P value was found to be significant.

**FIGURE 75: MEAN, MEDIAN AND SD OF TOTAL COUNTS IN STUDY AND CONTROL GROUPS**



**TABLE 9: DIFFERENTIAL COUNT IN STUDY AND CONTROL GROUPS.**

Variables	Study Group		Control Group		Mann Whitney U test	P value
	Mean (Median)	±SD	Mean (Median)	±SD		
N	63.78(62)	11.507	70.60(72)	10.203	U=642.50	P=0.003 HS
L	12.11(11)	6.833	11.47(10)	3.314	U=1010.50	P=987.0 NS
E	1.87(2)	1.325	1.60(1)	1.136	U=898.0	0.337 NS

**NS: Not significant HS: Highly significant**

In study group mean neutrophil count of (63.78+/-11.507) % with median of 62%.

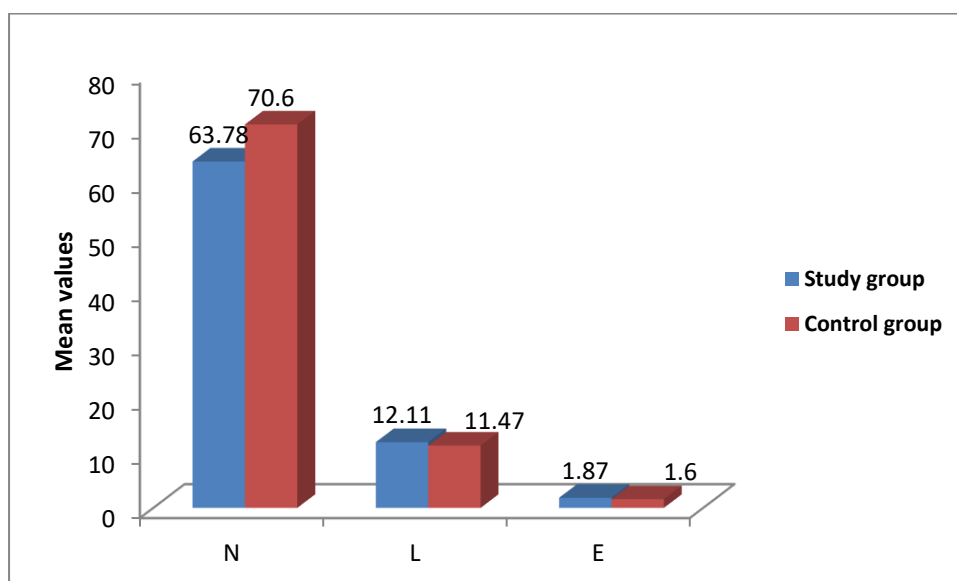
Lymphocyte count of 12.11+/-6.833 with median of 11. Eosinophil count of 1.87+/-1.325

with median of 2. In control group mean neutrophil count of 70.60+/-10.203 with median of

72. Lymphocyte count of 11.47+/-3.314 with median of 10. Eosinophil count of 1.60+/-1.136

with median of 1. P value was significant for neutrophil counts.

**FIGURE 76: DIFFERENTIAL COUNT IN STUDY AND CONTROL GROUPS.**



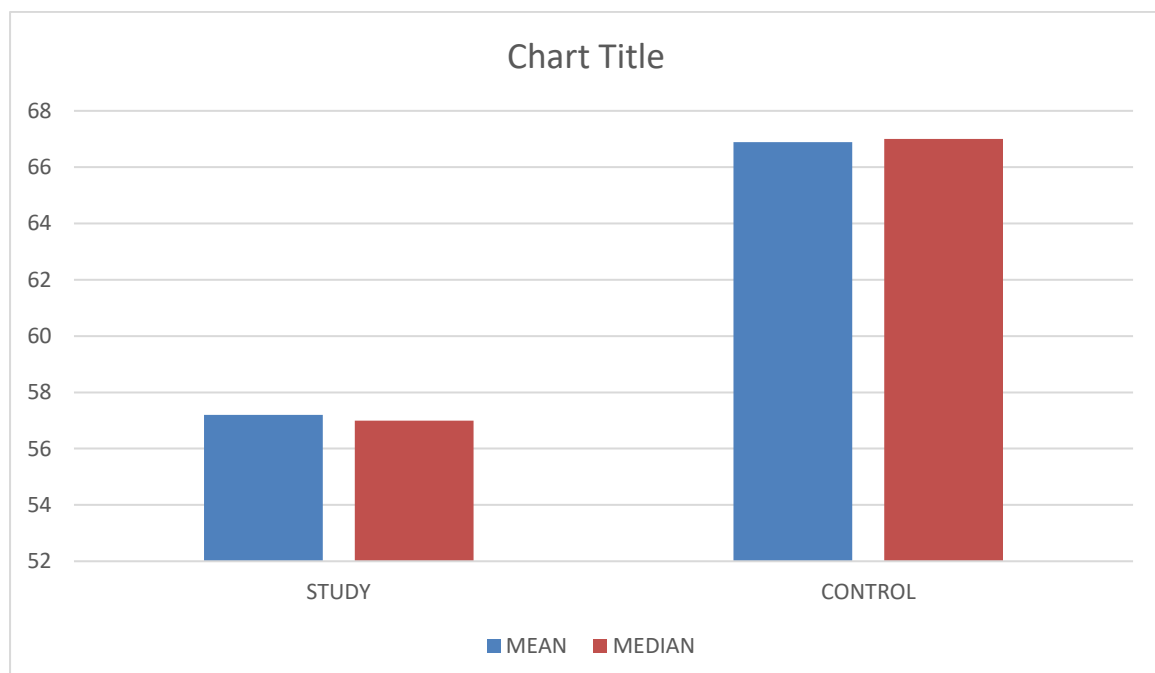
**TABLE 10: TIME OF SURGERY FOR STUDY AND CONTROLS**

Variables	Study Group		Control Group		Mann Whitney U test	P value
	Mean (Median)	±SD	Mean (Median)	±SD		
TIME OF SURGERY (MIN)	57.20(57)	1.254	66.89(67)	1.729	U=0.00	P<0.001 HS

**NS: Not significant HS: Highly significant**

In study group mean time of surgery was found to be 57.20+/-1.254minutes with median of 57 minutes. In control group it was 66.89+/-1.729minutes with median of 67 minutes. P value was found to be significant.

**FIGURE 77: TIME OF SURGERY FOR STUDY AND CONTROLS**





**TABLE 11: INTRAOPERATIVE COMPLICATIONS**

<b>INTRA OP COMPLICATIONS</b>	Study		Control	
	No. of patients	percentage	No. of patients	percentage
NONE	45	100.0	45	100.0
Total	45	100.0	45	100.0

According to our study none of the patients had any intraoperative complications.

**TABLE 12: POST OPERATIVE MOBILISATION**

<b>POST OP MOBILISATION</b>	Study		Control		Chi square test	P value
	No. of patients	percentage	No. of patients	percentage		
Absent	1	2.2	0	0	X <sup>2</sup> =1.011	P=0.3146 NS
DAY 1	44	97.8	45	100.0		
Total	45	100.0	45	100.0		
NS: Not significant						

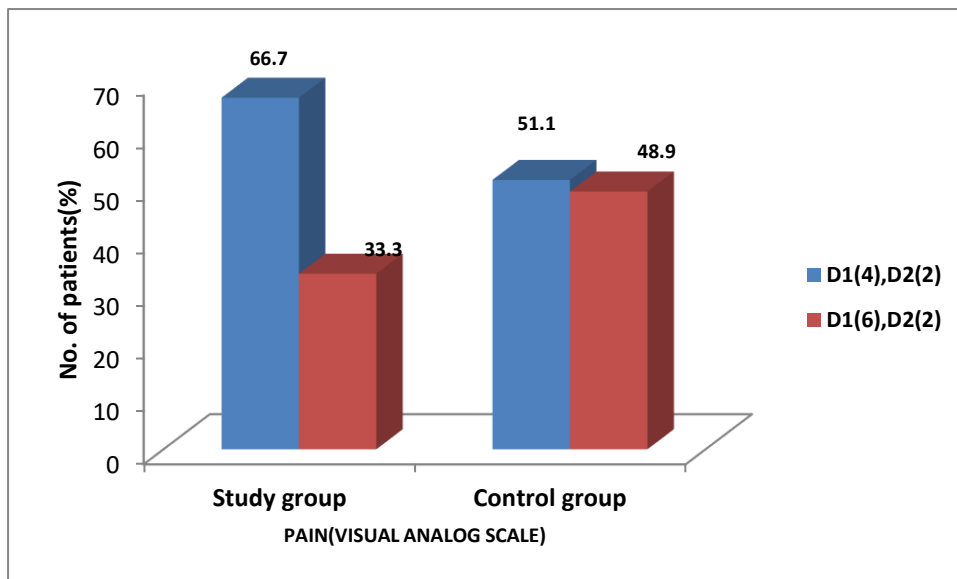
All patients in the control group were mobilised on day 1 in control group. Except one patient (2.2%) all patients were mobilised on day 1 in study group.

**TABLE 13: PAIN ACCORDING TO VISUAL ANALOG SCALE ON POST OPERATIVE DAY I AND DAY 2**

PAIN (VISUAL ANALOG SCALE)	Study		Control		Chi square test	P value
	No. of patients	percentage	No. of patients	percentage		
D1(4), D2(2)	30	66.7	23	51.1	X <sup>2</sup> =.249	P=0.1337 NS
D1(6), D2(2)	15	33.3	22	48.9		
Total	45	100.0	45	100.0		

In study group 30 patients (66.7%) had a score of 4 on day I while 15(33.3%) had score of 6 on day 1. In control group 23 patients had score of 4 (51.1%) and score 6 in 22(48.9%) on day 1 . Whereas all patients had score of 2 on day 2.

**FIGURE 78: PAIN ACCORDING TO VISUAL ANALOG SCORE ON DAY 1 AND 2 POSTOPERATIVELY**



**TABLE 14: POST OPERATIVE SURGICAL SITE INFECTIONS**

SURGICAL SITE INFECTIONS	Study		Control	
	No. of patients	percentage	No. of patients	percentage
ABSENT	45	100.0	45	100.0
Total	45	100.0	45	100.0

Surgical site infections were not seen in any patients in either group.

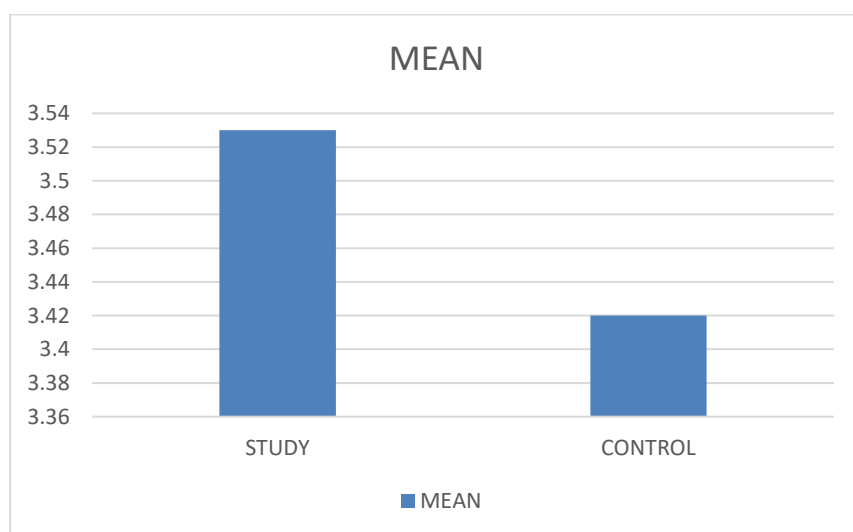
**TABLE 15: LENGTH OF HOSPITAL STAY**

Variables	Study Group		Control Group		Mann Whitney U test	P value
	Mean (Median)	±SD	Mean (Median)	±SD		
LENGTH OF STAY	3.53(4)	0.505	3.42(3)	0.499	U=900	P=0.294 NS

**NS: Not significant HS: Highly significant**

Mean length of hospital stay in study group was 3.53 and 3.42 in controls.

**FIGURE 79: LENGTH OF HOSPITAL STAY**



**TABLE 16: SUTURE REMOVAL**

<b>SUTURE REMOVAL</b>	Study		Control	
	No. of patients	percentage	No. of patients	percentage
DAY 7	45	100.0	45	100.0
Total	45	100.0	45	100.0

All patients underwent suture removal on day 7 postoperatively.

**TABLE 16: FOLLOW UP AT 2 MONTHS**

<b>FOLLOW UP AT 2MONTHS</b>	Study		Control	
	No. of patients	percentage	No. of patients	percentage
UNEVENTFUL	45	100.0	45	100.0
Total	45	100.0	45	100.0

Follow up of patients at 2 months post-surgery were found to be uneventful.

## **7.DISCUSSION**

A total of 90 patients having acute or chronic appendicitis were included in this study who underwent laparoscopic appendicectomy. In 45 patients titanium endoclips were applied at the appendix base. In the rest 45 Roeder's knot were applied. The patients were assessed regarding duration of surgery, intra and post-operative complications, length of hospitalisation and follow up period.

### **➤ AGE GROUP**

In our study maximum percentage of appendicitis was seen in age group of less than 20years, 57.8 % in study and 40% in control group. The mean age was 21.56+/-12.48 in study group while it was 24.04+/-11.580 in control group.

In a study by Nikhil Dixit it was reported that 18-30 years age group had the maximum presentation of appendicitis, in study group it was 70% and control group 63.33%<sup>1</sup>.

In other study by Lohar HP et al showed that appendicitis incidence gradually rises from young age specially in the teen age group and it reduces in the geriatric age group<sup>41</sup>.

In another study by Buckius et al showed that appendicitis peaks in the teen age group below 20yrs, and the incidence is usually less in older age groups<sup>42</sup>.

### **➤ GENDER**

In this study it was found that most of the patients in both study and control group were males. That is in study group it was 57.8 % and control group 55.6%.

However, a study by Nikhil Dixit and colleagues showed female dominance in 53.33 % in control group and 56.67% in study group, although it was not found to be statistically significant(p=0.795)<sup>1</sup>.

In a study by Ates et al who compared intracorporeal (polyglactin) knot-tying suture with titanium endoclips in appendiceal stump closure during LA, also showed majority of patients being males<sup>43</sup>.

A study by Rickert *et al.* to investigate the results after application of titanium clip for appendiceal stump closure also reported 59% of the females<sup>38</sup>.

#### ➤ **PRESENTING COMPLAINTS**

Complaints of pain abdomen were seen in both groups. Duration of symptoms were significant statistically. In the study group about 53.33% patients were found to have symptoms of 1-3months duration. While in control group majority of patients (82%) had symptoms of less than one-month duration. P value was found to be highly significant with respect to duration of symptoms.

Nikhil Dixit and colleagues in their study had reported that most of the patients in their study and control group were having symptoms of acute onset and symptoms in either group were found to be comparable<sup>1</sup>.

#### ➤ **EXAMINATION FINDINGS**

All patients were found to be haemodynamically stable. In the study group all patients had per abdomen finding of right iliac fossa tenderness only. In the control group all patients had right iliac fossa tenderness, but in 24.4% patients had localised guarding which was found to be statistically significant.

In a study by Nikhil Dixit and co- workers clinical signs were found to be not significant statistically<sup>1</sup>.

According to Bailey and Love's textbook of surgery initially pain occurs at the umbilical region which is vague in nature which is followed by shifting of pain to the right iliac fossa due to inflammation of parietal peritoneum leading to localised

tenderness, rebound tenderness guarding seen in 99 % patients. However, this shifting of pain is seen only in about 50% of patients.

➤ **DIAGNOSIS**

In our study majority of patients were found to have acute appendicitis in control group (75.6%). Whereas most of the patients in study group had chronic appendicitis (80%). It was found to be highly significant.

In another study the incidence of acute appendicitis was found to be more in both study and control, 83.33% in study and 80% in control<sup>1</sup>.

In another study by Rickert et al patients with acute appendicitis with severely inflamed base, clips were not applied<sup>38</sup>.

➤ **USG FINDINGS**

Maximum percentage of patients belonged to 6-7mm dilated range,26.67% in study group. While in control group it was seen that most patients had a base range of more than 10 mm, that is about 66.67%. P value was found to be significant.

A study by Noh Hyuck Park and co-workers in 2011 suggested that the mean outer diameter of more than 6mm is suggestive of appendicitis<sup>44</sup>.

In another by Ugur Ekici and colleagues reported a relation between the ratio of length is to diameter and rate of perforation in appendicitis so as to reduce the risk of complications and plan for an early intervention. According to this study it was documented that the ratio of length to diameter of appendix below 10 increases the risk of perforation<sup>45</sup>.

Also, the diameter of appendix base according to ultrasound or ct scan corresponds to the grade of inflammation and hence is a decisive factor for the use titanium clips<sup>38</sup>.

➤ **TOTAL LEUCOCYTE COUNT**

The mean total leucocyte count was found to be more in the control group (10154.22±2213.97) cells/cu mm. In the study group it was found to be 9059.56±2063.67 cells/cu mm.

In a study by Hoffman et al suggested that alongside clinical diagnosis few investigative measures have to be done for confirmation of acute appendicitis, and total leucocyte count is important as it differentiates from acute or chronic inflammation.<sup>46</sup>

This was supported by other studies saying that total count is an important investigation for diagnosing acute inflammation of the appendix<sup>47,48</sup>.

➤ **NEUTROPHILIA**

The mean neutrophil percentage in the study group was found to be 63.78±11.507%. In control it was 70.60±10.203%. P value was found to be significant.

In a study by Hoffman et al showed increased neutrophils in cases of acute appendicitis<sup>46</sup>.

Total count with neutrophil percentage and ultrasound are considered as important tools for diagnosing acute appendicitis<sup>47,48</sup>.

➤ **TIME OF SURGERY**

The mean duration of surgery for study group was found to be 57.20±1.254 minutes. In control group it was found to be 66.89±1.729 minutes. P value was found to be highly significant.

In a study by Nikhil Dixit and colleagues showed similar results of lesser mean duration of surgery for patients with titanium clip application (59.20±10.33minutes) as compared to knotting (68.47±6.30 minutes)<sup>1</sup>.



In another study by Beldi G et al showed comparable time of surgery (46.3–64.9 min<sup>50</sup>).

Findings of this study were also comparable when metal clips were used instead of intracorporal knotting techniques in two recent small randomized trials with shorter operation time<sup>43,49</sup>.

In several studies, polymeric non-metal clips have been used which resulted in reduced costs, shorter operation times, and comparable complication rates<sup>49,51-53</sup>.

#### ➤ **INTRA OPERATIVE COMPLICATIONS**

In our study intraoperative complications were not seen in any patient.

In a study Nikhil Dixit and colleagues showed few cases of subcutaneous emphysema (3.33% in study versus 13.33 % in controls) which was found to be insignificant<sup>1</sup>.

In various studies intraoperative complications like haemorrhage, injury to adjacent organs but were comparable for both titanium clips and knotting groups and were statistically insignificant<sup>4</sup>.

In a study by Rickert et al also showed that there were no intraoperative complications<sup>38</sup>.

#### ➤ **POST OPERATIVE MOBILISATION**

In our study most of the patients in study group (97.8%) and all patients in control group were mobilised on 1<sup>st</sup> day post-surgery. It was found to be insignificant statistically.

In other studies, also patients were mobilised on the same day or on the first postoperative day, it was found to be insignificant<sup>1,4</sup>.

➤ **POSTOPERATIVE PAIN**

In study group 66.7% had a pain score or 4 on day 1 and 2 on day 2 according to the visual analog scale. In controls 51.1% had the same score. It was not significant statistically.

In a study by Nikhil Dixit et al showed that post-operative pain rate was 6.67% in the group with titanium clips, same percentage in another group with Roeder's knot.

Hence it was statistically not found significant( $p=0.303$ )<sup>1</sup>.

In a study by M Nadeem et al, it has shown similar results that post-operative pain was not statistically significant among both groups that is roeder's knot versus titanium clips<sup>4</sup>.

➤ **SURGICAL SITE INFECTIONS**

In this study none of the patients had surgical site infections.

In another study surgical site infection was found to be 6.67% in knotting group while nil in clip group but it was statistically insignificant<sup>1</sup>.

In another study by Rickert et al showed that the complication rate post operatively was 13%. It was 20% in complicated appendicitis while 0% in uncomplicated appendicitis. They have reported one case of surgical site infection, which was treated conservatively with antibiotics.<sup>38</sup>

➤ **OTHER POSTOPERATIVE COMPLICATIONS**

In our study there were no other post-operative complications like ileus, surgical site infections, intra-abdominal abscess.

In another study by Rickert et al showed three patients having post-operative complications. One had an intra-abdominal abscess which was drained interventionally. One more patient had post-operative ileus which was treated conservatively<sup>38</sup>.

➤ **HOSPITAL STAY**

Mean duration of stay was 3.53 in study group and 3.42 in control which was not significant.

Similar results were reported by M Nadeem and coworkers<sup>4</sup>.

However, it was significant in another study where the group with clip application had lesser stay(3.16+/-0.53days) as compared to knotting group (3.70+/-1.02 days)<sup>1</sup>.

In another study the mean duration of hospital stay was 4 days<sup>38</sup>.

➤ **SUTURE REMOVAL**

All patients underwent suture removal on day 7. It was comparable to other study where in patients could resume daily activities early in both groups<sup>1</sup>.

It has been supported by other studies that suture removal were comparable among both groups of Roeder's knot and Titanium clips<sup>4</sup>.

In one study there was one patient with surgical site infection in which sutures were removed on third post-operative day to drain the collection and started with antibiotics<sup>38</sup>.

➤ **FOLLOW UP**

Follow up period was uneventful for all patients in this study at 2 months post-surgery.

However, in another study by Nikhil Dixit et al it was reported inconclusive as follow up period was not sufficient to state the long-term side effects of titanium clips<sup>1</sup>.

## 8.CONCLUSION

This study has concluded the following:

- Appendicitis is most commonly seen in younger age group of age less than 20years.
- Male preponderance is noted in this study.
- Most of the patients with acute onset of symptoms less than one-month duration were eligible for Roeder's knot whereas patients with symptoms of longer duration it was possible to apply clips at the base. This can be used as a tool to decide the severity of inflammation and hence decide to apply clips or knots.
- Patient with signs of localised guarding suggested severe inflammation and hence Roeder's knot was applied, whereas patients with only right iliac fossa tenderness clip application was done.
- Most of the patients with acute appendicitis were subjected to Roeder's knotting while in chronic patients clip application was done.
- On comparing ultrasound findings, appendix base of more than and equal to 10 mm dilatation we have applied knots. Base of less 10 mm it was easy to apply clips due to lesser inflammation and oedema.
- Total leucocyte count and especially neutrophil percentage was significantly high in control group which can be used as an indicator to rule out level of inflammation and hence decide on clips or knots.
- Time of surgery was significantly lower in titanium clip group which proved to be easy and good for learners
- Intraoperative and postoperative complications were none in both groups which proved that titanium clips were safe and effective for use.
- Post-operative pain was also comparable in both groups suggesting the safety of clips.

- Length of hospital stay and return to daily activities was similar in both groups proving that clips were safe.
- Follow up period of both groups were comparable
- With respect to cost factor clips were costlier than suture.
- It can be concluded that titanium clips are safe to use and are a good alternative to Roeder's knot with lesser learning curve.

## **9.SUMMARY**

This study was done to compare efficacy and safety of metallic endoclips with Roeder's knot for appendiceal stump closure in patients undergoing laparoscopic appendicectomy.

The study period was from November 2017 to July 2019 with follow up period of 2 months. A total of 90 patients were included with 45 in each clip application and Roeder's knotting group.

The results were evaluated and assessed and it was found that titanium endoclips were safe and easy to apply with lesser operative time as compared to Roeder's knotting. The intraoperative, post-operative and length of hospital stay were comparable in both the groups. Although titanium clips are little costly.

Follow up period for both groups were uneventful for both groups.

Hence it can be safely concluded that titanium clips are safe to use requiring lesser time of surgery and ideal for beginners.

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## **11. ANNEXURE I CERTIFICATE OF ETHICAL CLEARANCE**

## 12.ANNEXURE II -PARTICIPANT CONSENT FORM

Participant' s name:

Address:

TITLE OF THE PROJECT:

### **“Comparison of Endo Clips versus suture in laparoscopic appendiceal stump closure”**

The details of the study have been provided to me in writing and explained to me in my own language. I confirm that I have understood the above study and had the opportunity to ask questions. I understand that my participation in the study is voluntary and that I am free to withdraw at any time, without giving any reason, without the medical care that will normally be provided by the hospital being affected. I agree not to restrict the use of any data or results that arise from this study provided such a use is only for scientific purpose(s). I have been given an information sheet giving details of the study. I fully consent to participate in the above study.

\_\_\_\_\_  
(Participant)

\_\_\_\_\_  
(Date)

\_\_\_\_\_  
(Witness to signature)

\_\_\_\_\_  
(Date)

\_\_\_\_\_  
(Investigator to signature)

\_\_\_\_\_  
(Date)

## **PATIENT INFORMATION SHEET**

### **TITLE OF THE PROJECT:**

**“Comparison of Endo Clips versus suture in laparoscopic appendiceal stump closure”**

### **NAME OF THE INVESTIGATOR:**

### **NAME OF THE GUIDE:**

### **PROCEDURE:**

### **CONFIDENTIALITY OF RECORDS:**

This study will become a part of hospital records and will be subject to the confidentiality. If the data are used for publication, no name will be used. And photographs will be used with special written permission.

### **INJURY STATEMENT:**

In the unlikely event of injury resulting directly from participation in this study, the injury will be reported promptly and the appropriate treatment will be given.

### **REFUSAL OR WITHDRAWAL OF PARTICIPATION:**

Participation is voluntary and you may refuse to participate or withdraw consent and discontinue participation in the study at any time.

I, (Investigator) have explained to the patient in detail about the study in their own language and the written copy of the same will be given to participant.

**INVESTIGATOR' S NAME AND ADDRESS:**

### **13. ANNEXURE III-PROFORMA**

SL NO

NAME

AGE

IP NO

SEX

UNIT

RELIGION

DOA

OCCUPATION

DOO

ADDRESS

DOD

SOCIO-ECONOMIC STATUS

**Complaints:**

**HISTORY OF PRESENT ILLNESS**

**HISTORY OF PAIN**

**SYSTEMIC SYMPTOMS**

**PAST HISTORY:**

**PERSONAL HISTORY: SMOKER/ALCOHOLIC**

**GENERAL PHYSICAL EXAMINATION**

BUILT: WELL/MODERATE/POOR

NOURISHMENT: WELL/MODERATE/POOR [BMI= ]

PALLOR

ICTERUS

CYANOSIS

CLUBBING

PEDAL EDEMA

GENERAL LYMPHADENOPATHY



**VITAL DATA:**

TEMPERATURE:

PULSE

RESPIRATORY RATE

BLOOD PRESSURE:

**SYSTEMIC EXAMINATION**

**PER ABDOMEN:**

INSPECTION

PALPATION

**PERCUSSION**

**AUSCULTATION**

**SYSTEMIC EXAMINATION:**

RESPIRATORY SYSTEM

CARDIOVASCULAR SYSTEM

CENTRAL NERVOUS SYSTEM

**PER RECTAL EXAMINATION**

**CLINICAL DIAGNOSIS:**

**LABORATORY TESTS**

HB%

TOTAL COUNT

DIFFERENTIAL COUNT

N/L/E/B/M:

URINE ROUTINE:

RBS

B. UREA

S. CREATININE

CHEST X RAY:

ULTRASONOGRAPHY OF ABDOMEN AND PELVIS:

OTHERS: OPERATIVE PROCEDURE (DATE AND TIME):

**INTRA-OPERATIVE DIAGNOSIS:**

DURATION OF PROCEDURE-

ANY OTHER INTRA-OPERATIVE FINDING-

POST OPERATIVE INVESTIGATIONS:

**OTHER VARIABLES**

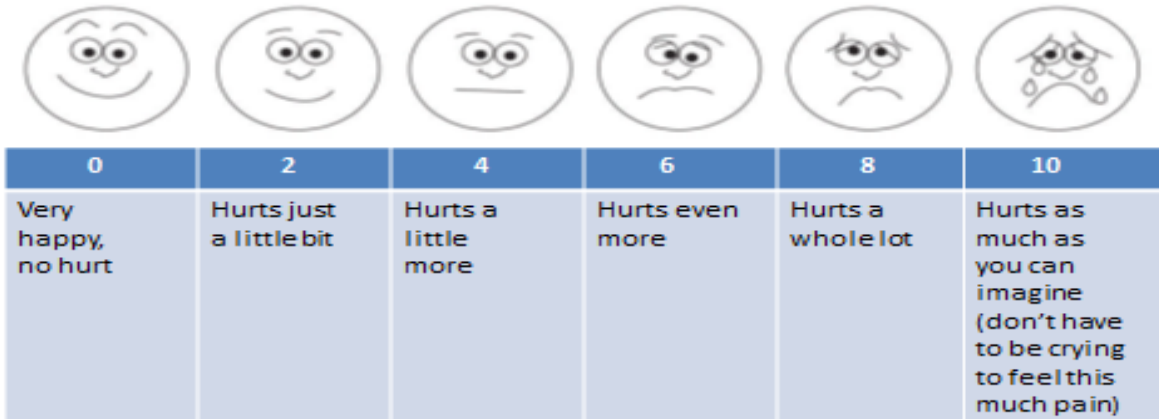
LENGTH OF STAY IN HOSPITAL AFTER PROCEDURE

NUMBER OF POST OPERATIVE DOSES OF INJECTABLE ANALGESICS-

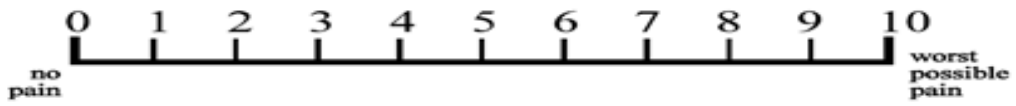
**POST OPERATIVE COMPLICATIONS**

1. POST OPERATIVE SURGICAL SITE INFECTIONS.
2. PAIN –ANALYSED BY VISUAL ANALOG SCALE (VAS)
3. PARALYTIC ILEUS

VISUAL ANALOG SCALE (VAS)  
Faces Pain Scale



Visual Analog Scale (VAS)



**FOLLOW UP-**

FOLLOW UP AT 2 MONTHS

## **KEY TO MASTER CHART**

SI NO- Serial number

Ip no- in patient number

S-sex, A-age

F- Female, M- male

P-pain, F- fever, V- Vomiting, W-Week, M- month, D- day

RIFT +-Right iliac fossa tenderness present

G- guarding present

Dx- Diagnosis

AA-acute appendicitis, CA- chronic appendicitis

TC- Total leucocyte count in cells per cubic millimetre

N/L/E- neutrophil/lymphocyte/eosinophil in percentage

USG-Ultrasonography, mm- millimetre, appendix base measurement

NV- appendix base not visualised

T-time of surgery

MIN-minute

VAS-visual analog score

IOC-intra operative complications, N- none

POM- post operative mobilisation, D1- Day one

SSI- Surgical site infection, N- none

LOS- length of stay in days

D1- post operative day 1, D2- postoperative day 2

S/R- suture removal, D7- day seven

F/U- follow up at 2 months.