

# **CRITICAL EVALUATION OF APPENDICITIS IN PAEDIATRIC AGE GROUP**

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## **CERTIFICATE**

This to certify that this is the Bonafide dissertation work done by  
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Examination held on August 2008 under the title of

**“ CRITICAL EVALUATION OF APPENDICITIS**

**IN PAEDIATRIC AGE GROUP ”**

under my guidance and supervision.

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## **STUDY PERIOD (AUGUST 2005 - JUNE 2007)**

### **INTRODUCTION**

Acute Appendicitis remains the most common indication for emergency abdominal Surgery. The life time risk is 9% for men and 7% for women. Considerable morbidity continues to be associated with appendicitis despite what is currently considered to be appropriate antibiotic and surgical care. Although the overall mortality rate is less than 1 % in many series, the mortality associated with appendicitis in elderly and infants ranges between 5 % and 15 %. The incidence of perforation commonly ranges from 17 % to 40% and is increased at both spectrums of age and is well known to be associated with significant morbidity.

In the early eighties in our department the incidence of appendicitis was so low, that a clinical diagnosis of acute appendicitis was not the first choice when a child presented with vomiting, pain, toxemia and acute abdomen.

Surgical doctrine suggests that a percentage of negative laparotomies are necessary and acceptable to limit the rate of perforation as the diagnosis of acute appendicitis is essentially clinical. Current studies demonstrate the negative Laparotomy rate to range from 15% to 30% and to be associated with significant morbidity. With the available gamut of investigations this can be lowered.

The purpose of this study is to know the accuracy of clinical diagnosis in appendicitis by correlating histopathological examination report of removed appendix specimen against clinical diagnosis in Madurai Medical College Hospital over a period of two years between August 2005 to June 2007 and discuss it in the light of available literature.

## **AIM OF THE STUDY**

The objectives of this clinical study are

1. To know the accuracy of clinical diagnosis in appendicitis by comparing with histopathological examination report of removed appendix specimen.
2. To find out the cause or causes for the increased incidence.

## **HISTORY**

Acute appendicitis is a common acute Abdominal emergency Condition requiring surgery.

1735 – Claudius Amyand - Performed first Appendicectomy in right scrotal hernia accompanied by a fistula.

1753 – Heister - Described appearances of the gangrenous and perforated appendix.

1827 – Melier - Suggested the ante mortem recognition of appendicitis.

1848 – Hancock - Drained the appendicular abscess.

1886 – Fitz coined the term appendicitis.

Parker - Described the three stages of Appendicitis–gangrene, perforation, abscess.

1887 – Morton - First successfully removed the Appendix with intention of curing appendicitis.



## REVIEW OF LITERATURE

### ANATOMY:

Vermiform appendix is a blind muscular tube with mucosal, submucosal, muscular and serosal layers. The appendix first becomes visible in the eighth week of embryological development as a protuberance of the terminal portion of Caecum. During both antenatal & postnatal development the growth rate of Caecum exceeds that of appendix displacing the appendix medially towards the ileo caecal valve. The relationship of the base of appendix to caecum remains constant whereas the tip can be found in:

Retro caecal	–	2 %
Pelvic	-	30 %
Para caecal	-	2 %
Sub caecal	-	65 %
Pre ileal	-	0.5 %
Post ileal	-	0.5 %

The tinea coli converge at the junction of Caecum with appendix and can be a useful landmark to identify the appendix. The appendix varies in length from less than 0.3cm to greater than 33cm and most appendix are 6 to 9 cm in length. Diameter of appendix varies from 5mm to 10mm. Appendiceal absence, duplication and diverticula have all been described. Mesentery of appendix or mesoappendix arises from

lower surface of mesentery of terminal ileum and is subject to great variation.

The appendicular artery, a branch of lower division of ileocolic artery passes behind the terminal ileum to enter the meso appendix and the free border of mesoappendix. Accessory appendicular artery may be present. In most people the appendicular artery is an end artery, its thrombosis results in necrosis of appendix.

Four to six or more lymphatic channels traverse the mesoappendix to empty into the ileo caecal lymph nodes.

Microscopy: The lumen is irregular, lined by columnar cells and the Intestinal mucosa is of colonic type. Crypts are present. Argentaffin cells are present in base of the crypts. The sub mucosa contains lymphatic aggregation (or) follicles.

#### **FUNCTION:**

It is now well recognized that the appendix is an immunological organ that actively participates in the secretion of immunoglobulin's particularly IgA.

Although appendix is an integral component of gut associated lymphoid tissue (GALT) system. Its function is not essential and appendicectomy is not associated with any predisposition to sepsis or any other manifestation of immune compromise. This must now be

viewed with the concept that the appendix is used as a conduit in many procedures. (e.g. Mitranoff's, Ureter).

### **INCIDENCE:**

Acute appendicitis is relatively rare in infants and becomes increasingly common in childhood and early adult life, reaching peak incidence in children aged 10-12 years. After the middle age the risk of developing appendicitis in the future is quite small.

The incidence of appendicitis is equal among males and females before puberty. In teenagers and young adults the male-female ratio increases to 3:2 at age 25 and thereafter the greater incidence in males declines.

### **EPIDEMIOLOGY**

- Highest incidence is 10-19 year old. It is unusual under the age of 1 year.
- The risk of perforation is greatest in 1-4 year old and least in 10-14 year old.
- Appendectomies is the most common emergency surgical procedures performed
- It is unusual in third world countries and there is a relationship to low fiber diets.

## **ETIOLOGY**

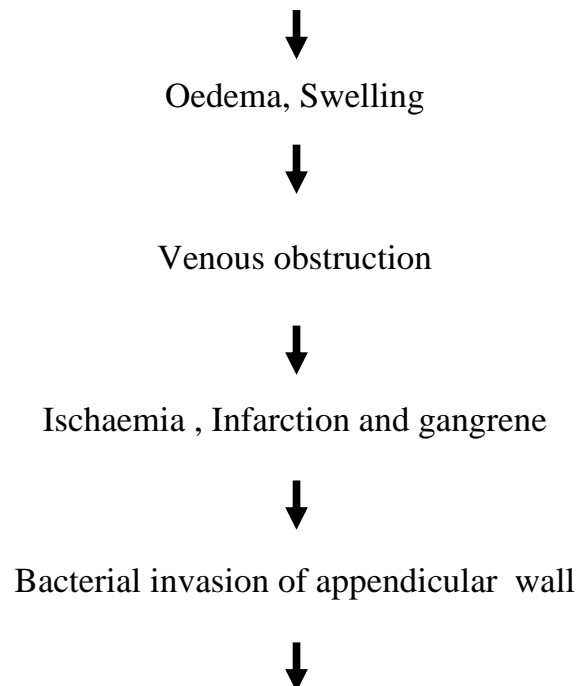
There is no unifying hypothesis regarding the etiology of acute appendicitis. The most commonly accepted theory is obstruction of appendicular lumen by

- Hyperplasia of submucosal lymphoid follicles.
- Fecolith
- Fibrotic Stricture
- Tumor – appendix, caecum
- Worms (pinworm-oxyuris vermicularis)

## **ACUTE APPENDICITIS PATHOPHYSIOLOGY**

Once the lumen of appendix is obstructed the sequence of events occurs as follows:

With increase in intra lymphatic pressure, lymphatic drainage is inhibited



(P.T.O)

Mediators are released from ischaemic tissues



Fever, leucocytosis, tachycardia



Inflamed serosa of appendix touches parietal peritoneum



Somatic pain fibres are stimulated



Pain localizes over Appendiceal site



Further breakdown of Appendiceal wall



Perforation and localized abscess formation



Generalized peritonitis

Mucus accumulates within the lumen and pressure within the organ increase. Bacteria convert the accumulated mucus into pus, which cause further increase in pressure and obstruction of lymphatic drainage leading to edema, diapedesis of bacteria and appearance of mucosal ulcers.

- Continued secretion and increasing edema cause venous edema, end in ischemia of appendix.

- As this pathological process continues venous and arterial thrombosis occur in the wall of appendix, resulting in gangrenous appendicitis. At this stage small multiple infarcts occur which results in perforation permitting escape of bacteria and contamination of peritoneal cavity.

Typically two clinical syndromes of acute appendicitis can be designed:

- Acute catarrhal (non obstructive)
- Acute obstructive.

**CLINICAL DIAGNOSIS:**

**Alvardo Score for Appendicitis**

<b>M</b> Migration of pain	1
<b>A</b> Anorexia	1
<b>N</b> Nausea or vomiting	1
<b>T</b> Tenderness in right lower quadrant	2
<b>R</b> Rebound pain	1
<b>E</b> Elevated temperature	1
<b>L</b> Leucocytosis > 10000	2
<b>S</b> Shift to left > 75%	1
<b>Total</b>	<b>10</b>

Score of 5 - 6 = Compatible with diagnosis

7 - 8 = Probable

9 - 10 = Very probable

**History:**

Pain: The typical pain initially diffuse, central, minimally severe visceral pain, followed by somatic pain that is more severe and well localized to right lower quadrant. This classical visceral to somatic sequence is present in up to 55% of cases.

Atypical pain may be somatic and localized to right lower quadrant from its initiation, common in old age. The pain may remain diffuse and never become localized in few cases. High retro caecal appendicitis may present with only diffuse pain in the right flank. When the entire appendix is within true pelvis, there may be no pain and instead may cause tenesmus and vague discomfort in the suprapubic area.

**Anorexia, Nausea, Vomiting:**

- Anorexia and nausea are present in almost all patients with acute appendicitis.
- Vomiting occurs in fewer than 50% of patients and when occurs it is usually once or twice, not persistent. Vomiting occurs after the onset of pain and if occurs before pain the diagnosis of appendicitis should be questioned.

**Constipation and Diarrhea:**

- Greater percentage of patients with appendicitis complain of constipation. Some will give history that defecation relieves the pain.

## **PHYSICAL EXAMINATION:**

The diagnosis of appendicitis rests more on thorough clinical history and examination of the abdomen than on laboratory investigation.

The cardinal features are, unwell patient with low grade pyrexia, localized abdominal tenderness, muscle guarding and rebound tenderness.

### **Tenderness, Muscle guarding:**

- Area of maximum tenderness will be elicited in McBurney's point, which is located in right spino umbilical line at the junction between medial 2/3<sup>rd</sup> and lateral 1/3<sup>rd</sup>.
- Cough tenderness may be present in 85% of patients.
- Rovsing's sign-palpation pressure in left lower quadrant elicits pain in RLQ (Right Lower Quadrant)
- Muscle guarding manifest as resistance to palpation, increases in severity as involvement of parietal peritoneum increases, initially it is only voluntary but is replaced by reflex involuntary rigidity.



**Abdominal Mass:**

- As the disease progresses there may be palpable tender mass in right lower quadrant.
- This may be due to abscess or adherence of Omentum and loops of intestine to an inflamed appendix.
- If appendix ruptures and infection is contained appendicular mass develop in right lower quadrant and area of tenderness will present in the entire right lower quadrant with guarding, rebound tenderness, rise of temperature and tachycardia.
- If Appendiceal rupture fails to localize, signs & symptoms of diffuse peritonitis will develop.

**Rectal Examination:**

- In uncomplicated appendicitis the finger cannot reach high enough to elicit pain on rectal examination.
- Pelvic abscess can be detected by rectal examination.

**RISK OF APPENDICULAR PERFORATION**

Risk prone factors: Young children experience the greatest risk for perforation. Several factors may account for this finding. First, the lower incidence of acute appendicitis in infants and young children may render physicians less suspicious of appendicitis when they examine a small child with acute abdominal pain. Second, limited ability of infants and small children to communicate their symptoms may contribute to

delays in care. The appendix may be retro caecal in position. The clinical signs may be misleading as the appendix may be higher in position, than in the Right Iliac fossa in children, and this may also increase the complication rate.

Signs indicating perforation

- Fever higher than 38.6<sup>0</sup> C
- Leucocytosis > 14000
- Generalized peritoneal signs

## **SPECIAL FEATURES, ACCORDING TO POSITION OF THE**

### **APPENDIX:**

#### **Retro caecal**

- Rigidity is often absent
- Deep palpation may fail to elicit Tenderness
- Psoas spasm due to inflammed appendix in contact with the muscle may cause flexion of hip.

#### **Pelvic**

- Early diarrhea due to contact with rectum
- When it lies completely within the true pelvis no pain, tenderness, rigidity at McBurney's point.
- Rectal examination may reveal tenderness in rectovesical pouch or pouch of Douglas.

- When inflamed appendix is in contact with Bladder, may cause frequency of micturition.

### **Post-Ileal**

Presents great difficulty in diagnosis

- The pain may not shift, diarrhea is a feature, marked retching may occur. Cause ill defined tenderness immediately right of umbilicus.

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

#### **INFANTS:**

- Appendicitis is relatively rare in infants under 36 months of age.
- Diagnosis is often delayed & incidence of perforation and postoperative morbidity is high.

#### **CHILDREN**

- Usually associated with vomiting and have aversion to food, in addition do not sleep during attack, very often bowel sounds are completely absent in early stages.

#### **ELDERLY**

- Gangrene and perforation occur much more frequently
- As the abdominal wall is lax or obese the signs and symptoms are masked or very minimal.
- Coexisting medical condition, late presentation cause more morbidity & mortality.

## **PREGNANCY:**

- Appendicitis is the most common extra uterine acute abdominal condition in pregnancy with the frequency of 1 in 1500 to 2000 pregnancies.
- Diagnosis complicated by delay in presentation due to early nonspecific symptoms, which are often attributed to pregnancy and progressive displacement of Caecum and appendix as pregnancy advances.
- Fetal loss occurs in 3.5% of cases and increase to 20% if perforation is found at operation.

## **DIFFERENTIAL DIAGNOSIS:**

There are number of common conditions that is wise to consider carefully and if possible exclude. The differential diagnosis differs in patients of different ages.

### **Children:**

**Acute Gastroenteritis:** Intestinal colic together with diarrhea and vomiting but no localized tenderness. Other family members being affected.

**Mesenteric lymphadenitis:** Intermittent colicky abdominal pain, Cervical lymphnodes may be enlarged, Shifting tenderness when the child turns on his / her left is strong evidence.

**Meckel's diverticulitis:** Pain is similar, signs may be central or left sided, it is difficult to distinguish.

**Intussusception:** Appendicitis is uncommon before the age of 2, whereas median age for -Intussusception is 18 months. A mass may be palpable on right lower quadrant.

**Henoch schonlein purpura:** Abdominal pain is severe and confused with appendicitis or intussusception. There is nearly always an ecchymotic rash in the extensor surface of limbs and buttocks.

**Lobar pneumonia, pleurisy:** May give rise to right side abdominal pain and mimic appendicitis. Abdominal tenderness is minimal, pyrexia is marked and chest examination may reveal pleural friction rub (or) altered breath sounds. Chest X-ray is diagnostic.

**Adults:**

**Ileitis:** an antecedent history of abdominal pain, weight loss and diarrhea suggests regional enteritis rather than appendicitis. Ileitis may be nonspecific, due to Crohn's disease (or) Yersinia infection.

**Ureteric colic:** The character and radiation of pain differs from appendicitis. Urine analysis should always be performed and presence of RBC should prompt a supine abdominal radiograph. Renal USG or IVP is diagnostic.

**Right sided acute Pyelonephritis:** Pain is accompanied and often by increased frequency of micturition. It may cause difficulty in diagnosis in women.

**Perforated Peptic ulcer:** Duodenal contents pass along the paracolic gutter to right iliac fossa and produce pain, tenderness, rigidity in right iliac fossa. An abdominal CT is valuable when there is diagnostic difficulty.

**Testicular Torsion:** Pain can be referred to right iliac fossa and shyness on the part of the patient may lead the unwary to suspect appendicitis unless scrotum is examined in all cases.

**Acute Pancreatitis:** Should be considered in differential diagnosis of all adult patients suspected of acute appendicitis and when appropriate excluded by serum or urinary amylase measurement.

**Rectus Sheath hematoma:** Is a rare but easily missed diagnosis. Localized pain without gastrointestinal upset is the rule.

**Adult female:** A careful gynecological history should be taken in all woman with suspected appendicitis concentrating on menstrual cycle, vaginal discharge and possible pregnancy.

**Pelvic Inflammatory disease:** Spectrum of disease include Salpingitis, endometritis, and tubo ovarian sepsis. Typically pain is lower than appendicitis and burning pain, dysmenorrhoea vaginal discharge usually present. Adnexal and cervical tenderness on vaginal examination.

Trans vaginal USG may be helpful. When uncertainty persists, diagnostic laparoscopy should be undertaken.

**Mittelschmerz:** Mid cycle rupture of follicular cyst with bleeding produce lower abdominal pain, systemic upset is rare. Pregnancy test is negative and symptoms usually subside within hours.

**Torsion/Hemorrhage of an ovarian cyst:** When suspected, pelvic USG and gynecological opinion should be sought. If encountered at operation, untwisting of the involved adnexa and ovarian cystectomy should be performed, if necessary in women of child bearing years.

**Ectopic pregnancy:** Severe pain is felt when cervix is moved on vaginal examination. Sign of intra peritoneal bleeding usually apparent. Pelvic USG should be performed in all cases in which an ectopic pregnancy is a possible diagnosis.

**Elderly:**

**Sigmoid diverticulitis:** In some patients with a long sigmoid loop the colon lies to the right of the midline and it may be impossible to differentiate between diverticulitis and appendicitis.

**Intestinal obstruction:** The diagnosis is usually clear, the subtlety lies in recognizing acute appendicitis as occasional cause in elderly.

**Carcinoma of the Caecum:** When obstructed (or) locally perforated carcinoma of Caecum may mimic or cause obstructive appendicitis in adults.

### **RARE DIFFERENTIAL DIAGNOSIS:**

- Preherpetic pain of the right 10 & 11<sup>th</sup> Dorsal nerves
- Tabetic crises.
- Spinal conditions; TB Spine, Metastatic deposits, osteoporotic collapse, multiple myeloma.
- Porphyria and diabetes mellitus.
- Typhilitic or leukaemic ileo caecal syndrome; is rare but fatal entero colitis occurring in immuno suppressed patients.

The diagnosis of acute appendicitis is essentially clinical however a decision to operate based on clinical suspicion alone can lead to removal of a normal appendix in 15 to 30% of cases. There is no laboratory (or) radiological test yet devised that is 100% diagnostic of this condition. Controversy exists as to whether imaging is required in patients with the classic history and physical findings of acute appendicitis. Opinion varies as to whether these modalities should be performed in all patients with suggested appendicitis or if radiology should be reserved for select patients with atypical or confusing clinical presentations.



**White blood cell count:**

- The leucocyte count is raised above 12000 in about 75% of the patients with appendicitis.
- Neutrophilia may be present.
- One must not discount the diagnosis under these circumstances.

**C-reactive protein:**

- It has been introduced as potential marker. CRP in combination with total count and differential count may help in improving the diagnostic accuracy.

**Urine examination:**

- Should be done routine in every patient with acute abdominal pain.
- Hematuria, pus cells in urine points to UTI but by no means excludes acute appendicitis.

**Radiography:**

**Plain x ray films of the abdomen** with the patient in the erect and supine position are of value in differential diagnosis of acute abdominal pain, but radiological features are non specific and must be interpreted with caution.

- Fluid levels localized to Caecum and to the terminal ileum.
- Localized ileus with gas in Caecum, ascending colon and terminal ileum.

- Increased soft tissue density in right lower quadrant
- Blurring of right flank Pre peritoneal fat strip.
- Faecolith in right iliac fossa
- Blurring of psoas shadow on right side.
- Gas filled appendix
- Free intraperitoneal gas.
- Deformity of caecal gas shadow owing to an adjacent inflammatory mass.

**Barium Enema:**

- Persistent non visualization of appendix.
- Partial visualization of appendix.
- Pressure effect on the caecum.
- Irritability of the caecum and terminal ileum on scarring.

**Ultrasonography:**

Continuous improvements in imaging technology, technique, and interpretation that have been achieved over the past 15 years have substantially increased the accuracy of imaging methods.

Graded-compression US has been shown to be a useful examination because of this technique's safety and high accuracy (approximately 90%) in the diagnosis of acute appendicitis. Advantages of US include lack of radiation exposure, noninvasiveness, short acquisition time, and the potential for diagnosis of other causes of abdominal pain,

particularly in the subset of patients who are women of childbearing age. Several authors suggest that US should be the first imaging method used in pregnant women and paediatric patients because x-ray exposure is especially undesirable in these groups.

May be helpful in differentiation of gynaecological, urological causes of acute abdominal pain, with improved techniques, the acutely inflamed appendix itself can be visualized. The USG appearances of acute appendicitis are

- Non compressible aperistaltic tubular structure
- Central dilated lumen
- Inner echogenic mucosal layer and an outer edematous wall that shows few echoes.
- Presence of appendicolith
- Complex mass.

**CT scan: (contrast enhanced)**

CT scanning have gained acceptance as the primary imaging techniques for acute appendicitis by virtue of their ability to directly image the appendix, adjacent fat, and gut. Contrast-enhanced, thin-section (0.5 mm) helical CT scanning has become the preferred imaging technique in the diagnosis of acute appendicitis and its complications, with a high diagnostic accuracy of 95-98%. The literature suggests that limited helical CT scanning with rectal contrast is a highly accurate, time-

efficient, cost-effective way to evaluate patients with equivocal presentations for appendicitis. CT scanning is particularly preferred in patients in whom Appendiceal perforation is suspected, because the diagnostic accuracy remains high and because CT scanning is useful for characterizing peri Appendiceal inflammatory masses.

- Is more accurate than USG
- Diagnostic features; thickened appendix with a diameter >6mm. Phlegmon, fluid, Abscess, presence of appendicolith, inflammatory changes in periappendiceal fat.
- It is not indicated in patients with an unequivocal diagnosis of appendicitis or in patients with a low risk of the diagnosis.

#### **Radionuclide Imaging:**

- Radio labelled autologous leukocytes have been developed that have a high sensitivity and specificity in the diagnosis of appendicitis.
- <sup>99m</sup>Tc-labelled intact polyvalent human immune globulin and <sup>99m</sup>Tc labelled anti-granulocyte antibody Fab fragments also having high sensitivity and specificity.

#### **Other Investigations:**

Other advanced radiologic examinations, such as ultra fast magnetic resonance imaging (MRI), Scintigraphy, and color Doppler US, have been used in the diagnosis of acute appendicitis, with a diagnostic accuracy of approximately 91-95%. Currently, no practical role exists

for MRI and Scintigraphy in acute appendicitis. Advantages of MRI include better visualization of abnormal appendices and adjacent inflammatory processes, visualization of the appendix in an atypical location, delineation of pathology, operator independence, and ease of examination of patients who are obese. MRI, similar to enhanced CT scanning, can demonstrate the extent of inflammatory infiltration

The decision to obtain US or CT scan studies depends on institutional preference and the available user expertise, although patient age, sex, and body habitus are important influencing factors. However, US is rapid, safe, inexpensive, and noninvasive, and it requires no contrast material or patient preparation.

At our institution, graded-compression US and color and power Doppler US techniques are routinely used in the diagnosis of acute appendicitis, with a diagnostic accuracy of approximately 95-100% in all patients with suspected acute appendicitis. Helical CT scans or MRIs are complementary to US and are used for patients in whom the US findings are equivocal or suboptimal.

#### **Limitations of Techniques:**

A significant disadvantage of US is that it is operator dependent. Intestinal peristalsis, pulsations of the iliac artery (when it is close to the appendix), deep respiration in non cooperative patients, and difficulty maintaining the probe at the same location for a long time are

disadvantages of color Doppler US in detecting increased vascularity of the appendix.

Disadvantages of CT scanning include radiation exposure, the potential for anaphylactic reaction if intravenous (IV) contrast is used, lengthy preparation time if oral contrast is used, and patient discomfort if rectal contrast is used.

Disadvantages of MRI include high cost, use of IV contrast, the requirement that patients fully cooperate, difficulty with patients who are claustrophobic, the inability to observe an appendicolith in the lumen (an important finding in acute appendicitis), and the inability to differentiate between gas and an appendicolith in the perforation site.

Disadvantages of radionuclide scanning include long acquisition times (approximately 5 h) and the lack of availability of this modality.

## **TREATMENT**

The treatment of acute appendicitis is appendectomy.

### **Preoperative preparation:**

All patients especially those with a presumed diagnosis of peritonitis should be adequately prepared before being taken to the operating room.

Intravenous fluid replacement and resuscitation as rapidly as possible as should be made especially when peritonitis is suspected.

Naso gastric suction if peritonitis and profound Ileus are present and temperature  $> 39^{\circ}\text{c}$ . Broad spectrum antibiotic to cover gram-negative, anaerobic organism preoperatively to control and reduce incidence of wound sepsis. Antibiotics should be continued in case of gangrenous and ruptured appendix, while single dose is sufficient for early appendicitis.

### **Examination under Anaesthesia**

All patients abdomen should be examined after induction of appropriate anesthesia, such examination may reveal other diagnosis, and appendicular mass.

### **Uncomplicated appendicitis without palpable mass**

In these circumstances appendicectomy should be performed. Earlier the diagnosis made, sooner the appendicectomy is performed, better the prognosis.

The recommended incisions are

- Transverse skin crease Lanz incision
- Grid – Iron incision
- Rutherford Morison's if appendix is Para/retro caecal and fixed

### **Methods to be adopted in special circumstances :**

- When the base of appendix is inflamed, it should not be crushed but ligated close to caecal wall just tightly enough to occlude the

lumen, after which appendix is amputated and stump invaginated.

- When the base is gangrenous neither crushing nor ligation must be attempted, two stitches are placed through the caecal wall close to the base of gangrenous appendix which is amputated flush with caecal wall, after that these stitches are tied.
- Retrograde appendicectomy; when the appendix is retro caecal and adherent, it is an advantage to divide the base first and proceed distally. Occasionally this maneuver requires division of lateral peritoneal attachments of Caecum.
- Drainage of peritoneal cavity: Usually unnecessary, may be needed when considerable purulent fluid in retro caecal space or pelvis is present.

### **Laparoscopic Appendicectomy**

Most valuable aspect of laparoscopy is as diagnostic tool and if required to be used as therapeutic tool.

Open technique should be used to establish pneumoperitoneum with empty bladder in moderate Trendelenburg tilt of operating table.

The appendix is found and Appendicectomy done as in conventional method.

Patients who undergo laparoscopic Appendicectomy have less postoperative pain, early discharge and less wound infection. The incidence of postoperative intrabdominal sepsis may be higher in



patients operated on for gangrenous or perforated appendicitis when compared to open method.

### **Problems encountered during Appendicectomy**

If a normal appendix is found; demands careful exclusion of other possible diagnosis – terminal ileitis, Meckel’s diverticulitis, tubal or ovarian causes. It is usual to remove the appendix to avoid future diagnosis difficulties.

The appendix cannot be found; Caecum should be mobilized and the taeniae coli should be traced to their confluence on the Caecum before diagnosis of absent appendix is made.

An appendicular tumor is found; small tumors (less than 2cm in diameter) can be removed by appendicectomy. Larger tumors should be treated by right hemicolectomy.

An appendix abscess is found and appendix cannot be removed; should be treated by local peritoneal toilet, drainage of any abscess and IV – antibiotics. Very rarely a caeectomy or partial right hemicolectomy is required.

### **Appendicitis complicating Crohn’s disease:**

- If caecal wall is healthy at the base of appendix Appendicectomy can be performed.
- Appendix is rarely involved in Crohn’s disease and in this situation Conservative approach may be warranted.

### **Appendix abscess:**

- CT or USG guided percutaneous drain, if it fails, Laparotomy is indicated

### **Pelvic abscess**

- Is an occasional complication of appendicitis, can occur irrespective of position of the appendix, it cause spiking pyrexia, pelvic pressure, discomfort, tenesmus.
- Rectal examination reveals a boggy mass in pelvis. Pelvic USG, or CT scan will confirm the diagnosis
- Treatment is tran srectal drainage under GA

### **Management of an appendix mass**

If an appendix mass is present and the condition of the patient is satisfactory the standard treatment is conservative OCHSNER-SHERREN regimen by careful record of the patient's general condition, extent of mass, its periodic examination, intravenous fluids and antibiotics.

Clinical deterioration or evidence of peritonitis are indication for early Laparotomy. If an abscess is present, it should be drained under imaging control or open method.

Postoperative complications: These are relatively uncommon and reflect the degree of peritonitis which was present at the time of operation and inter current disease that may predispose to complications.

Wound infection: Most common complication, occur in 5 to 10% of all patients.

Intra abdominal abscess: Relatively rare after use of pre op antibiotics.

Fever, malaise, Anorexia after 5-7 days of surgery suggest an intra peritoneal collection, Inter loop, Para colic, pelvic and sub Phrenic sites should be considered.

Abdominal USG/CT- confirm diagnosis Treated by Per cutaneous drainage or Laparotomy.

Ileus: Persistent ileus may be indicative of intra abdominal abscess.

Respiratory: Rare, adequate postoperative analgesia and physiotherapy reduce the incidence.

Venous thrombosis and embolism:

Portal Pyaemia: Rare, but serious complication of gangrenous appendicitis associated with high fever, rigors and jaundice. It is caused by septicemia in portal venous system and leads to development of intra hepatic abscess.

Fecal fistula : occurs rarely. Occasionally a fistula may result following Appendicectomy in Crohn's disease.

Adhesive intestinal obstruction.

Right inguinal hernia: Due to injury to Ilio inguinal nerve.

**Chronic and recurrent appendicitis:**

- One or more attacks of acute appendicitis.

- Between the attacks patients are free of symptoms and physical examination is normal
- If faecolith is present an X ray, no filling of the appendix on barium enema.
- On repeated examination during an attack shows evidence of recurrent Appendicitis. Elective Appendicectomy should be undertaken.

### **Pathological examination of appendix:**

Early acute appendicitis:

- Sub serosal vessel congestion,
- Moderate peri vascular Neutrophil infiltrate.
- Normal glistening serosa into dull granular red membrane.

Acute suppurative appendicitis.

- Prominent neutrophilic exudates generates a fibro purulent reaction over the serosa. Abscess formation within the wall of appendix
- Necrosis ulceration in the mucosa.

Acute gangrenous appendicitis :

- Large areas of hemorrhagic green ulceration of mucosa and green black gangrenous necrosis through the wall extending to serosa.

Chronic appendicitis:

- Fibrosis in Appendiceal wall. Partial to complete Obstruction of the lumen.

- Evidence of old mucosal Ulceration, scarring and infiltration of wall with Chronic inflammatory cells.

### **Operative Techniques**

Appendicectomy can be done by two methods :

- OPEN SURGICAL METHOD
- LAPAROSCOPIC APPENDICETOMY

Open surgical method is still the commoner method used and can be done through various incisions.

LANZ INCISION is similar to the grid-iron incision except that it is transverse rather than oblique. Lanz incision is made 2cm below the umbilicus, centered on the mid clavicular – mid inguinal line. It gives a better cosmetic result and is being increasingly used. The incision can be extended medially and when necessary the rectus abdominus muscle can be divided in the line of the incision.

### **Technique**

- When the abdomen is opened, any free fluid should be taken for culture and sensitivity. The rest of the pus and free fluid is sucked away.
- The Caecum is identified and held in a moist pack, gradually withdrawn towards its lower ends and medially . This normally delivers appendix into the wound.
- In case of difficulty in identifying appendix then one should trace the taenia coli on the Caecum which leads to appendix. In case of

difficulty there should be no hesitation in extending the incision or conversion to a muscle cutting incision.

➤ Once the appendix is clearly visualized it is raised up and held by a Babcock's tissue holding forceps. The meso-appendix is then clamped, divided and ligated.

➤ Thereafter the appendix is crushed by a forceps applied to the base which is moved distally to be reapplied and left in place. A catgut ligature is tied around the crushed portion close to the caecum. An atraumatic cat gut purse string or a Z suture is inserted into the caecal wall near the base of the appendix.

➤ Abdominal mops are placed all round the appendix which is divided by a knife distal to the forceps. The appendiceal stump is then invaginated into the caecum while the purse-string suture is tied. However, this may be impossible if the adjacent caecal wall is edematous and friable. Some surgeons omit the step of invagination.

➤ Haemostasis is secured and peritoneal lavage with saline should be done, especially so in presence of pus.

➤ Drainage is usually not necessary though in gross contamination soft drain may be kept for 48 hours

➤ The wound is closed in layers. Some recommend if there is a gross contamination, skin wound should be left open and closed after few days under local anaesthetic.

## **LAPAROSCOPIC APPENDICECTOMY**

Is another possible method of performing this operation.

### **Steps of Laparoscopic Appendicectomy**

- Exploration of the peritoneal cavity and confirmation of diagnosis.
- Tip of the appendix is grasped with a grasper.
- Meso appendix is coagulated and cut with bipolar cautery or Harmonic scalpel.
- Two absorbable endo loops are tightened at the base of the appendix.
- Appendix is cut with scissors above the endo loops.
- The cut appendix is removed through one of the working ports.
- Any pus or fluid is suctioned out and lavage given if required.
- Pneumo peritoneum is evacuated completely and port sites are closed.

### **Indications for Laparoscopic Appendicectomy**

- All stages of acute appendicitis including perforation
- Interval Appendicectomy
- Recurrent abdominal pain where no other pathology is found:

However one must use laparoscopy only as a last resort in cases of repetitive chronic abdominal pain syndrome, after all other diagnostic and noninvasive modalities are exhausted and the “innocent looking

appendix” can be attributed as the cause of pain only after all other diagnoses and therapeutic possibilities have been ruled out and the pain does not allow the child to continue his / her school life.

- The histopathological documentation of endoappendicitis in normal looking appendices in cases of recurrent abdominal pain favours laparoscopic Appendicectomy.
- Incidental Appendicectomy done in conjunction with other operations should not be promoted.

In children the appendix proves to be extremely useful in:

- Certain urinary diversions as in Mitroanoff stoma
- Ureteric replacement
- Antegrade colonic washouts (Malone’s procedure)
- Porto enteral biliary drainage

### **Advantages of Laparoscopic Appendicectomy**

1. Allows meticulous exploration of entire peritoneal cavity
2. Allows for definitive treatment of non-Appendiceal lesions.
3. Reduces hospital stay.
4. Reduces postoperative morbidity.
5. Reduces wound complications.
6. Reduces incisional hernia and infertility, adhesions.
7. Improves cosmesis.
8. Allows thorough peritoneal toileting.



9. More rapid return to school and sports.

10. Safe and effective.

### **Disadvantages of Laparoscopic Appendicectomy**

1. Needs long and specific training.
2. Requires expensive equipments.
3. Accidents leading to visceral injury are intolerable in cases of benign pathology such as appendicitis.
4. Pneumo peritoneum leads to hemodynamic changes and postoperative shoulder pain.
5. Operating time depends upon surgeon's training and temperament.
6. Cost of disposables if disposable devices are used.

## **MATERIALS AND METHODS**

### **Materials**

This work includes the study of 202 patients with clinical diagnosis of acute appendicitis admitted in Madurai Medical College Hospital between Aug.2005 to June 2007.

All of them were admitted as emergency.

### **Methods:**

This includes detailed history from the patients, clinical examination, blood studies (total count, differential count), plain X- ray abdomen and urine examination.

All the information were entered in the proforma specially designed for this study.

### **Management**

All the cases were informed that surgery is the definite treatment. The nature of surgery and its complication were explained and informed consent was obtained.

All patients were operated under regional or general Anaesthesia

All patients were given preoperative and Post operative antibiotics. Appendicectomy done by open conventional method,

through Lanz transverse skin crease incision, depending on the preoperative findings.

During surgery the macroscopic pathological anatomy of the appendix noted. If the appendix was found to be normal, the other etiologies were identified and treated in appropriate manner. In this situation, even though the appendix was normal, appendectomy done to avoid future confusion in diagnosis.

All the Appendectomy specimen were sent for histopathological examination in the Department of Pathology Madurai medical college for clinicopathological correlation.

After surgery the patients were discharged on 3-7days except in cases of complications.

## OBSERVATION

In our study the following observation were made

Total Major Surgeries [Elective & Emergency ]	2273
Emergency Surgeries	533
Total Appendectomy { n }	202
Emergency Appendectomy	156

- In this study earnest effort was made within our limitations to find the causes for the increased incidence.

## Patient Profiles

Age	N= 202
5 - 8 yrs	10
9 - 10 yrs	68
11 - 13 yrs	124

Region	n= 202
City	72
Small town	23
Village	107

Sex	n= 202
Male	135
Female	67

Social status	n =202
Low	183
Middle	19
High	0

Dietary habits	n =202
Veg [pure]	0
Non-Veg [Mixed]	202
Staple	RICE / MAIDA

## HISTORY OF ABDOMINAL PAIN

Site	Patients
RIF	123
Umbilical	32
Generalised	47

Duration	Patients
1-2 days	115
2-4 days	64
>4 days	23

Nature	Patients
Colicky/Intermittent	179
Burning	23

### NAUSEA

	Patients
Vomiting Mild	69
Vomiting Moderate	73
No Vomiting	60

Duration	Patients
<24 hrs	92
24-48 hrs	40
>48 hrs	10

Nature	Patients
Bilious	7
Nonbilious	135

### FEVER

Duration	n = 202
<24 hrs	120
24-48 hrs	30
>48 hrs	10
No fever	42

Nature	Patients
Low grade	27
Moderate	113
High grade	20

### OTHER COMPLAINTS

Dysuria	n=202
Present	9

Bowel habits	n=202
Spurious diarrhoea	9
Constipation	23

### PAST HISTORY

Similar Episode	Patients
Present	17

Previous Surgery	Patients
Yes	2

## FAMILY HISTORY

Incidence In Family	Patients
Present	7

Relationship	Patients
Father	-
Mother	-
Siblings	7

## CLINICAL EXAMINATION [on admission]

### GENERAL EXAMINATION

Fever	Patients
Present	160

Anemia	Patients
Present	49

### ABDOMEN

#### Tenderness

Site	Patients
RIF	153
Umbilical	15
Diffuse	34

Nature	Patients
Mild	12
Moderate	33
Severe	157

# MASS

	Patients
Present	17

Site	Patients
RIF	17

Size	Patients
<5cm	10
>5cm	7



## INVESTIGATIONS

### BLOOD

Hb %	Patients
<10gms	49
>10gms	153

Total Count	Patients
Raised	193
Normal	7

Probe Tenderness	Patients
Present	60
Absent	67

## RADIOLOGICAL

X-Ray Abdomen	Patients
Fecolith	5
Air under diaphragm	3
Sentinal loop	100

### USG Done 127 { n = 202 }

Appendicular Findings	127
Normal	7
Inflammed	93
Mass	17
Perforation	10

U S G	127
False Negative	7
False Positive	11

## SURGICAL STATISTICS

Anaesthesia	
ETGA	195
Regional	7

Appendectomy	Open	Laparoscopy
Emergency	156	0
Elective	27	19

**OPEN APPENDICECTOMY**

<b>Incision</b>	<b>Patients</b>
Lanz	150
Transverse	33

<b>Position</b>	<b>Patients</b>
Retrocaecal	8
Pelvic	22
Subcaecal	168
Post ileal	0
Pre ileal	4

**TYPE**

Turgid and inflamed	156
---------------------	-----

**PERFORATION**

<b>Site</b>	<b>Patients</b>
Tip	10
Base	7

<b>Presentation</b>	<b>Patients</b>
With peritonitis	10
With pus	7

**GANGRENE**

<b>Gangrene</b>	<b>Patients</b>
Present	13

<b>Site</b>	<b>Patients</b>
Tip	7
Base	6

# Laparoscopic Appendicectomy

Male	Female
9	10

Port sites	Port Size
Subumbilical	10mm
Suprapubic	5mm
Sub hepatic	5mm

•Associated Meckel's Diverticulum - Nil

•Conversion to open - Nil

## POST OPERATIVE EVALUATION

### Open Appendicectomy [183]

Pain score	Patients
Mild	5
Moderate	160
Severe	18

Oral feeds	Patients
<24 hrs	0
24-48 hrs	168
>48 hrs	15

Discharged pod	Patients
< 3 days	0
4 - 7 days	170
> 8 days	13

### Laprosopic Appendicectomy [19]

Pain score	Patients
Mild	15
Moderate	4
Severe	0

< 24 hrs	12
24-48 hrs	7
>48 hrs	0

<3 days	19
4-7 days	0
> 8 days	0

## COMPLICATIONS

- Prolonged fever - 9
- Paralytic ileus - 2
- Adhesive obstruction -1
- Incisional hernia - 1

## Histopathology

Normal	0
Features of Appendicitis	202
Others	-

## DISCUSSION

It is known from various current studies and textbooks, removal of normal appendix rate to range from 15 % to 35%. Piper and associates conducted a careful study to know the accuracy of diagnosis in acute appendicitis, they reviewed 1018 appendicectomies, carried out in Stockholm, in patients whose age ranged from 1 to 89 years,

- The diagnosis was correct in 67% of the cases.
- In Male the accuracy was 77.7 %
- In Female the accuracy was 58 %
- In the Reproductive female patients aged between 10 to 39 the diagnostic accuracy was 52.7 % due to high incidence of co existing gynecological disorders. (which were accounted in 15.5 % of cases) .

It is known from the study that detailed clinical history and examination can reduce the rate of removal of normal appendix.

The diagnostic accuracy can still more improved by appropriate use of USG, CT abdomen in equivocal cases, for exclusion of other disease and diagnosis of appendicitis.

### **Limitations of this study**

- 1 Less number of patients.
- 2 No patients were included in the aged group less than 5 years and more than 13 years.
- 3 Less number of female patients.
- 4 Possibilities of bias.

## **SUMMARY**

The observations made in this study are.

1. 202 cases were admitted with the diagnosis of acute appendicitis.

Age of the patients ranged from 5 to 13 years.

2. 135 were males and 67 were females.

3. All patients were resuscitated and given pre and post operative antibiotics.

4. All patients were treated by surgery with Appendicectomy.

5. All the removed appendix specimen were studied by macroscopic and microscopic examination.

6. The overall and sex specific diagnostic accuracy was calculated by clinicopathological correlation.

## CONCLUSION

1. Appendicitis is common in 5 - 13 years of age. In 202 surgically treated patients diagnostic accuracy was nearing cent percent. The incidence of Appendicitis is significantly higher in males (67%) as compared to females (33%).
2. We found that the proportion of children with complicated disease did not change during the 10-year period. Young children had the lowest incidence of acute appendicitis, but they had a 5-fold greater risk of complicated disease than older children.
3. The annual crude incidence of acute appendicitis was 89 % in the surgeries performed in our Department.
4. The overall perforation rate was 15%. Perforation rates and complication rates were higher in smaller children. There were no differences between genders.
5. Acute appendicitis is essentially clinical diagnosis, but is aided by the present gamut of investigations.
6. Detailed clinical history and examination can reduce the removal of normal appendix. Logistic regression analysis showed that a history of nausea or vomiting and pain migration to the right iliac fossa independently predicted a correct diagnosis of acute appendicitis.

7. The clinical diagnostic accuracy is better in male sex than in female.
8. Commonly used inflammation markers (CRP, WCC, fraction of neutrophil granulocytes and rectal body temperature) are useful in predicting active disease.
9. By appropriate use of Ultrasound and CT Abdomen removal of normal appendix in equivocal cases can be reduced further. In fact if laparoscopy is included as a diagnostic tool the incidence of negative Appendicectomy would be 0 %.
10. Total white blood cell count may be normal in acute appendicitis.
11. Acute appendicitis was histologically proven in all the cases.
12. Increased usage of ultrasound may be the reason for early reference.
13. “Natives live on a diet abundant in cellulose and fibres are immune from this disease. When they adopt the diet of civilization they loose that immunity.” - William Boyd. The incidence of appendicitis is higher in more affluent societies that have a prevalence of low-fiber diets. Low-fiber diets change the bacterial flora, increasing stool viscosity, bowel transit time, and intra luminal pressure, which encourage the formation of faecoliths. These diets contribute to low-residue stool, which can become impacted within the appendiceal lumen. We believe that the changes we see in the economic status, life style and food habits of people who live in rural and semi urban



areas may be the causes for this increased incidence, as evinced by Bush's recent statements that there is a demand for increased amount of posh food stuffs in the third world countries.

PROFORMA

Acute appendicitis

HISTORY

Name

Age

DOA

Sex

DOS

Ip No

DOD

Address

Occupation

Wd.

UNIT

COMPLAINTS:

Abdominal pain

Nausea

Vomiting

Fever

Anorexia

Diarrhea

Constipation

Past History:

Previous Similar episode

General Examination:

Built & nourishment

Anemia

Temperature

Vital signs

Cardio vascular system

Respiratory system

Abdomen:

Distension

Localized Tenderness, Rebound Tenderness

Guarding and rigidity

Bowel sounds.

External genitalia

Per rectal Examination

Investigation

URINE – Albumin

Sugar

Deposits

Hb%, Total count,

Blood Urea,

Blood Sugar,

Sr Creatinine,

ECG, X Ray Chest

Plain X ray Abdomen, USG Abdomen

Anaesthesia,

Surgery

Post operative period

Complications

Follow up

Histopathological Examination Report.

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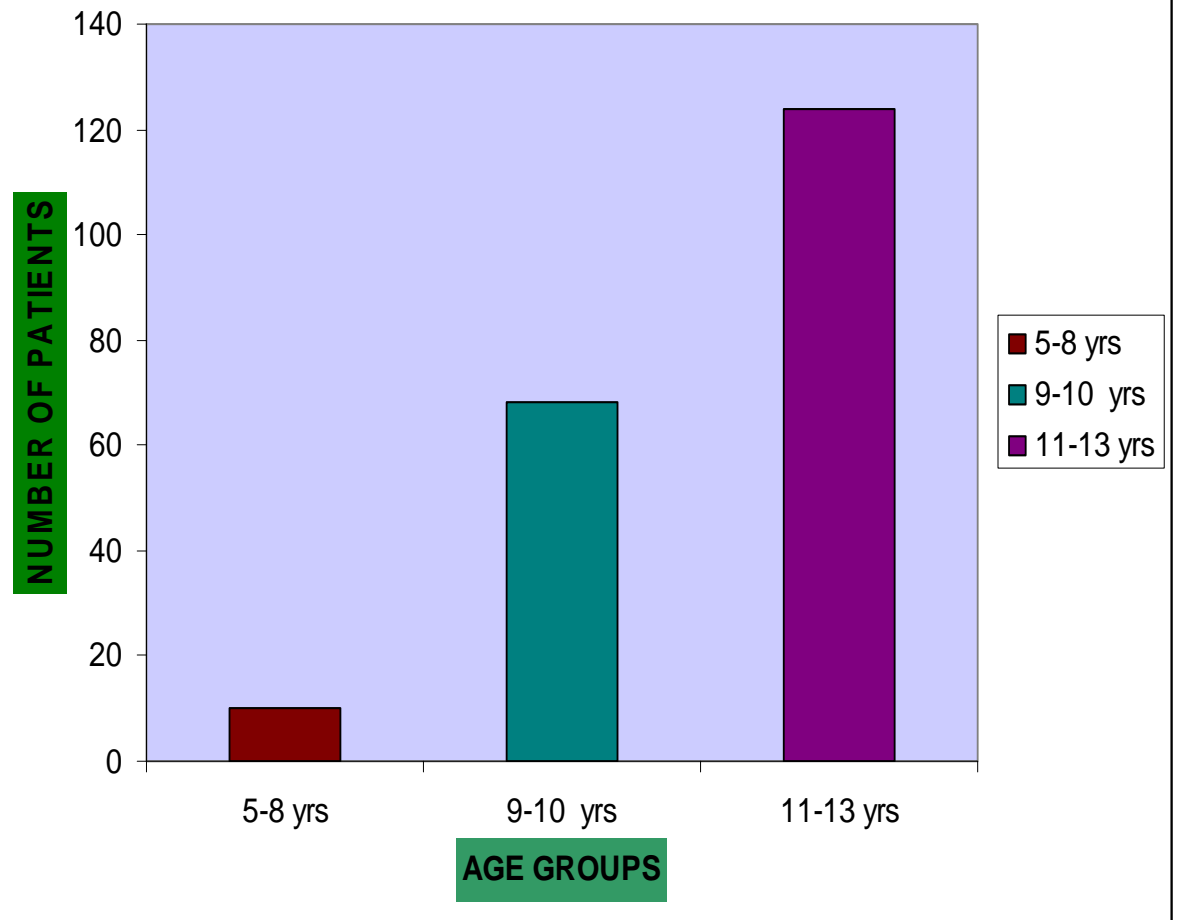


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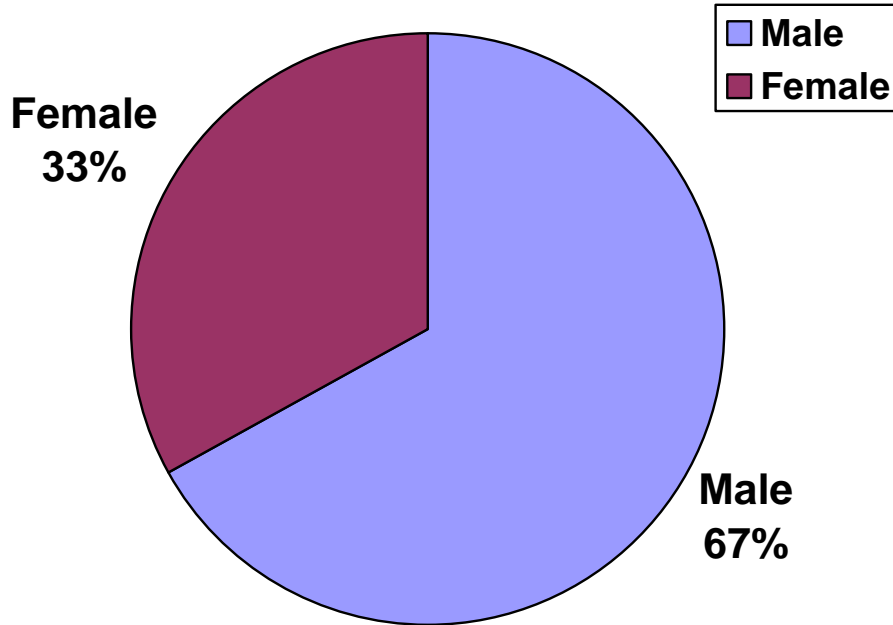
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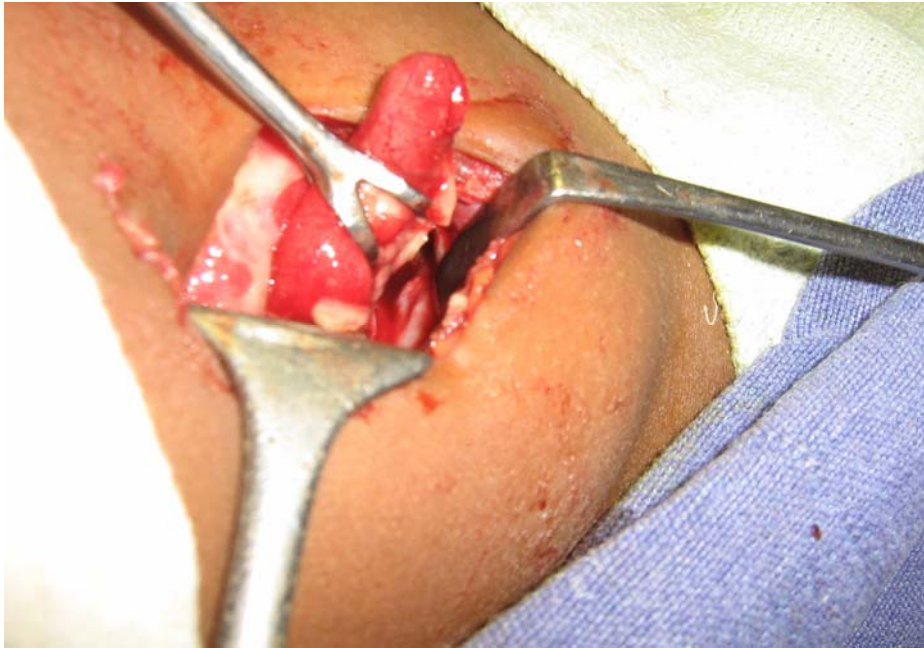
## AGE INCIDENCE



# Sex Incidence



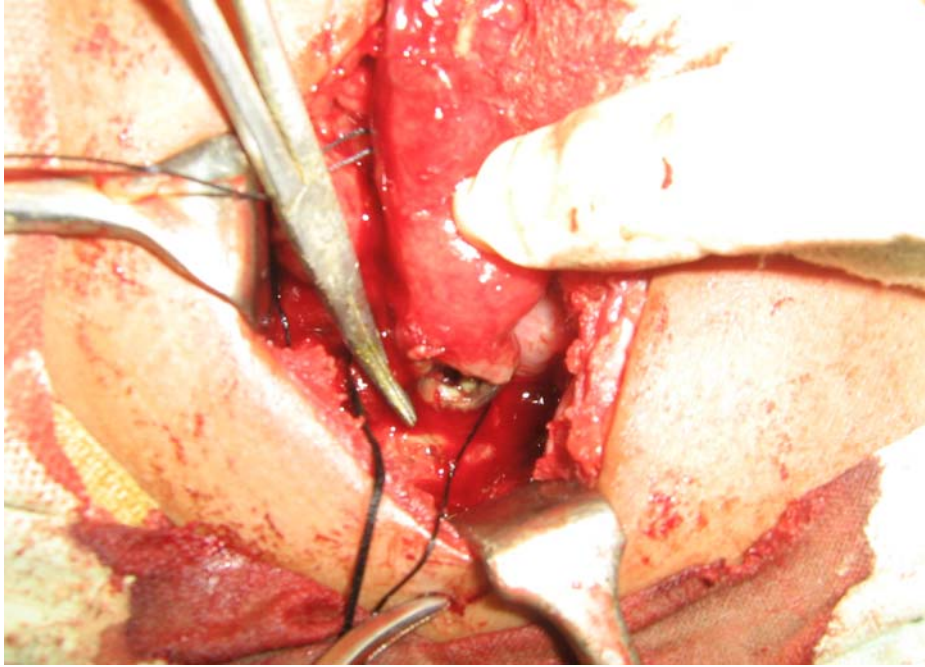
**FIG-1**



**FIG-1. INFLAMMED AND TURGID**

**APPENDIX**

**FIG-2**



**FIG-2. PERFORATED APPENDIX**

**FIG-3**



**FIG-3. GANGRENOUS APPENDIX**



**FIG-4**



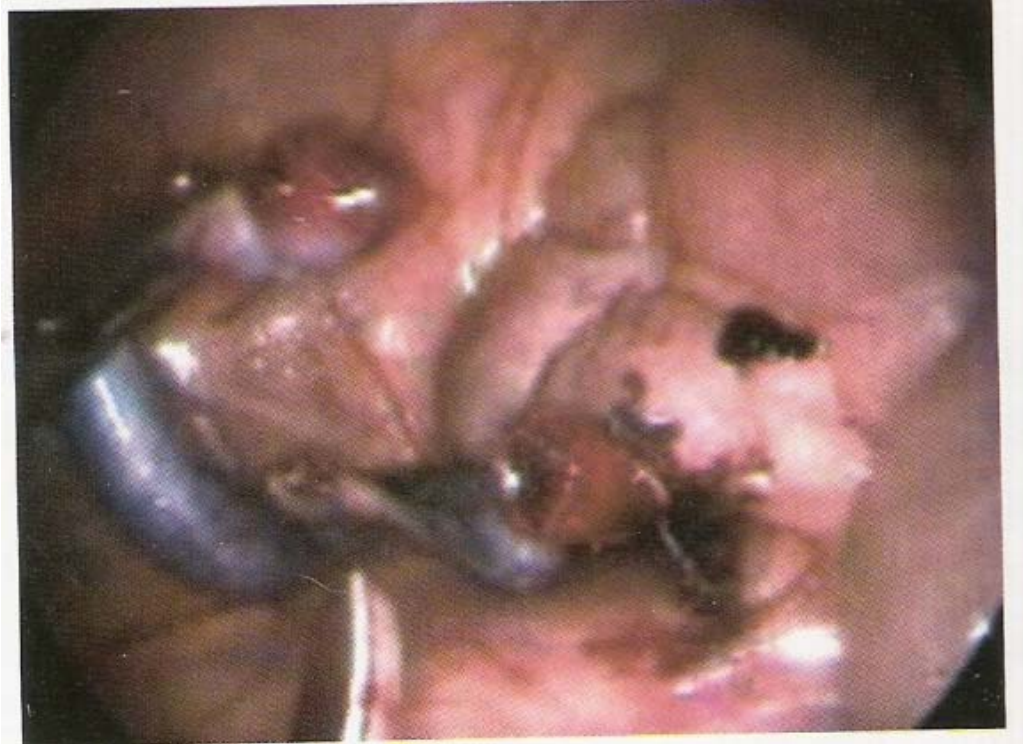
**FIG-4. MESOAPPENDIX BEING COAGULATED  
WITH BIPOLAR COAGULATION FORCEPS**

**FIG-5**



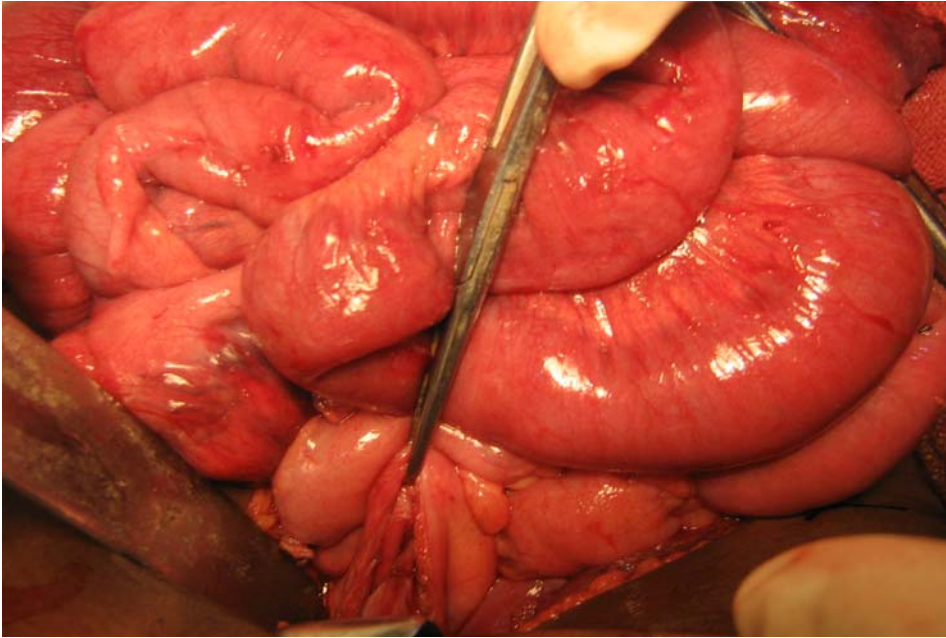
**FIG-5. ENDOLOOP BEING TIGHTENED AT THE  
BASE OF APPENDIX AFTER DISSECTION**

**FIG-6**



**FIG-6. APPENDICULAR STUMP AFTER  
LAPAROSCOPIC APPENDICETOMY**

**FIG-7**



**FIG-7. ADHESIVE INTESTINAL OBSTRUCTION**

**FIG-8**



**FIG-8. INCISIONAL HERNIA**