

**EVALUATION OF ALVARADO SCORING IN ACUTE  
APPENDICITIS**

**DISSERTATION SUBMITTED FOR THE DEGREE OF**

**M. S. BRANCH-I (GENERAL SURGERY)**

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**THE TAMILNADU DR.M.G.R. MEDICAL UNIVERSITY,  
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## **DECLARATION**

I **Dr.M.HARIS VIJILA RANI** declare that, I carried out this work on, **“EVALUATION OF ALVARADO SCORING IN ACUTE APPENDICITIS”** at the Department of surgery, Govt. Rajaji Hospital during the period of June 2006 to June 2008. I also declare that this bonafide work or a part of this work was not submitted by me or any others for any award, degree, diploma to any other University, Board either in India or abroad.

This is submitted to The Tamilnadu Dr.M.G.R. Medical University, Chennai in partial fulfillment of the rules and regulations for the M.S. degree examination in General Surgery.

Place: Madurai.

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Date:

## **BONAFIDE CERTIFICATE**

This is to certify that the dissertation entitled “Evaluation of Alvarado scoring in acute appendicitis” submitted by Dr.M.Haris vijila Rani to The Tamilnadu Dr.M.G.R. Medical University, Chennai in partial fulfillment of the requirement for the award of M.S. Degree branch - I (General Surgery) is a bonafide research work and was carried out by her under direct supervision and guidance.

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*PART I*

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# *INTRODUCTION*

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Acute appendicitis has been treated surgically for over 100 years, the first appendicectomy being performed by Lawson Tait in May 1880. Despite its high prevalence with the population, accurate diagnosis still remains difficult. The percentage of appendicectomy where appendix is normal (negative appendicectomy) varies between 15 and 50% and post operative complications occur in upto 15 % of these patients. The greatest diagnostic error occurs in women whose symptoms and signs may be caused by many gynaecological conditions. Compared with men, the diagnosis of appendicitis in women is twice as likely to be more incorrect, and the complications of negative appendicectomy vary, from superficial wound infection to adhesions, intestinal obstruction, infertility (due to fimbrial adhesions), right inguinal and incisional hernia and even death.

The vermiform appendix is only found in humans, certain anthropoid apes and the wombat, and some surgeons advocate that rather than being a degenerate and vestigial structure, the appendix may be considered specialized and useful in reconstructive biliary, tubal and urologic surgery. Negative appendicectomy therefore robs the patient of a useful asset.

The risks of negative appendicectomy, however, must be balanced against the increased morbidity and mortality associated with late diagnosis and perforation. Following perforation, the length of stay in hospital increases, the risk of infertility rises, wound infection rates may treble, post operative intra abdominal collections develop 15 times more frequently, and the mortality of appendicitis (normally quoted as 1%) rises to 8.5%. Therefore, a high negative appendicectomy rate has been regarded as acceptable in the light of severe complications of 'sitting on a hot appendix' and risking perforation.



# *AIM*

The aim of this study is to evaluate **THE ALVARADO SCORING SYSTEM** as a diagnostic tool to aid the early and accurate diagnosis of acute appendicitis.

# *HISTORICAL REVIEW*

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The first appendicectomy was performed by Amyand, Surgeon to Westminster and ST. George's Hospitals and Sergeant Surgeon to George II. In 1736, he operated on a boy aged 11 years who had a right scrotal hernia accompanied by a fistula. Within the scrotum was found the appendix, perforated by a pin. The appendix was ligated and all or, more likely, part of it, removed, with recovery of the patient

In 1755, Heister recognised that the appendix might be the site of acute primary inflammation. He described an autopsy on the body of a criminal who had been executed and wrote:

When about to demonstrate the large bowel, I found the vermiform appendix of the caecum preternaturally black. As I was about to separate it, its membranes parted and discharged two to three spoonfuls of matter. It is probable that this person might have had some pain in the part.

In 1824, Loyer - Villermay gave a presentation to the Royal Academy of Medicine in Paris, entitled "Observations of Use in the inflammatory Conditions of the Caecal Appendix", in which he described two examples of acute appendicitis leading to death. In both cases the appendix was found at autopsy to be black and gangrenous, whereas the caecum was scarcely involved. Three years later these observations were confirmed by Melier. Unfortunately, at this stage the pathologic picture became obscured. The writings of Husson and Dance in 1827, Goldbeck in 1830, and, most powerfully of all, Dupuytren in 1835 developed the concept of inflammation arising in the cellular tissue surrounding the caecum; it was Goldbeck who invented the term 'perityphilitis' which did much to delay the progress of the understanding of this disease.

The first textbook to give a description of the symptoms that accompanied inflammation and perforation of the appendix was published by

Bright and Addison in 1839. The appendix 'typhilitis' and 'perityphilitis' remained in use until the end of the nineteenth century. It was Fitz, professor of medicine at Harvard, who in 1886 gave a lucid and logical description of the clinical features and described in detail the pathologic changes of the disease ; he was also the first to use the term 'appendicitis'. He wrote:

In most fatal cases of typhilitis, the caecum is intact whilst the appendix is perforated. The question should be entertained of immediate opening. If any good result is to arise from such treatment it must be applied early.

The evolution of the operative treatment of appendicitis proceeded significantly when Hancock in London successfully drained an appendix abscess in a female patient aged 30 who was in her eighth month of pregnancy. In 1848, he wrote:

It may be premature to argue from the result of one case, but I trust that the time will come when this plan will be successfully employed in other cases of peritonitis terminating in effusion, which usually end fatally.

Parker of New York advocated earlier incision of appendix abscesses in 1867; after the publication of this paper, many similar accounts were published.

From the priority point of view, Sheperd showed that in 1880 Tait of Birmingham operated on a patient with gangrenous appendicitis and removed the appendix, with recovery of the patient. Tait, however did not record this case until 1890, Credit for the first published account of appendicectomy must go to Kronlein in 1886, although the patient aged 17 years, died 2 days later. In 1887, Morton of Philadelphia successfully diagnosed and excised an acutely inflamed appendix lying within an abscess cavity. Two years later, McBurney in New York pioneered early diagnosis and early operative intervention and also devised the

muscle splitting incision named after him. Early intervention was still further popularized by the teaching of Murphy of Chicago. Both these surgeons pioneered the removal of the appendix before perforation had been allowed to take place.

It soon became evident that although the results of appendicectomy for the acutely inflamed unperforated appendix were satisfactory, the operative death rate for the later cases of perforated appendix with peritonitis was distressingly high. Ochsner in Chicago and Sherren at The London Hospital were both advocates in the early years of the Twentieth century of conservative treatment in late cases. The discovery of antibiotics, fortunately, resolved the controversy between the schools of conservative and active surgery in such cases.

# *ANATOMY*

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# **EMBRYOGENESIS OF APPENDIX**

## **Normal development**

The appendix and caecum develop as outpouchings of the caudal limb of the midgut loop in the sixth week of human development. By the fifth month, the appendix elongates into its vermiform shape. At birth the appendix is located at the tip of caecum, but due to unequal elongation of lateral wall of caecum, the adult appendix typically originates from the posteromedial wall of caecum, caudal to the ileocecal valve.

The appendix averages 9 cm in length, with its outside diameter ranging from 3-8 mm and its lumen ranging from 1-3 mm. The base of the appendix is consistently found by following the taenia coli of the colon to their confluence at the base of the caecum.

## **The position of appendix**

The tip of appendix can vary significantly in its location. The most common position is retro caecal position 74%. The second most common position is pelvic position 21%. In 5% of cases the appendix lies either paracecal, subcecal, preileal or post ileal.

Malrotation or maldescent of the caecum is associated with abnormal locations of appendix, which may be found anywhere between the right iliac fossa and left infra splenic area. In cases of situs inversus, the appendix is in the left lower quadrant. Such abnormal positions of the caecum introduce difficulties in diagnosis if appendicitis supervenes.

## **Microscopic anatomy**

The appendix varies considerably in length and circumference. The lumen is irregular, lined by multiple longitudinal folds of mucous membrane lined by columnar cell intestinal mucosa of colonic type. Crypts are present but are not numerous. In the base of crypts lie argentaffin cells. The submucosa contains numerous lymphatic aggregations or follicles. The muscular coat consists of two complete layers of smooth muscle, inner circular and outer longitudinal, the latter is formed by the joining together of the taenia coli at the base of the appendix. The visceral layer of peritoneum envelops the appendix completely except for narrow line of attachment of the meso appendix.

## **Blood supply:**

The mesentery of the appendix or mesoappendix arises from the lower surface of the mesentery or the terminal ileum and is itself subject to great variation. The appendicular artery a branch of the lower division of the ileo colic artery runs in the free border of mesoappendix. An accessory appendicular artery may be present arising from the posterior caecal artery.

The **veins** from the appendix drain into the ileocolic veins, which in turn empties into the superior mesenteric vein.

A variable number of slender lymphatic channels traverse the meso appendix to empty into the ileocecal nodes.

## **Nerve supply:**

The nerves of appendix derived from the plexus of the sympathetic nerves around superior mesenteric artery. They run to the mesenteric plexus and is situated between the circular and longitudinal muscle bundles from where the nerve fibres are distributed to the muscular coats of the appendix. From this plexus, a secondary plexus called submucous plexus supplies the circular muscle bundles.



# *ACUTE APPENDICITIS*

## *CLINICAL FEATURES AND EVALUATION*

## INCIDENCE

Acute appendicitis is relatively rare in infants and becomes increasingly common in childhood and early adult life, reaching a peak incidence in the teens and early twenties. After middle age the risk of developing appendicitis 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 the age of twenty five years, thereafter the greater incidence in males declines.

## AETIOLOGY

There is no unifying hypothesis regarding the aetiology of acute appendicitis. While appendicitis is clearly associated with bacterial proliferation within the appendix, no single organism is responsible, indeed a mixed growth of aerobic and anaerobic organisms is usual. The initiating event causing bacterial proliferation is controversial. Obstruction of the appendix lumen has been widely held to be important and indeed some form of luminal obstruction either a faecolith or a stricture is found in the majority of cases. The possible aetiology include :

- ⊕ Obstruction by a faecolith which is composed of inspissated faecal matter, calcium phosphates, bacteria and epithelial debris.
- ⊕ The incidental finding of a faecolith is a relative indication for prophylactic appendectomy.
- ⊕ A Fibrotic stricture of the appendix usually indicates previous appendicitis which resolved without surgical intervention.
- ⊕ Obstruction of the appendiceal lumen by carcinoma of caecum in middle aged and elderly.
- ⊕ Obstruction by carcinoid tumour of appendix
- ⊕ Obstruction by intestinal parasites, particularly *Oxyuris vermicularis*.

## PATHOLOGY

Obstruction of the appendiceal lumen seems to be essential for development of appendiceal gangrene and perforation. Yet in many cases of early appendicitis the appendix lumen is patent.

**Wangensteen** extensively studied the structure and function of appendix and the role of obstruction in appendicitis.

Based on anatomic studies, he postulated that mucosal folds and a sphincter like orientation of muscle fibres at the appendiceal orifice make the appendix susceptible to obstruction.

He proposed the following sequence of events :

- Closed loop obstruction is caused by a faecolith and swelling of the mucosa and submucosal lymphoid tissue at the base of the appendix.
- Intraluminal pressure rises as the appendiceal mucosa secretes fluid against the fixed obstruction.
- Increased pressure in the appendiceal wall exceeds capillary pressure and causes mucosal ischemia and
- Luminal bacterial overgrowth and translocation of bacteria across the appendiceal wall result in inflammation, edema and ultimately necrosis – gangrenous appendicitis. .
- If the appendix not removed perforation ensues.

Alternatively, the greater omentum and loops of small bowel become adherent to the inflamed appendix, walling off the spread of peritoneal contamination resulting in a phlegmonous mass or **paracaecal abscess**.

Rarely, appendiceal inflammation resolves leaving a distended mucous filled organ termed a **mucocele** of the appendix.

It is the potential for peritonitis that is the great threat of acute appendicitis. Peritonitis occurs as a result of free migration of bacteria through an ischaemic appendicular wall, through frank perforation of a gangrenous appendix or delayed perforation of an appendix abscess. Factors which promote this include extremes of age, immunosuppression, diabetes mellitus, faecolith obstruction of the appendix lumen, a free lying pelvic appendix and previous abdominal surgery which limits the ability of the greater omentum to wall off the spread of peritoneal contamination. In these situations a rapidly deteriorating clinical course is accompanied by signs of diffuse peritonitis and systemic sepsis syndrome.

## **CLINICAL FEATURES OF ACUTE APPENDICITIS**

The Clinical features of acute appendicitis include:

- Periumbilical colic
- Pain shifts to right iliac fossa
- Anorexia
- Nausea and vomiting
- Mild fever

The classical features of acute appendicitis begin with poorly localised colicky abdominal pain. This is due to midgut visceral discomfort in response to appendiceal inflammation and Obstruction. The pain is frequently first noticed in the periumbilical region and is similar to. But less intense than, the colic of small bowel obstruction. Central abdominal pain is associated with

anorexia, nausea and usually one or two episodes of vomiting which follow the onset of pain (Murphy's syndrome).

Anorexia is a useful and constant clinical feature, particularly in children. The patient often gives a similar history of which settled spontaneously.

With progressive inflammation of the appendix, the parietal peritoneum in the right iliac fossa becomes irritated producing more intense, constant and localised somatic pain which begins to predominate. This is often reported by the patient as an abdominal pain which has shifted and changed in character. Typically, coughing or sudden movement exacerbates the right iliac fossa pain.

The classical visceral – somatic sequence of pain is present in only about half of those patients subsequently proven to have acute appendicitis. Atypical presentations include pain which is predominantly somatic or visceral and poorly localised.

Atypical pain is more common in the elderly in whom localization to the right iliac fossa is unusual. An inflamed appendix in the pelvis may never produce somatic pain involving the anterior abdominal wall and may instead cause suprapubic discomfort and tenesmus. In this circumstance tenderness may only be elicited on rectal examination which should be performed in every case of lower abdominal pain.

During the first six hours there is rarely any alteration in temperature or pulse rate. After that time, slight pyrexia with corresponding increase in the pulse rate to 80 or 90 is usual. Typically, two clinical syndromes of acute appendicitis can be discerned, **acute catarrhal appendicitis** (non obstructive appendicitis) and **acute obstructive appendicitis**. The latter is characterized by a much more acute course. The onset of symptoms is abrupt and there may be generalised abdominal pain from the start. The temperature may be normal and vomiting is common, so that the clinical picture may mimic acute intestinal Obstruction. Once recognised, urgent surgical intervention is required because of more rapid progression to perforation.

## CLINICAL SIGNS IN ACUTE APPENDICITIS

- ♣ Pyrexia
- ♣ Localised tenderness in the right iliac fossa
- ♣ Muscle guarding
- ♣ Rebound tenderness

**SIGNS** to elicit :

**1. POINTING SIGN** : The patient is asked to point to where the pain began and to where it moved.

**2. ROVSINGS SIGN**: Deep palpation of the left iliac fossa may cause pain in the right iliac fossa

**3. PSOAS SIGN** : Occasionally an inflamed appendix lies in on the psoas muscle and the patient , often young adult , will lie with the right hip flexed for pain relief .

**4. OBTURATOR SIGN** : Spasm of the obturator internus is sometimes demonstrable when the hip is flexed and internally rotated. If an inflamed appendix is in contact with the obturator internus, this manoeuvre will cause pain in the hypogastrium.

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

### **1. RETROCAECAL :**

Rigidity is often absent and even on deep pressure tenderness may be lacking (silent appendix), the reason being that the caecum distended with gas, prevents the pressure exerted by the hand from reaching the inflamed structure. Psoas spasm, due to the inflamed appendix being in contact with the muscle, may be sufficient to cause flexion of the hip joint. Hyperextension of the hip joint may induce abdominal pain when the degree of Psoas spasm is sufficient to cause flexion of the hip.

### **2. PELVIC :**

Occasionally early diarrhoea results from the inflamed appendix being in contact with the rectum. In some instances deep tenderness can be made out just above and to the right of the symphysis pubis. A rectal examination reveals tenderness in the recto vesical pouch or the pouch of Douglas, especially on the right side. Spasm of the psoas and obturator internus muscles may be present when the appendix is in this position.

### **3. POST ILEAL :**

Although this is rare, it accounts for some of the cases of 'missed appendix'. Here the inflamed appendix lies behind the terminal ileum. It presents the greatest difficulty in diagnosis, because the pain may not shift, diarrhoea is a feature and marked retching may occur.

# *MANAGEMENT*

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## **INVESTIGATIONS**

The diagnosis of acute appendicitis is essentially clinical. There is no laboratory or radiological test yet devised that is 100% diagnostic of this condition.

### **WHITE BLOOD CELL COUNT**

80% of patients with acute appendicitis will have a leukocytosis and about 80% of these will have a neutrophilia greater than 75%. However, the diagnostic value of this common investigation is brought into perspective by the fact that upto 70% of patients presenting with other causes of right iliac fossa (RIF) pain will also have leukocytosis. On the other hand, many patients with a perforated appendix have a normal white blood cell count. It has been noted that if the test is repeated some hours later in patients with acute appendicitis, the WBC count tends to remain raised with sensitivity greater than 80% and specificity greater than 90%. Studies have reported that this trend is especially helpful in the management of children with suspected appendicitis. On admission to the hospital, this test may be considered as sensitive but with a lower specificity and serial WBC counts may be more diagnostic.

### **SCORING SYSTEMS**

Many scoring systems have been advocated with varying degrees of complexity. The **ALVARADO** score is both simple to remember and to use, being based on three symptoms, three signs & two laboratory values. It has a sensitivity of 100% in children, 93% in men, and 67% in women with scores greater than 6. Although scoring systems aid diagnosis in men and children, they have a low sensitivity in women.

## RADIO ISOTOPE LABELLED LEUKOCYTES

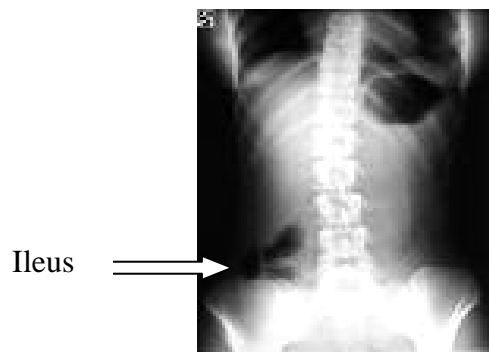
Incubation of the patient's leukocytes with Indium – 111 or Technetium 99m following intravenous injection has shown uptake in an inflamed appendix with a sensitivity and specificity of upto 85% and 100% respectively.

## RADIOGRAPHY :

In 1965, **Brooks and Killen** described radiological signs in plain X-ray films of the abdomen in patients with acute appendicitis.

- ★ Fluid level localised to caecum
- ★ Localised ileus with gas in caecum , ascending colon or terminal ileum
- ★ Increased soft tissue density in right lower quadrant.
- ★ Blurring of the right flank stripe, the radiolucent line produced by fat between the peritoneum and transversus abdominis.
- ★ A faecolith in the right iliac fossa
- ★ Blurring of psoas shadow in the right side
- ★ A gas filled appendix
- ★ Free intraperitoneal gas
- ★ Deformity of the caecal gas shadow due to an adjacent inflammatory mass.

However none is pathognomonic of appendicitis.



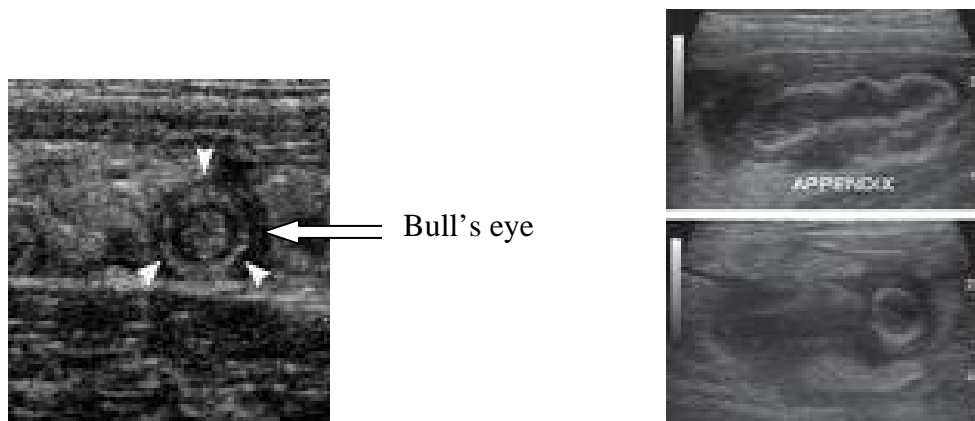
*x- ray abdomen picture showing localised ileus*

## **BARIUM ENEMA:**

If the appendix fills on barium enema appendicitis is excluded. Sensitivity and specificity of this test is 90% and 75% respectively. It may also diagnose other conditions included in the differential diagnosis of RIF pain e.g. colonic carcinoma, terminal ileitis, ischemic colitis. However upto 10% of normal appendix cannot be demonstrated. There is radiation hazard.

## **BARIUM SWALLOW:**

This is an alternative to barium enema and has been reported as having 95% accuracy in children.



*Ultrasound features of acute appendicitis*

## **ULTRASONOGRAPHY:**

With abdominal ultrasound the inflamed appendix looks like a 'bull's eye' and is tender on graded compression. Findings that suggest appendicitis include thickening of the appendiceal wall >6mm, loss of wall compressibility, periappendiceal fluid, and increased echogenicity of surrounding fat.

Advantages include widespread availability, no ionizing radiation, useful in assessing other gynaecological conditions. Disadvantages will be highly operator dependent.

## **COMPUTED TOMOGRAPHY :**

Computed tomography has reduced the incidence of negative appendicectomy. On CT scan, The inflamed appendix appears dilated > 6mm, thick walled appendix that does not fill with enteric contrast or air, 'dirty fat ', thickened mesoappendix. It demonstrated a sensitivity of 0.94 and a specificity of 0.95.

Expense and radiation exposure limit its use to the few patients with whom diagnosis is difficult.

## **COMPUTERS :**

Computer aided clinical diagnosis of patients with RIF pain has been used since 1972 and studies since then have consistently shown an increase in diagnostic accuracy. Clinical data are entered into a computer, which compares them with its database and calculates the likelihood of acute appendicitis. The improvement in diagnostic accuracy is partly because of a more accurate and complete gathering of clinical data, as well as the analysis by computer. The attraction lies in the accuracy and cost benefit, but it requires specialized training and equipment.

## **FINE CATHETER PERITONEAL CYTOLOGY :**

A smear from the peritoneal cavity showing a percentage of Polymorphonuclear cells above 50% directly correlates with the presence of acute inflammatory conditions such as acute appendicitis.

A small umbilical catheter (3.5 Fr) is passed through a 14G cannula inserted into the peritoneal cavity under local anaesthesia. Midway between the

umbilicus and symphysis pubis, keeping clear of the pelvic brim. Aspirate is stained by a modified Romonowsky method and the percentage obtained by counting 500 nucleated cells. This method has the sensitivity of 91% and a specificity of 94% as to a positive predictive value of 95% in acute appendicitis. In children it is questionable whether it is appropriate. In women it does not differentiate between pelvic inflammatory disease .May be useful to identify women who should have laparoscopy. In one study the results showed a reduction in the percentage of negative appendicectomy rate from 33% to 10% and also reduction in the number of patients with pelvic inflammatory disease under going appendicectomy.

## **LAPAROSCOPY:**

Laparoscopy increases the accuracy of appendicitis diagnosis in patients with RIF pain. It not only identifies those patients who do not need surgery but also reveals those patients who requires surgery, and who might otherwise have been incorrectly subjected to observation. It must be remembered that this method is invasive and requires general anaesthetic, which carries its own risks and complications, and also requires specialized equipment and adequate training.

There is still controversy surrounding the management of patients in whom clinical diagnosis of appendicitis has been made but there is other cause for right iliac fossa pain at laparoscopy and the appendix appears normal. Overall it is prudent to remove the appendix for histological examination. This view is supported by papers which confirm that surgeons may incorrectly identify an inflamed appendix as macroscopically normal in upto 26% of cases.

## CONDITIONS SIMULATING APPENDICITIS

Any differential diagnosis is simply recognition that more than one disease process is capable of producing a specific clinical picture.

The following conditions may simulate Appendicitis

- **Other intra abdominal causes of acute pain:**
  - ★ perforated peptic ulcer
  - ★ acute cholecystitis
  - ★ cyclical vomiting
  - ★ enterocolitis
  - ★ non specific mesentric lymphadenitis
  - ★ Meckel's diverticulitis
  - ★ Diverticulitis of caecum
  - ★ Diverticulitis of sigmoid colon extending in Right iliac fossa
  - ★ Regional ileitis
  - ★ Carcinoma of the caecum
- **Acute pain of gynaecological origin:**
  - ★ Salpingitis
  - ★ Ectopic gestation
  - ★ Ruptured ovarian follicle (mittelschmerz)
  - ★ Twisted right ovarian cyst
- **Urinary tract condition:**
  - ★ Right ureteric colic
  - ★ Right sided acute pyelonephritis
- **Chest Conditions**
  - ★ Pneumonia
  - ★ Pleurisy
- **Diseases of CNS:**
  - ★ Preherpetic pain of right 10, 11<sup>th</sup> dorsal nerves
  - ★ Tabetic crises

- ☆ Spinal conditions (eg) Potts's disease, secondaries spine, Osteoporosis etc.,
- **Other medical conditions:**
  - ☆ Diabetic abdomen
  - ☆ Acute pancreatitis
  - ☆ Abdominal crisis of porphyria

In our series, we have come across 2 cases which clinically presented as perforated peptic ulcer and turned out to be Acute Appendicitis with perforation at laparotomy.

## **COMPLICATIONS OF ACUTE APPENDICITIS**

### **1. PERITONITIS**

It is obvious that the prerequisite for the treatment of appendiceal peritonitis is the diagnosis of perforated Appendicitis. The progress of peritonitis is altered with the treatment as well as among the individuals. Usually it leads to localisation of intraperitoneal infection. The sites at which localization most frequently occurs are:

Right iliac fossa, Pouch of Douglas, Sub phrenic area

### **2. ILEUS AND MECHANICAL INTESTINAL OBSTRUCTION:**

Ileus in the early stage of appendicitis and peritonitis is a localised and protective process, since it brings about a decrease of peristaltic activity in the region of the diseased organ and thus provides the state of physiological rest desirable in the treatment of any disease.

As it involves more and more of the intestine, however the processes become pathological and differ in effect from mechanical obstruction: only in that there is no single point of blockage.

The distinction between the ileus and mechanical obstruction is extremely important, because the latter must be treated usually surgically, whereas in the former condition, surgery aggravates the process.

### **3. APPENDICEAL MASS:**

In clear cut cases of appendiceal abscess, it is possible to demonstrate a right iliac fossa mass. The following are indications for opening an appendix abscess

- ▲ When the swelling is not diminishing in size after the fifth day of treatment
- ▲ When the temperature is swinging above 37.8°C on several successive days.
- ▲ A pelvic abscess seldom resolves.

### **4. PELVIC ABSCESS:**

Once it is suspected it is the easiest of all varieties of abscess to diagnose. But because of its location, it is frequently overlooked until it is of considerable size. The diagnosis is made by repeated per rectal examination. In early stages an area of softening is felt, which is painful on pressure. In late stages a large mass may bulge into the rectum.

### **5. SUBPHRENIC SPACE INFECTION:**

It is one of the most complicating features of acute appendicitis. It is covered by thoracic cage and is therefore not readily available for clinical examination. Radiological examination and ultrasound are the most valuable methods of diagnosis available.



## **6. FAECAL FISTULA:**

Although faecal fistula may occur after abdominal operations particularly following Appendicectomy, fistula are frequent following inadequate drainage of the abscess or following drainage procedures in which the appendix has not been removed.

## **CAUSES OF DELAY IN REMOVING INFLAMMED APPENDIX**

The morbidity and mortality of delay in removing acutely diseased appendix is obvious. The first cause of the delay may be failure of the patient to secure medical attention. In our series 5 cases admitted within 8 hours from the onset of symptoms, 6 cases 9-12 hrs, 28 cases in 24 hour, 22 cases in 48 hours. The second cause of the delay may be error of judgement of the doctors in diagnosing and deciding the type of management.

## **TREATMENT OF ACUTE APPENDICITIS :**

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

1. The patient is moribund with advanced peritonitis.
2. The attack has already resolved. Here appendicectomy is advised as an elective procedure to prevent recurrence.
3. Circumstances make operation difficult or impossible, for example in a small boat at sea.
4. An appendix mass has formed without evidence of general peritonitis.

## **ADEQUATE PREOPERATIVE PREPARATION:**

The typical patient with appendicitis has a relatively brief history of symptoms and little evidence of systemic reaction. If an adequate period has elapsed since the ingestion of food, surgical management in these instances is simple and straight forward. There is no necessity for extensive preparation and appendectomy may be performed immediately.

Adequate pre operative stabilization of the critically ill patients involves reexpansion of intravascular volume, restoration of electrolyte imbalance, resolution of fever and antibiotic administration when inflammatory complications are suspected.

In our series, the entire patient received parenteral injection of ampicillin, cefotaxime and metronidazole combination. Remaining cases received ciprofloxacin and metronidazole preoperative combination. Sponging done when the patient was febrile. Ryle's tube introduced when there were associated signs of generalised peritonitis or abdominal distension.

Bacterial flora commonly present in acute appendicitis are anaerobic eg Bacteroids & Clostridium perfringens. Aerobic bacteria are E.Coli, Klebsiella, proteus and Enterococci.

## **ANAESTHESIA**

When the diagnosis is sure, the incision is based on Mc Burney's point. The spinal anaesthesia is usual one, in our hospital unless contraindicated.

## **INCISION**

Various incisions used are :

- ❖ Grid –iron
- ❖ Rutherford Morrison
- ❖ Right paramedian
- ❖ Midline
- ❖ Lanz's

## **TREATMENT :**

### **CONSERVATIVE MANAGEMENT :**

The conservative management of appendicitis is usually reserved for cases where no operating facilities are available, e.g. on board on ships at sea. A prospective controlled study of 40 patients with suspected acute appendicitis was published. Twenty patients received antibiotics intravenously for 2 days followed by oral treatment for 8 days, while the other 20 patients were randomized to surgery, one patient in the antibiotic group required surgery because of peritonitis secondary to perforation, and seven others were readmitted within 1 year with recurrent appendicitis, and underwent surgery. It was claimed that the short term treatment with antibiotics was as effective as surgery less painful and required less analgesia. However, the recurrence rate was high.

## **SURGICAL MANAGEMENT :**

### **METHODS OF APPENDICECTOMY:**

There are two methods of appendicectomy

1. Open appendicectomy
2. Laparoscopic appendicectomy

### **OPEN APPENDICECTOMY**

This is conventionally performed through a muscle splitting incision. Inversion of the appendix stump is now thought to be unnecessary as it has been shown to make no difference to complication rates and also has the advantages of not deforming caecal wall which may subsequently be mistaken for a caecal neoplasm.

### **LAPAROSCOPIC APPENDICECTOMY**

The first Laparoscopic appendicectomy was described in 1987. Laparoscopy has been the subject of many recent papers and much public debates. Many case series, non – randomized trials and randomized prospective studies demonstrate that it is associated with less post operative pain, fewer complications, a shorter stay in hospital and ultimately an earlier return to full activity. .

# *PART II*

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# *MATERIALS & METHODS*

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This prospective study was carried out from June 2006 to June 2008 in the Department of Surgery in a single surgical unit 60 patients suspected of acute appendicitis were included in the study.

Patients included in this study were haemodynamically stable and were without any concurrent illness. Women were operated after ruling out other gynaecological pathology.

Alvarado scoring was done for all patients presenting with right abdominal pain and they were classified into 3 groups:

Group I – Clinically typical (Alvarado score >6),

Group II – Clinically doubtful (Alvarado score 4-6).

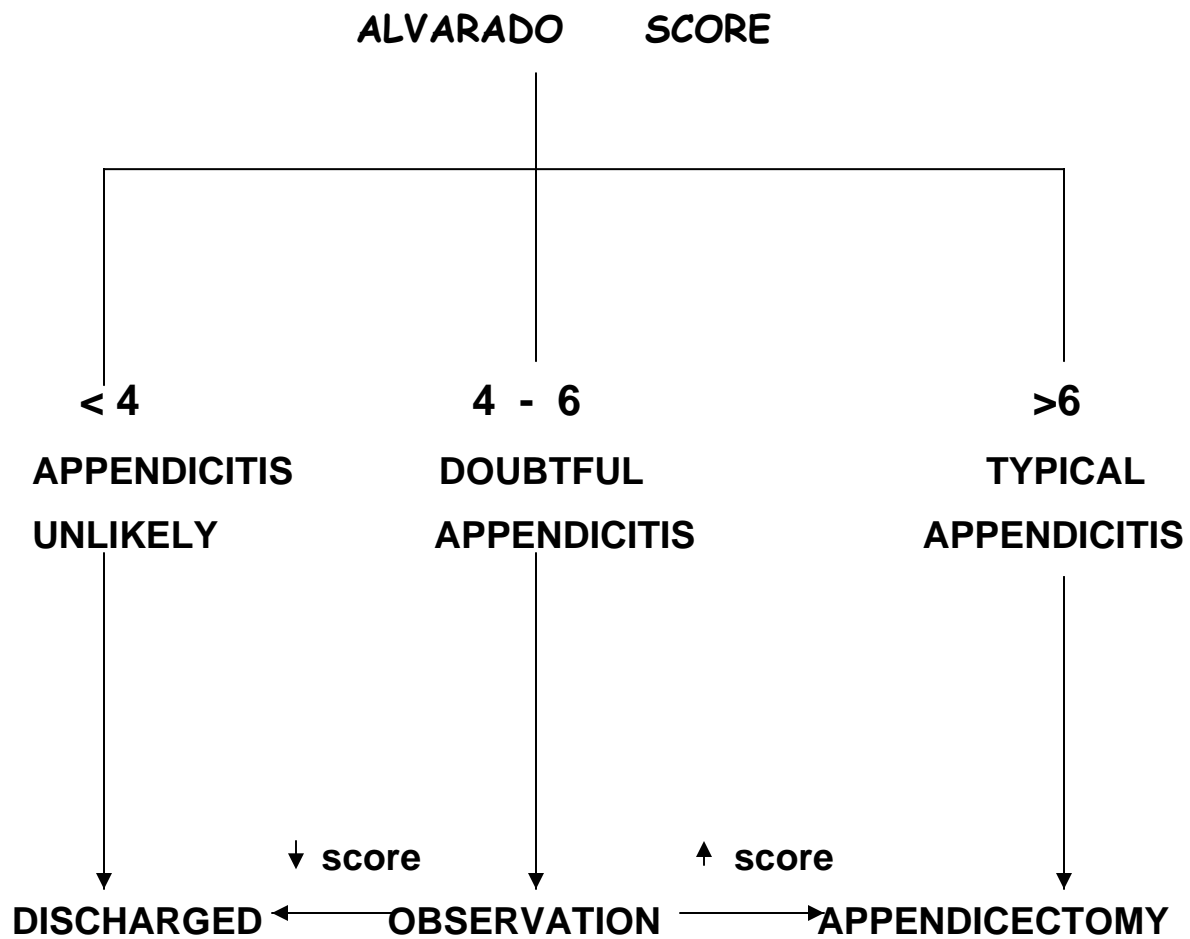
Group III – Clinically *very unlikely* (Alvarado score < 4).

## THE ALVARADO ( MANTRELS ) SCORE

MANIFESTATIONS		NORMAL SCORE
SYMPTOMS	MIGRATORY RIGHT ILIAC FOSSA PAIN	1
	ANOREXIA	1
	NAUSEA/ VOMITING	1
SIGNS	TENDERNESS RIGHT ILIAC FOSSA	2
	REBOUND TENDERNESS	1
	ELEVATED TEMPERATURE	1
LAB FINDINGS	LEUKOCYTOSIS	2
	SHIFT TO THE LEFT OF NEUTROPHILS	1
TOTAL SCORE		10

- Abdominal pain that migrates to the right iliac fossa
- Anorexia (loss of appetite) \* Nausea or vomiting
- Pain on pressure in the right iliac fossa
- Rebound tenderness
- Fever of 37.3 °C or more
- Leukocytosis, or more than 10000 white blood cells per microliter in the serum  
Left, or an increase in the number of immature leukocytes in the peripheral  
blood, particularly neutrophil band cells





In patients with score 1-3, appendicitis was considered unlikely. The patients with scores 4-6 were observed. Analgesics and antibiotics were not administered. Hourly clinical examination and second hourly white blood cell count and smears were done.

Appendicectomy was performed on patients with scores 7-10.

Under spinal anaesthesia, open Appendicectomy was performed through a paracaecal muscle splitting incision. Inversion of Appendix was not done & the peritoneum was not sutured.

Inj. Ampicillin 1gm, Inj Cefotaxime 1gm and Inj Metronidazole were given preoperatively followed by per operative and postoperative doses.

In cases with Appendicular perforation Inj Ceftriaxone 1gm and Inj Metronidazole were used. Besides, peritoneal toiletting done using warm normal saline. Corrugated rubber drain was used selectively in patients depending on the duration of perforation and the nature of contamination. The drain was removed on 4<sup>th</sup> POD.

All the Appendicectomy specimens were sent for histopathological examination.

The wound was considered infected when the discharged pus or when the culture from the wound grew pathogenic organisms.

Stitch abscess was not considered as wound infection and no additional antibiotic therapy was given.

Sutures were removed on the 8<sup>th</sup> POD and the patient was discharged.

The patients were advised to come for follow up after one week, one month, three months and one year.

## *REVIEW OF LITERATURE*

**Ohmann** in his prospective study of diagnostic scores for acute appendicitis concluded that scoring systems seem to be ideal for supporting the diagnosis of acute appendicitis because they are accurate, non-invasive, and require no special equipment.

**Chan et al** in a previous study found that patient with low Alvarado score (less than 5) did not have appendicitis.

**Owen et al** (1992) reported that there was no perforated appendicitis in patient with a score of less than 6, and suggested the use of the score by general practitioners.

# *RESULTS*

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Total number of patients who presented  
with suspected appendicitis : 60

On admission

Number of patients with scores >6 : 40

Number of patients with scores 4 - 6 : 9

Number of patients with scores < 4 : 11

Number of patients whose score  
increased to > 6 during the  
period of observation : 6

Number of patients who score  
decreased to < 4 during the  
period of observation : 3

Number of patients who  
underwent appendicectomy : 46

Number of patients who did not undergo  
appendicectomy : 14

Number of patients who had a positive  
histopathological report suggestive of  
acute appendicitis : 45

Number of patients who had  
normal appendix : 1

Number of patients with  
scores < 4 who subsequently  
developed acute appendicitis : nil

ALVARADO TEST RESULT	DIAGNOSIS		TOTAL
	DISEASED	NOT DISEASED	
POSITIVE	45 ( True Positive) a	1 (False Positive) b	46 a+b
NEGATIVE	0 ( False negative) c	14 (True Negative) d	14 c+d
TOTAL	45 a+c	14 b+d	60

Sensitivity of the test : 100 %

Specificity of the test : 93%

Positive predictive value : 97.82 %

Negative appendicectomy rate : 2.17 %

COMPLICATIONS	PERFORATED 5	NON PERFORATED 40	NORMAL 3	TOTAL 1
WOUND INFECTION	2	0	0	2
STITCH ABSCESS	1	1	0	2
INCISIONAL HERNIA	0	0	0	0
MORTALITY	0	0	0	0

Wound infection rate : 2.6%

Complications rate : 5.2%



# *DISCUSSION*

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Acute Appendicitis is the most common acute surgical condition of the abdomen. Over the past 100 years, the morbidity and mortality rates related to this condition have markedly decreased. This is because of the recognition of deleterious effects of appendiceal perforation. Thus an aggressive surgical treatment strategy involving early operation with acceptance of a high negative appendicectomy rate of 15% to 30% is universal. Although the negative appendicectomy has negligible mortality, it has associated morbidity rate of 10%.

Alvarado score is an objective assessment of right lower quadrant pain. The score indicated  $\geq 7$  indicates high probability of acute appendicitis. Practically speaking, it is equivalent to one's degree of clinical suspicion. Therefore this scoring system was used to reach the clinical diagnosis. Other studies have shown that Alvarado score has accuracy of 88%.

The present study revealed Alvarado score  $\geq 7$  were found to have accuracy of 93%. Thus Alvarado score is a practical, reliable and easy to score. It can be helpful for safe and accurate decision making in patients with acute appendicitis. It can also categorize the patients for observation.

Various diagnostic aids have been used to increase the diagnostic accuracy of acute appendicitis but still the clinical diagnosis is superior. Radiological methods such as ultrasonography, which is operator dependent and computed tomography with its expense and radiation hazard as well as laparoscopy, which is invasive and expensive, are all methods that have been investigated previously.

In my study, 66.6% (40 / 60) of patients presented with a score of  $>6$ . Of the 9 observed, 4 had score  $>6$  within 6 hrs and 2  $\leq 6$  within 12 hrs. Only three patients presented with a score of  $<4$ . So 76% of appendectomies could be decided within the first 6 hours of admission.

The wound infection rate is 2.6 %. The mortality in my study is nil.

In the follow up of upto 6 months, of the patients who did not undergo appendicectomy none has reported with recurrent iliac fossa pain.

In the group operated no delayed complication has been observed in a six month follow up period.

# *CONCLUSION*

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In patients with Right iliac fossa pain, Alvarado score is found to be helpful in the diagnosis and management of acute appendicitis. Diagnosis of acute appendicitis is virtually confirmed with score 7-10 especially in males and should undergo appendicectomy. Patients with score 5-6 must be admitted and scored frequently. Score 1-4 can be discharged unless otherwise indicated.

Though the diagnosis of acute appendicitis remains mainly clinical, Alvarado score can be recommended as a helpful tool for the admission criteria and further management in order to reduce unnecessary admissions and to reduce the morbidity and mortality of acute appendicitis.

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## MASTER CHART

<b>N O</b>	<b>NAME</b>	<b>AGE</b>	<b>SEX</b>	<b>IP NO</b>	<b>DIAGONISIS</b>	<b>TREATMENT</b>
1	CHANDRA	24	F	23750	ACUTE APPENDICITIS	EMERGENCY APPENDICECTOMY
2	KENNEDY	20	M	25862	ACUTE APPENDICITIS	EMERGENCY APPENDICECTOMY
3	YASHAR ARAFATH	14	M	25501	ACUTE APPENDICITIS	EMERGENCY APPENDICECTOMY
4	KANNAN	31	M	25509	ACUTE APPENDICITIS	EMERGENCY APPENDICECTOMY
5	SELVARANI	26	F	30924	ACUTE APPENDICITIS	EMERGENCY APPENDICECTOMY
6	INDURANI	27	F	34663	ACUTE APPENDICITIS	EMERGENCY APPENDICECTOMY
7	CHINNAKALAI	25	M	30924	ACUTE APPENDICITIS	EMERGENCY APPENDICECTOMY
8	MANI	36	M	31245	ACUTE APPENDICITIS	EMERGENCY APPENDICECTOMY
9	UMA	17	F	34662	ACUTE APPENDICITIS	EMERGENCY APPENDICECTOMY
10	KANNAN	25	M	35469	ACUTE APPENDICITIS	EMERGENCY APPENDICECTOMY
11	RAJA	42	M	36240	ACUTE APPENDICITIS	EMERGENCY APPENDICECTOMY
12	MAHALAKSHMI	20	F	38337	ACUTE APPENDICITIS	EMERGENCY APPENDICECTOMY
13	IRULLAYE	38	F	39813	ACUTE APPENDICITIS	EMERGENCY APPENDICECTOMY
14	PONNMUTHU	24	M	39762	ACUTE APPENDICITIS	EMERGENCY APPENDICECTOMY
15	KANIMOZHI	20	F	41294	ACUTE APPENDICITIS	EMERGENCY APPENDICECTOMY
16	MURUGESAN	15	M	41267	ACUTE APPENDICITIS	EMERGENCY APPENDICECTOMY
17	MASILAMANI	28	F	42372	ACUTE APPENDICITIS	EMERGENCY APPENDICECTOMY
18	VIGNESH	13	M	43002	ACUTE APPENDICITIS	EMERGENCY APPENDICECTOMY
19	SATISH	20	M	44063	ACUTE APPENDICITIS	EMERGENCY APPENDICECTOMY
20	CHELLADURAI	28	M	44753	ACUTE APPENDICITIS	EMERGENCY APPENDICECTOMY
21	NITHYA	22	F	46935	ACUTE APPENDICITIS	EMERGENCY APPENDICECTOMY
22	ARUMUGAM	25	M	46979	ACUTE APPENDICITIS	EMERGENCY APPENDICECTOMY
23	SHANMUGA SUNDARAM	14	F	48625	ACUTE APPENDICITIS	EMERGENCY APPENDICECTOMY
24	CHINAKARUPPU	16	F	48830	ACUTE APPENDICITIS	EMERGENCY APPENDICECTOMY



25	RAMESH	30	M	48653	ACUTE APPENDICITIS	EMERGENCY APPENDICECTOMY
26	PITCHAL	28	M	70771	ACUTE APPENDICITIS	EMERGENCY APPENDICECTOMY
27	SENTHIL	21	M	52688	ACUTE APPENDICITIS	EMERGENCY APPENDICECTOMY
28	NAGOORKANI	25	M	55301	ACUTE APPENDICITIS	EMERGENCY APPENDICECTOMY
29	PANDEESWARI	17	F	55242	ACUTE APPENDICITIS	EMERGENCY APPENDICECTOMY
30	RAJAPANDI	24	M	56629	ACUTE APPENDICITIS	EMERGENCY APPENDICECTOMY
31	KADAR ALI	45	M	56711	ACUTE APPENDICITIS	EMERGENCY APPENDICECTOMY
32	MUPPIDATHI	15	M	59772	ACUTE APPENDICITIS	EMERGENCY APPENDICECTOMY
33	ESWARAN	29	M	59768	ACUTE APPENDICITIS	EMERGENCY APPENDICECTOMY
34	RAJA	15	M	72224	ACUTE APPENDICITIS	EMERGENCY APPENDICECTOMY
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36	NASREEN	30	F	78057	ACUTE APPENDICITIS	EMERGENCY APPENDICECTOMY
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38	SANKAR	18	M	95308	ACUTE APPENDICITIS	EMERGENCY APPENDICECTOMY
39	JOHN PAULRAJ	18	M	95251	ACUTE APPENDICITIS	EMERGENCY APPENDICECTOMY
40	TAMILARASAN	20	M	97378	ACUTE APPENDICITIS	EMERGENCY APPENDICECTOMY
41	DEIVANAI	30	F	102903	ACUTE APPENDICITIS	EMERGENCY APPENDICECTOMY
42	MARIAPPAN	19	M	103625	ACUTE APPENDICITIS	EMERGENCY APPENDICECTOMY
43	GOPAL	26	M	00465	ACUTE APPENDICITIS	EMERGENCY APPENDICECTOMY
44	SUDHA	17	F	04061	ACUTE APPENDICITIS	EMERGENCY APPENDICECTOMY
45	RADHA KRISHNAN	40	M	04119	ACUTE APPENDICITIS	EMERGENCY APPENDICECTOMY
46	THIRUMANI	17	F	05765	APPENDICULAR PERITONITIS	EMERGENCY APPENDICECTOMY
47	ANITHA	16	F	05923	ACUTE APPENDICITIS	EMERGENCY APPENDICECTOMY
48	MUTHU IRULAYEE	29	F	09063	ACUTE APPENDICITIS	EMERGENCY APPENDICECTOMY
49	VALAYAPATHI	21	M	10718	ACUTE APPENDICITIS	EMERGENCY APPENDICECTOMY
50	RAJATHI	20	F	16564	ACUTE APPENDICITIS	EMERGENCY APPENDICECTOMY
51	MURUGAN	19	M	12569	ACUTE APPENDICITIS	EMERGENCY APPENDICECTOMY
52	SUGANYA	16	F	14139	ACUTE APPENDICITIS	EMERGENCY APPENDICECTOMY

53	SAMSATH	17	F	14161	ACUTE APPENDICITIS	EMERGENCY APPENDICECTOMY
54	MUTHUKUMAR	23	M	14123	ACUTE APPENDICITIS	EMERGENCY APPENDICECTOMY
55	NAGAMUTHU	24	F	17866	ACUTE APPENDICITIS	EMERGENCY APPENDICECTOMY
56	KARRUPASAMY	26	M	17853	ACUTE APPENDICITIS	EMERGENCY APPENDICECTOMY
57	LAL CHAND	24	M	17991	ACUTE APPENDICITIS	EMERGENCY APPENDICECTOMY
58	YOGAMANIGANDAN	20	M	18049	ACUTE APPENDICITIS	EMERGENCY APPENDICECTOMY
59	ANITHA	14	F	19794	ACUTE APPENDICITIS	EMERGENCY APPENDICECTOMY
60	RAMALAKSMI	25	F	19931	ACUTE APPENDICITIS	EMERGENCY APPENDICECTOMY

## ALVARADO SCORING SYSTEM IN ACUTE APPENDICITIS

NAME & ADDRESS :

AGE :

IP NO :

DOA :

DOS :

DOD :

### COMPLAINTS:

### HISTORY OF PRESENTING ILLNESS:

MIGRATORY ILIAC FOSSA PAIN

PRESENT / ABSENT

NAUSEA/ VOMITING

PRESENT / ABSENT

ANOREXIA

PRESENT / ABSENT

FEVER

PRESENT / ABSENT

### PAST HISTORY:

### TREATMENT HISTORY :

### GENERAL EXAMINATION:

FEBRILE / AFEBRILE

TEMPERATURE :            \* C

PULSE RATE :        / min.

### EXAMINATION OF ABDOMEN :

TENDERNESS IN RIGHT ILIAC FOSSA

PRESENT / ABSENT

REBOUND TENDERNESS

PRESENT / ABSENT

GUARDING

PRESENT / ABSENT

RIGIDITY

PRESENT / ABSENT

### PER RECTAL EXAMINATION :

**LABORATORY INVESTIGATION :**

**BLOOD :**

**TOTAL COUNT :**

**DIFFERENTIAL COUNT :**

**ULTRASONOGRAPHY ABDOMEN :**

**FINDINGS AT SURGERY :**

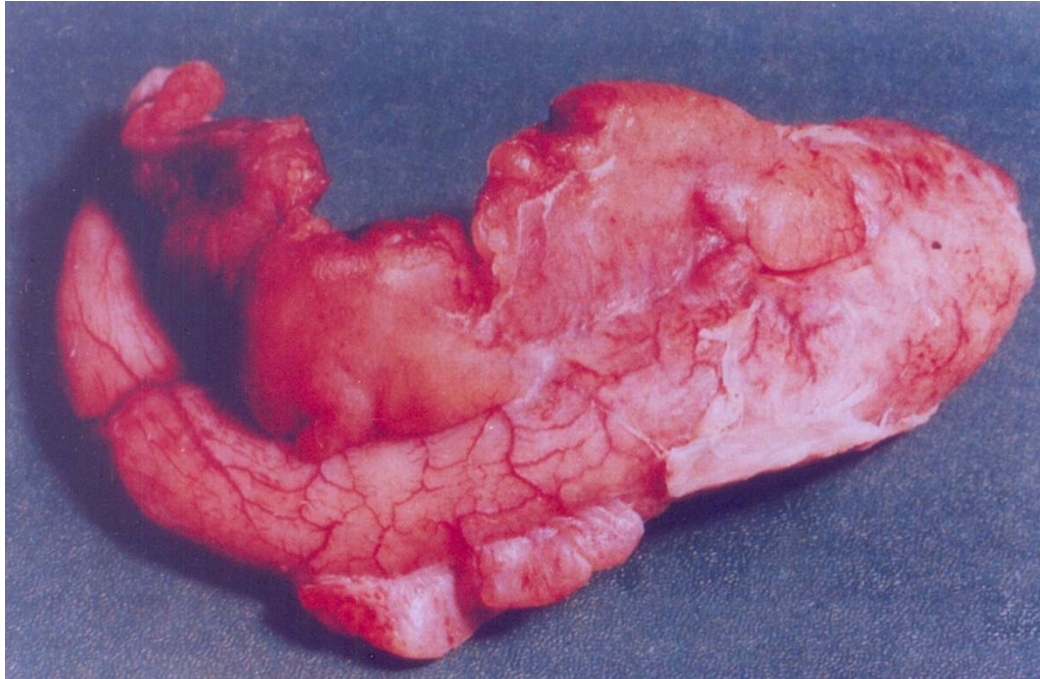
**SURGICAL PROCEDURE DONE :**

**HISTOPATHOLOGICAL REPORT :**

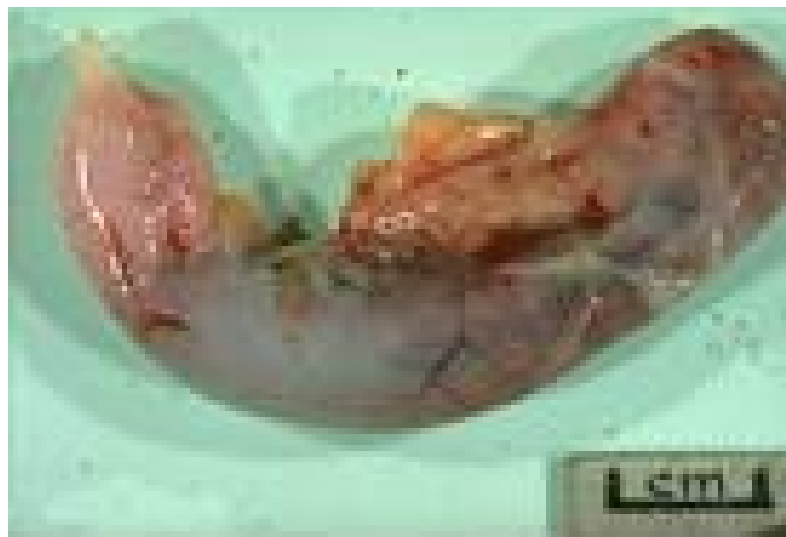
**POSTOPERATIVE PERIOD :**

**FOLLOW UP :**

## **ACUTE CATARRHAL APPENDICITIS**



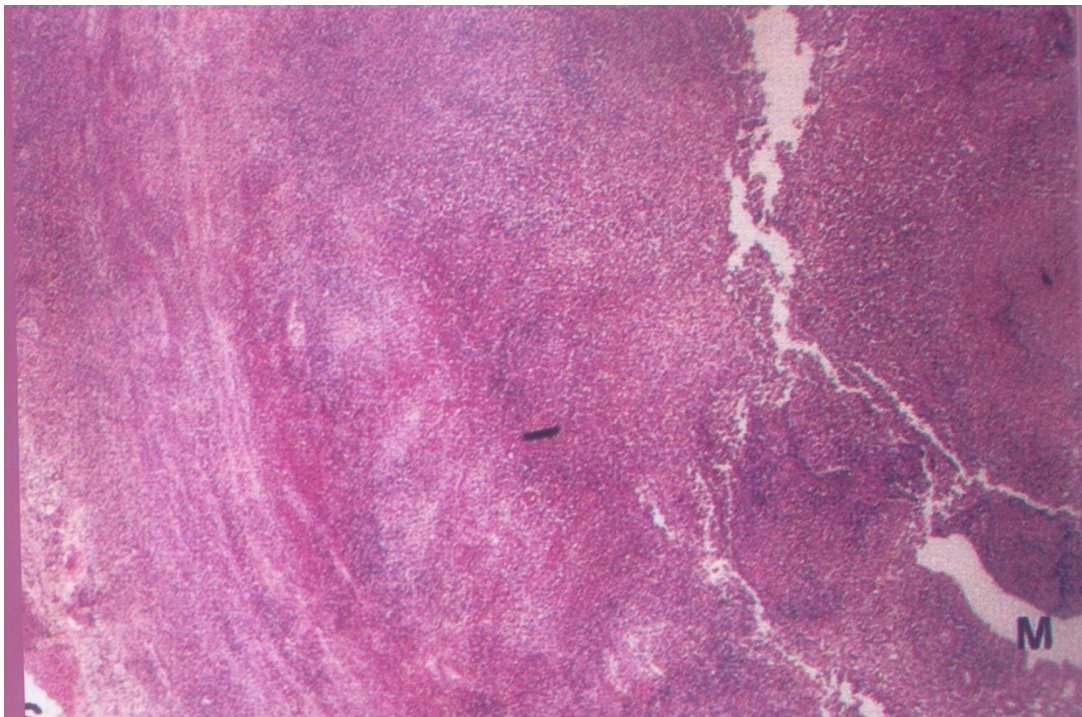
## **ACUTE GANGRENOUS APPENDICITIS**



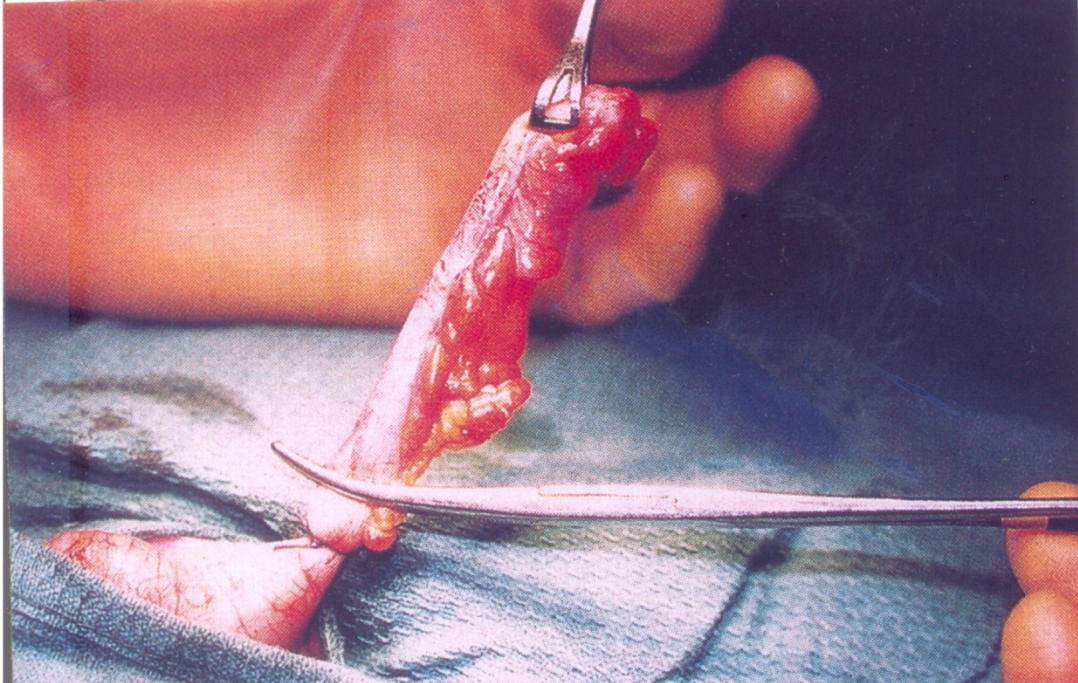
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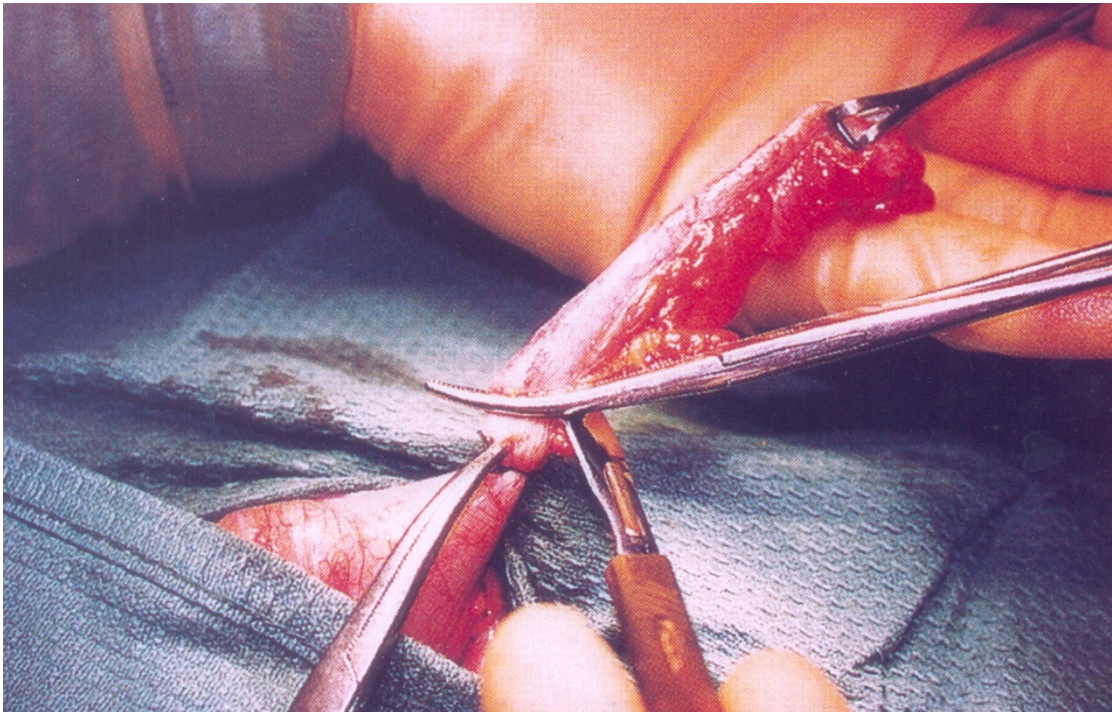
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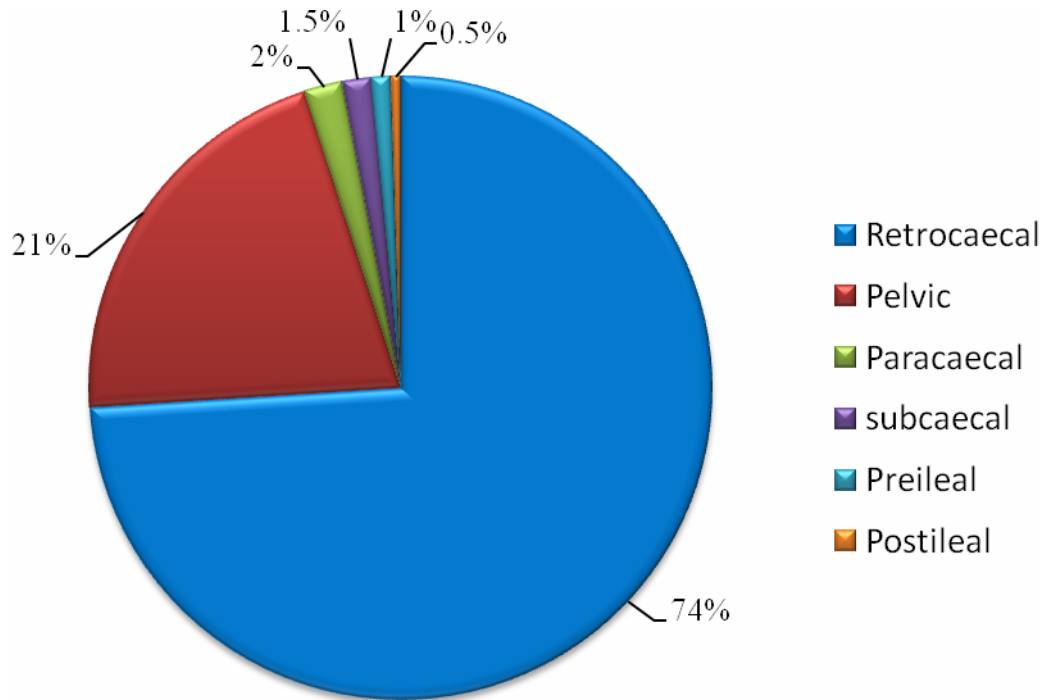
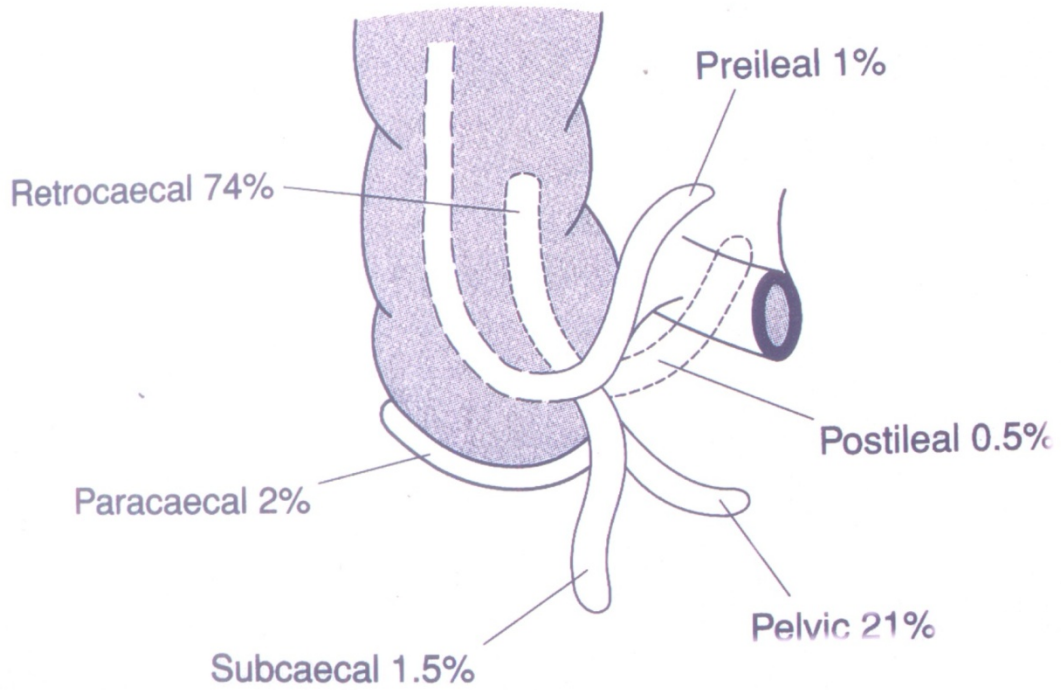
**MESO APPENDIX DIVIDED AND LIGATED**



**APPENDIX CRUSHED AND LIGATED  
ABOUT TO BE DIVIDED**



## VARIOUS POSITIONS OF APPENDIX





## COMPUTERISED TOMOGRAPHIC PICTURES OF ACUTE APPENDICITIS



