

Dissertation

On

**A STUDY ON ACUTE APPENDICITIS INCORPORATING
MODIFIED ALVARADO SCORE AND ULTRASONOGRAM**

Submitted to

**THE TAMIL NADU DR. M.G.R. MEDICAL UNIVERSITY
CHENNAI.**



**M.S. BRANCH I
GENERAL SURGERY**

SEPTEMBER 2006

CERTIFICATE

This is to certify that “A STUDY ON ACUTE APPENDICITIS INCORPORATING MODIFIED ALVARADO SCORE AND ULTRASONOGRAM” is a bonafide work done by

Dr. SHANMUGAVELAYUTHAM.C Post Graduate Student in MS, Department of General Surgery, Government General Hospital, Chennai - 3 under my guidance and supervision in fulfillment of regulations of The Tamilnadu Dr. M.G.R. Medical University for the award of M.S. Degree Branch I, (General Surgery) during the academic period from July 2003 to September 2006.

Prof. P.G. KOLANDAIVELU, M.S.,
Professor and Head
Department of General Surgery
Madras Medical College &
Government General Hospital
Chennai 600 003.

Prof. S. MUTHU, M.S.,
Chief Surgical Unit VI
Department of General Surgery
Madras Medical College &
Government General Hospital
Chennai 600 003.

Prof. KALAVATHI PONNIRAIIVAN M.D.,
The Dean
Madras Medical College &
Government General Hospital
Chennai - 600 003.

ACKNOWLEDGEMENT

I wish to thank **Prof. KALAVATHI PONNIRAIVAN, MD.**, Dean, Madras Medical College and Government General Hospital, Chennai – 600 003 for permitting me to conduct this study.

I am deeply indebted to my respected and kindhearted Professor, **Prof.P.G.KOLANDAIVELU, M.S.**, Professor and Head of the Department of General Surgery, Government General Hospital, Chennai- 600 003 for his invaluable help, guidance and encouragement in preparing this study.

I have great pleasure in expressing my gratitude and indebtedness to **Prof. S. MUTHU, M.S.**, my surgical unit chief for his constant inspiration and guidance to me throughout my course of study.

I thank my Assistant Professors who have guided me throughout my course with ample encouragement.

I am grateful to the faculty of Barnard Institute of Radiology for their valuable guidance and support.

I am grateful to the faculty of Department of Pathology for their valuable guidance and support.

My hearty thanks to all my post graduate colleagues for their constant help and encouragement in completing this study.

Last but not the least, I express my sincere gratitude to all patients, without whom this study would not have been accomplished.

CONTENTS

Chapter No.	Title	Page No.
1.	INTRODUCTION	1
2.	AIM OF STUDY	2
3.	MATERIALS AND METHODS	3
4.	HISTORICAL DATA	5
5.	REVIEW OF LITERATURE	7
6.	OBSERVATIONS & RESULTS	40
7.	SUMMARY AND CONCLUSION	50
8.	BIBLIOGRAPHY	52
9.	MASTER CHART	54

INTRODUCTION

Acute appendicitis is the commonest cause of acute surgical abdomen. Acute appendicitis and its complications continue to be a significant source of morbidity and mortality, so prompt recognition and proper treatment is essential. Appendix usually referred as a vestigial organ with no known function is now considered as a specialised part of gastro intestinal tract with concentration of lymphoid tissue. It is an integral part of gut associated lymphoid tissue (GALT). Appendix is present only in humans, certain anthropoid apes and the wombats. Appendix is useful in reconstructive biliary, tubal and urological surgery. Negative appendicectomy therefore robs the patient of a useful asset and also has a morbidity of 15%.

With this introduction, to be followed are review of appendix, acute appendicitis, case study, discussion and conclusion.

AIMS OF THE STUDY

Aim of this study is to analyse the following aspects in acute appendicitis

1. to analyse the incidence of acute appendicitis in Government General Hospital in relation to the total number of surgical emergencies and in relation to age group and sex
2. to analyse the usefulness of Modified Alvarado Score as the prime diagnostic criteria in the diagnosis of acute appendicitis
3. to analyse the usefulness of incorporation of ultrasonogram in patients with low / equivocal Modified Alvarado Score in improving the diagnostic accuracy in acute appendicitis

MATERIALS AND METHODS

This study was conducted in our unit in Government General Hospital and Madras Medical College between July 2004 and February 2006.

Selection criteria

Persons more than twelve years of age who were operated on the same day of admission for acute appendicitis. this included

1. persons with an Alvarado score of > 7
2. persons with an Alvarado score of < 7 but with ultrasonogram findings suggestive of acute appendicitis
3. persons not satisfying above criteria but clinical features favouring acute appendicitis

Following were excluded

1. persons less than twelve years of age
2. patients who were managed conservatively

Total number of patients studied = 137.

All patients in the study were subjected to estimation of total leucocyte count and plain x-ray abdomen after thorough history evaluation and clinical examination. Alvarado score was found in all cases . Shift to left was not taken into consideration. Ultrasonogram was done in patients with an Alvarado score < 7. All of them were operated on the day of admission itself and peroperative findings were noted. All appendicectomy specimens were subjected to HPE. All cases were operated with clinical diagnosis irrespective of the Alvarado score and ultrasonogram findings and analyzed retrospectively with HPE report.

HISTORICAL DATA

1736 - First appendectomy was performed by Claudius Amyand, Surgeon to west minister and St. George's hospital.

1755 – Heister described appendix as the primary site of inflammation in a criminal.

1830 – Goldbeck introduced the term perityphilitis

1839 – Bright and Addison first published a textbook on symptoms that accompanied inflammation and perforation of the appendix.

1886 – Fitz coined the term appendicitis. Gave a lucid and logical description of clinical features of disease and pathological changes.

1848 – Hancock successfully drained appendix abscess in a 30 yr female in 8th month of pregnancy.

1867 - Parker advocated earlier incision of appendicular abscess.

1880 – Shepherd successfully removed a gangrenous appendix.

1886 – Kronlein first to publish an account of gangrenous appendix

1887 – Morton successfully removed inflamed appendix within an abscess cavity.

1889 – McBurney pioneered early diagnosis and early operative intervention in acute appendicitis. Introduced muscle splitting incision.

Ochsner and Sherren advocated conservative treatment in late cases.

1983 – First laparoscopic appendectomy done by Semm.

REVIEW OF LITERATURE

Anatomy and embryology

Appendix is a worm shaped blind tube of varying length (2-25)cm opening into the posteromedial wall of the caecum 2cm below the ileocaecal valve. It is the only organ in the body that has no constant position. Its only constant feature is it arises from the site at which the three taenia coli coalesce. Its tip lies in the following positions

Retrocaecal	65.28% *
Pelvic	31.01%
Subcaecal	2.26%
Retroileal	1.00%#
Paracolic	} 0.40%
Postileal	

* - commonest position found at operation

- commonest position in the absence of disease.

It has its own mesentery, a prolongation of the inferior layer of the mesentery of the terminal ileum.

Blood supply:

Appendicular artery, a branch of the posterior caecal artery.

Appendicular vein drains into ileocolic vein and then into superior mesenteric vein.

Lymph drainage:

Into nodes associated with the ileocolic artery.

Embryology:

It develops as a protuberance from the terminal portion of caecum at the 8th week of intrauterine life. During both antenatal and postnatal development, the growth rate of the caecum exceeds that of the appendix, displacing the appendix medially toward the ileocaecal valve.

Anomalies

Position - found in left iliac fossa in transposition of viscerae

- found in right hypochondrium / epigastrium in case of malrotation of gut with failure of descend of caecum.

Number: Absence – rare

Duplication

Wallbridge classification

Type A – partial duplication of appendix on single caecum

Type B - single caecum with two completely separate appendices.

B₁ - Birdlike appendix, two appendices symmetrically placed on either side of the ileocaecal valve

B₂ - one appendix arises from the usual site

Another rudimentary appendix along one of the taenia coli

Type C – two caeca each with an appendix

Acute appendicitis:

It is the acute inflammation of the appendix. Most common cause of “Acute surgical abdomen”

Incidence: Incidence of acute appendicitis parallels that of lymphoid development with peak incidence in early adulthood. It is rare before the age of two. Before puberty the incidence of acute appendicitis is equal in both sexes. But after puberty there is a slight male preponderance Male: female = 1.3: 1. It is more common in people with western dietary habit.

Pathology: Cases of appendicitis are best classified as

1. acute appendicitis without perforation, and
2. acute appendicitis with perforation

This includes acute appendicitis with peritonitis, acute appendicitis with local abscess and appendicular mass.

Causative organism: Not associated with any single bacterial, viral or protozoal invader.

Following organisms have been isolated

- Bacteroides } almost all
- E.coli } cases
- Peptostreptococcus 80%

- Pseudomonas 40%
- Bacteroides splanchnicus 40%
- Lactobacillus 37%
- CMV associated appendicitis is common in immuno compromised individuals.

Two types of inflammation are noted

1. catarrhal appendicitis
2. obstructive appendicitis

Catarrhal appendicitis:

It is initially a mucosal and submucosal inflammation and later may involve the serosa. It has a normal or hyperaemic external appearance and cut open specimen shows oedematous, thickened and reddened mucosa with or without ulceration. Bacterial invasion of the lymphoid follicles is the cause. Gangrene is relatively rare. This is the type in which the acute inflammatory process may resolve spontaneously.

Obstructive appendicitis:

It is the dangerous type, since the appendix becomes a closed loop of bowel containing decomposing faecal matter. The process of events begin with the accumulation of normal mucus secretion, proceeds to proliferation of the contained bacteria and pressure atrophy of the mucosa, which allows bacterial access to deeper tissue planes, and continues with inflammation of the walls of the appendix with vessel thrombosis and eventual gangrene.

The cause of obstruction may be

1. faecolith – present in two thirds of gangrenous appendixes.
2. lymphoid hyperplasia
3. kinks, adhesions
4. food debris
5. parasites particularly pinworm, ascaris
6. gall stone
7. Strangulation of appendix within a hernial sac.

Appendicular perforation

Pathophysiology of Appendicular perforation:

Bacterial and chemical contamination of the peritoneal cavity following the perforation of appendix leads to peritonitis, which is referred as secondary peritonitis (infection arising from an intra abdominal source).The pathophysiology of secondary peritonitis are discussed under local response and systemic response.

1) Local response to peritoneal infection:

- An increase in local blood flow and influx of fluid into the infective foci in peritoneal cavity. Histamine and bradykinin are the main mediators of this response. Depending on the extent of peritoneal insult, fluid volumes of 10 L or more may accumulate into peritoneal cavity leading to massive third-space fluid loss which may result in hypovolaemic shock. Initially the inflammatory fluid is transudate, which later becomes exudate due to increased vascular permeability resulting in leaking of Igs, complement factors, coagulation factors, autocooids & cytokines.
- Bacterial phagocytosis – The recruitment and accumulation of large number of

leucocytes (mainly neutrophils and macrophages) to the site of inflammation is accomplished by changes in local blood flow as well as increased margination and adherence of WBCs to endothelial and mesothelial cells. These are mediated by bradykinin, anaphylatoxins C3a & C5a, platelet activating factor, TNF, IL-1. By 4 to 6 hours following peritoneal insult, significant neutrophil influx had occurred and is peaked at 8 hrs. These inflammatory mediators also stimulate the recruited WBCs to phagocytose and kill the bacteria by release of lysosomal enzymes.

- Fibrin deposition – under normal circumstances, intact mesothelial cells maintain fibrinolytic activity within peritoneal cavity by secretion of tPA. In the setting of mesothelial injury and active inflammation, local fibrinolytic activity is suppressed due to loss of tPA. Moreover, with high fibrinogen concentrations in these situations, fibrin deposition is increased through intrinsic pathway. Fibrin deposition is further enhanced by release of tissue thromboplastin (Factor III) from mesothelial cells which stimulates extrinsic pathway. The objective of fibrin deposition is to isolate and contain the peritoneal contamination and prevent widespread dissemination. These fibrinous adhesions cause the adherence of loops of intestine and omentum to one another and with parietal peritoneum thus creating a physical barrier against widespread peritoneal contamination.
- Abscess formation: is the culmination of the sequestration process described above. Within the adherent mass of viscera, fibrin and bacterial exudate, liquefaction develops due to release of proteolytic enzymes from WBCs and the action of bacterial exoenzymes. The abscess capsule is formed with organized fibrin and adherent adjacent viscera.
- Peritoneal healing: peritoneum heals rapidly after insult/injury. Rate of healing is

independent of size of the peritoneal wound. Within 3 days after injury, the wound is covered by connective tissue cells and by day 5, these new cells resemble mesothelial cells. Following resolution of the inflammation, normal fibrinolytic activity returns as mesothelial cell regeneration occurs and fibrinous adhesions are degraded and removed. However in setting of severe peritoneal injury or persistent infection, filmy fibrinous adhesions are transformed to fibrous adhesions by the in growth of fibroblasts, capillaries and collagen deposition.

2) Systemic response to peritoneal infection

- Hypovolaemia – due to third space fluid loss.
- Hypovolaemia leads to decreased cardiac output and compensatory tachycardia. Systemic Hypotension may also be mediated by potent vasodilators like TNF, IL-I, PAF, Nitric Oxide, leading to decreased peripheral vascular resistance.
- Precapillary shunting occurs in pulmonary and splanchnic circulation leading to peripheral hypoxia.
- Decreased urine output occurs due to hypovolaemia and decreased renal blood flow with compensatory RAAS activation.
- ‘Warm shock’ sets in with tachycardia, fever, oliguria, hypotension and warm extremities.
- Abdominal distension creates mechanical restriction to diaphragmatic mobility and decreases ventilation, creating atelectasis. Increased pulmonary vascular permeability also leads to pulmonary oedema, increased work of breathing and hyperventilation with worsening of pulmonary oedema and alveolar collapse, severe hypoxaemia resulting in ARDS.
- Tissue metabolism is increased due to high peripheral catecholamines and cortisol. But peripheral hypoxia leads to increased anaerobic glycolysis leading to lactic acid accumulation

and metabolic acidosis.

- Following early depletion of glycogen storage, protein catabolism is augmented in skeletal muscles to release branched chain aminoacids for use by myocytes for energy. Other aminoacids are released into circulation for hepatic gluconeogenesis and for production of acute phase proteins in SIRS. Utilisation of free fatty acids as an energy source is not efficient in early septic period. Thus severe loss in lean body mass occurs rapidly in sepsis.

The most frequent site of appendicular perforation is the antimesenteric border of appendix.

Appendicular perforation can lead onto

- localised abscess formation,
- diffuse peritonitis or
- appendicular mass formation

After perforation, a localized abscess may form in the right iliac fossa or the pelvis, or diffuse peritonitis may ensue depending on

- age of the patient
- virulence of the invading bacteria,
- rate at which inflammation has progressed
- Position of appendix – retrocaecal and pelvic locations are more likely to form a localised abscess.

In 2 – 6% of patients, an ill defined mass will be palpable on physical examination.

Phlegmon - it consists of matted loops of bowel adherent to adjacent inflamed

appendix.

Periappendiceal abscess – it contains pus in-between the bowel loops in addition to the above findings.

Poorer localisation of infection occurs in infants because the omentum is filmy and is less able to form a protective sheath around the inflamed appendix.

CLINICAL MANIFESTATIONS

Migratory RIF pain

Initially the pain of acute appendicitis is poorly localized & colicky in nature.

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.

With progressive inflammation of the appendix, the parietal peritoneum in the right iliac fossa becomes irritated, producing more intense, constant and localized somatic pain that begins to predominate. Patients often report this as migratory pain.

In children and elderly this visceral-somatic pain sequence is often absent.

An inflamed appendix in the pelvis may never produce somatic pain involving the anterior abdominal wall but may instead cause suprapubic discomfort and tenesmus.

Anorexia, nausea and vomiting

Central abdominal pain is associated with anorexia, nausea and usually one or two episodes of vomiting which follow the onset of pain (Murphy). Anorexia is a constant clinical feature, particularly in children.

Right iliac fossa tenderness

This is due to the irritation of parietal peritoneum.

Rebound tenderness (Blumberg's sign or release sign)

With each inspiration the examiner gradually presses his hand down in RIF and withdraws his hand suddenly and completely. The patient will immediately cry or wince with pain due to the springing back of parietal peritoneum along with the abdominal muscles.

Elevated temperature

A low grade pyrexia $< 38.7^{\circ}\text{C}$ is usually present in 80% of the patients.

Temperature $> 39^{\circ}\text{C}$ is strongly suspicious of appendicular perforation.

Other signs include

Rovsing's sign – pressure over left iliac fossa produces pain in right iliac fossa.

This is because the coils of ileum shift slightly to the right and press on the inflamed appendix.

Baldwing test – this test is useful in cases of retrocaecal appendix. A hand is placed over the flank of the patient. The patient is now asked to raise the right lower limb off the bed keeping the knee extended. The patient will immediately complain of pain in case of retrocaecal appendicitis. Retrocaecal appendix remains in close contact with the psoas major muscle which becomes contracted during flexion of the hip joint.

Psoas sign - patient lies with his right hip flexed. HyperExtension of right hip with the patient turned to the left produces pain, due to stretching of psoas major muscle.

Zachary Cope (obturator test): An inflamed pelvic appendix lies in contact with the obturator internus. Flexion and internal rotation of right hip stretches this muscle produces pain in the hypogastrium.

INVESTIGATIONS

Leucocytosis

The total WBC count of over 10,000/cu.mm is taken as positive in Alvarado score. It is present in 80 -85% of patients with acute appendicitis. WBC count is also raised in 25% of patients with other causes of RIF pain. Leucocytosis bound to increase with progress of inflammation.

Shift to Left

Arneth pointed out that the number of lobes in neutrophils is related to their age. The senile one has the maximum number of lobes and the youngest one has no lobe but a single nucleus showing a sign of indentation. Arneth index is calculated by counting the number of nuclear lobes in 100 neutrophils.

STAGES				
I	II	III	IV	V
1-5%	30%	45%	18%	2%

When the number of cells belonging to stages I & II are greater denoting a shift to left, it suggests infective conditions that stimulate the bone marrow to produce new cells to combat infection.

Imaging

Plain films of the abdomen:

According to Brook and Killen the following signs are suggestive of acute appendicitis:

1. Fluid levels close to the caecum and terminal ileum

2. Localised ileus – gas in caecum, ascending colon, terminal ileum.
3. Increased soft tissue density in right lower quadrant
4. Blurring of right flank stripe
5. Fecolith in right iliac fossa
6. Blurring of right psoas shadow
7. Gas filled appendix
8. Free intraperitoneal gas
9. Deformity of caecal gas shadow

The presence of a fecolith is rarely noted on plain films, but if present, is highly suggestive of the diagnosis.

Barium enema

Smith and associates enumerated the radiologic signs of appendicitis after barium enema as

1. persistent non visualisation of the appendix
2. partial visualisation of the appendix
3. pressure defect of the caecum, and
4. irritability of the caecum and terminal ileum on screening.

Ultrasonography:

Ultrasonography is useful in the differentiation of gynaecological causes of acute abdominal pain, such as detection of ovarian mass, ectopic pregnancy. With graded compression technique the appendix itself can be visualised.

Advantages

1. relatively inexpensive
2. doesn't require contrast
3. no radiation – can be used even in pregnant patients
4. helps to identify gynaecologic pathology
5. can be used to drain appendicular abscess

Disadvantages

1. operator dependent

The ultrasonographic signs of acute appendicitis are –

Blind ending tubular structure in right iliac fossa originating from cecum

1. that is aperistaltic
 2. noncompressible
 3. with anteroposterior diameter $> 6\text{mm}$
 4. presence of faecolith
 5. thickening of wall – serosa to mucosa thickness $> 2\text{mm}$
 6. presence of periappendiceal fluid collection
- } highly suggestive
of Acute
Appendicitis

False – positive scans

1. in the presence of periappendicitis from surrounding inflammation
2. a dilated fallopian tube can be mistaken for an inflamed appendix

3. in obese patients, the appendix may not compressible because of overlying fat.

False - negative scans

1. inflammation is confined to tip of appendix
2. retrocecal appendix
3. appendix is markedly enlarged and is mistaken of small bowel
4. appendix is perforated and therefore compressible.

CT Signs of acute appendicitis:

1. Appendix measuring $> 6\text{mm}$ diameter
2. Failure of appendix to fill with oral contrast / air up to its tip.
3. An appendicolith
4. Enhancement of appendicular wall with i.v. contrast.
5. Surrounding inflammatory changes include increased fat attenuation, fluid, inflammatory phlegmon, caecal thickening, abscess, extraluminal gas and lymphadenopathy.
6. Arrow head sign: Luminal contrast / air in caecum pointing towards the obstructed origin of the appendix (present in 30% cases of appendicitis).

Laparoscopy

Laparoscopy is useful in equivocal cases of appendicitis. According to the study by Paterson-Brown and his associates only 3 out of 40 patients (7.5%) had an unnecessary appendectomy compared with 11 of 60 patients (22%) operated on without laparoscopy. This is

particularly useful in female patients.

Diagnosis of acute appendicitis

The diagnosis of acute appendicitis is essentially clinical. A number of clinical and laboratory based scoring systems have been devised to assist the diagnosis. The most widely used is the Alvarado score.

MODIFIED ALVARADO SEVERITY SCORING (MASS) / (MANTRELS) SCORE

Symptoms	score
• migratory RIF pain	1
• anorexia	1
• nausea and vomiting	1
Signs	
• tenderness (RIF)	2
• rebound tenderness	1
• elevated temperature	1
Laboratory	
• leucocytosis	2
• shift to left	1
Total	10

A score of more than 7 is strongly predictive of acute appendicitis. A score of 5 or 6 is equivocal and a score of less than 5 is less likely to be a case of acute appendicitis.

DIFFERENTIAL DIAGNOSIS

The differential diagnosis of acute appendicitis depends upon four major factors:

1. the anatomic location of the inflamed appendix
2. the stage of the process
3. the patient's age and
4. the patient's sex

Acute mesenteric adenitis – is the disease most often confused with acute appendicitis in children. Almost invariably an upper respiratory infection is present or has recently subsided. Voluntary guarding may be present but true rigidity is rare. Generalised lymphadenopathy may be present. A relative lymphocytosis, when present is diagnostic of acute mesenteric adenitis. Acute gastroenteritis – is common in children. Viral gastroenteritis is an acute self limited disease with profuse watery stools, nausea and vomiting. The abdomen is relaxed between cramps and there are no localizing signs. Salmonella gastroenteritis results from consumption of contaminated food and there will be a point source.

Intestinal perforation in typhoid usually mimics acute appendicitis.

Diseases of the Male urogenital system - in males the following diseases are often confused with acute appendicitis.

Torsion testis, epididymitis and seminal vesiculitis.

Meckel's diverticulitis - is extremely difficult to diagnose preoperatively. Both have the same

complications and require prompt surgical treatment.

Intussusception - Nearly all idiopathic intussusception occur under the age of 2. it mostly occurs in well nourished infants and in between the episodes the child is normal. After several hours the patient passes bloody mucoid stool. A sausage shaped mass is palpable in the right lower quadrant but later on, the quadrant becomes empty as the intussusception progresses distally.

Treatment is hydrostatic reduction, if seen before peritonitis.

Regional Enteritis - It mostly mimics acute appendicitis. The presence of diarrhea and infrequency of anorexia, nausea, vomiting clinches the diagnosis. Acute ileitis must be differentiated from Crohn's. When distal ileum is acutely inflamed with no caecal involvement and a normal appendix, appendicectomy is indicated.

Perforated peptic ulcer - The spilled gastro duodenal contents gravitating to the right paracolic gutter closely mimics acute appendicitis (St. Valentino's appendicitis).

Other lesions:

Diverticulitis, perforating carcinoma of the caecum or the portion of sigmoid lying on the right side.

Epiploic appendagitis - It usually presents secondary to torsion. The symptoms correspond to the contour of the colon, and the pain may last several days.

Urinary tract infection - Acute pyelonephritis right side mimics retroileal appendicitis. But here they have chills, right costovertebral angle tenderness and bacteria in urine.

Ureteral stone - If a calculus is present near the appendix, it may simulate the condition, provided here the pain is referred to scrotum labia, penis. Hematuria and presence of fever, leucocytosis suggests it's a stone.

Primary peritonitis - It rarely mimics the condition. We might have nothing but cocci in the aspirate. It can be treated medically.

Henoch-Schonlein purpura - It occurs 2 to 3 weeks following a streptococcal infection. Joint pain, purpura and nephritis are nearly present.

Yersiniosis - *Y.enterocolitica* and *Y.pseudotuberculosis* gets transmitted through faecal and urinary contamination and infects humans causing mesenteric adenitis, ileitis, colitis, acute appendicitis of which many are self limited. If left untreated there is a risk of high fatality. These organisms are mostly sensitive to tetracycline, ampicillin, and kanamycin. 6% of the cases are of mesenteric adenitis, and 5% are of appendicitis. *Campylobacter jejuni* causes diarrhoea and pain mimicking acute appendicitis.

Gynaecologic disorders

In the decreasing order of frequency,

- PID
- Ruptured Graffian follicle
- Twisted ovarian cyst/ tumour
- Endometriosis
- Ruptured ectopic pregnancy.

P.I.D. - Nausea and vomiting are mostly absent here. pain and tenderness are usually lower.

Motion of cervix is exquisitely painful. The purulent vaginal discharge shows intracellular diplococci. The ratio of appendicitis : PID is low in early menstrual phase and none in luteal phase.

Ruptured Graffian follicle: The ovulation causing spilling of blood and follicular fluid. It is

unusually copious and from right ovary mostly. Leukocytosis and fever are absent. Pain occurring in the midpoint of menstrual cycle, it is called as Mittelschmerz.

Other diseases:

- Foreign body perforation of the bowel
- Closed loop obstruction
- Mesenteric vascular occlusion.
- Pleuritis of right lower chest.
- Acute cholecystitis, pancreatitis
- Abdominal wall hematoma / abscess

TREATMENT

Because of the risk of progression to rupture, its attendant morbidity and mortality, immediate appendectomy is recommended in acute appendicitis. The sooner it is done, the better. There are four exceptions to this rule are

1. the patient is moribund with advanced peritonitis: here the only hope is to improve the condition by intravenous fluids, nasogastric suction, antibiotics, and blood transfusion in an attempt to get the patient fit for operation
2. the attack has already resolved; in such a case, appendectomy can be advised as an elective procedure to prevent recurrence, but there is no immediate emergency,
3. circumstances make operation difficult or impossible. Here conservative treatment is given hoping that resolution will occur, or local appendix mass forms.
4. an appendix mass has formed without evidence of general peritonitis.

Preoperative preparation

In a straight forward case of acute appendicitis no special steps are required apart from those for other abdominal operation.

Broad spectrum antibiotic therapy to cover gram negative and anaerobic organisms, preferably cefuroxime and metronidazole.

If generalised peritonitis is established, resuscitation is very important.

Resuscitation

It is an axiom that in all cases of generalised peritonitis, some degree of hypovolaemia is present. This is due to the “Third spacing” of extracellular fluid within the peritoneal cavity. The rapidity at which resuscitation is accomplished is dependent upon the degree of hypovolaemia and the physiologic status of the patient and also the acuity of the situation. The effectiveness of fluid replacement efforts can be judged by the normalisation of pulse rate, blood pressure and mental status. Placement of a urinary drainage catheter is essential since restoration of urine output is a reliable indicator of adequate fluid resuscitation. Invasive peripheral arterial and central venous pressure monitoring catheters should be placed in patients with frank septic shock, advanced age, or in patients with cardiac, pulmonary, renal insufficiency to provide more précised determinations of intravascular volume and cardiac output. Supplemental oxygen may be necessary and in more extreme circumstances endotracheal intubation and mechanical ventilation may be needed to preserve oxygenation. Nasogastric decompression should be done in presence of ileus, to prevent pulmonary aspiration and to reduce abdominal distension and to contain further soiling of peritoneal cavity. Anti acid agents like ranitidine should be administered to prevent stress induced gastric ulceration.

Broad spectrum antibiotics covering gram negative and anaerobic organisms is to be given.

Appendicectomy can be conventional / laparoscopic.

APPENDICEAL PERFORATION AND ITS MANAGEMENT

The overall rate of perforated appendicitis is 25.8% and hence immediate appendectomy has long been the recommended treatment of acute appendicitis for the known risk of progression to perforation. Children younger than 5 years of age and patients older than 65 years of age have the highest rate of perforation (45 & 51% respectively). It has been suggested that delays in presentation are responsible for the majority of perforated appendices. There is no accurate way of determining when an appendix will rupture prior to resolution of the inflammatory process.

Appendiceal rupture occurs most frequently distal to the point of luminal obstruction along the antimesenteric border of the appendix. Rupture should be suspected in the presence of fever greater than 39°C (102°F) and a WBC count > 18000/mm³. In the majority of cases, rupture is contained and patients display localised rebound tenderness. Generalised peritonitis will be present if the walling off process is ineffective in containing the rupture.

In 2 to 6% cases, an ill-defined mass will be detected on physical examination. This could represent a Phlegmon (matted loops of small bowel adherent to adjacent inflamed appendix) or a periappendiceal abscess.

The ability to distinguish acute, uncomplicated appendicitis from acute appendicitis with perforation on the basis of clinical findings is often difficult but it is important to make the distinction because their treatment differs.

CT scan is beneficial in this setting.

Management

Phlegmon and small abscesses can be treated conservatively, with intravenous antibiotics.

Well localised abscesses can be managed with percutaneous drainage with USG / CT guidance.

Complex abscesses should be considered for surgical drainage. If operative drainage is required, it should be performed by an extraperitoneal approach with appendicectomy reserved only for cases in which appendix is easily accessible. Otherwise interval appendicectomy after 6 weeks following the acute event is the classical recommendation, for those patient treated non-operatively or with simple abscess drainage.

Generalised peritonitis needs a laparotomy with drainage of abscess cavities and appendicectomy with peritoneal lavage and drainage.

Management of appendicular mass

Occasionally, a walled off perforated appendix will form an inflammatory mass. Usually there is a history of 4 or 5 days of pain. The clinical features are a shifting temperature with an increased pulse rate. There is a tender mass in the right iliac fossa that can often also be palpated on rectal examination. However, there is no evidence of a generalised peritonitis, in that the rest of the abdomen is soft and bowel sounds are present. The WBC count is raised considerably.

If an appendix mass is present and the condition of the patient is satisfactory, the standard treatment is the conservative Ochsner-Sherren regimen. This is based on the premise that the inflammatory process is already localised and that inadvertent surgery is difficult and may be dangerous. It may be impossible to find the appendix and, occasionally, a faecal fistula may form. For these reasons it is wise to observe a nonoperative programme, but to be prepared

to operate should clinical deterioration occur.

Careful record of the patient's condition and the extent of the mass should be made, and the abdomen regularly reexamined. It is helpful to mark the limits of mass on the abdominal wall using a skin pencil. A nasogastric tube should be passed and intravenous fluid and antibiotic therapy instigated. Temperature and pulse rate should be recorded 4 hourly and a fluid balance record maintained. Clinical deterioration or evidence of peritonitis is indication for early laparotomy. Clinical improvement is usually evident within 24-48 hours at which time the nasogastric tube can be removed and oral fluids introduced. Failure of the mass to resolve should raise the suspicion of a ileocaecal tuberculosis, carcinoma or Crohn's disease. Using this regime approximately 90% of cases resolve without incident. It is advisable to remove the appendix usually after an interval of 6-8 weeks.

Criteria for stopping conservative treatment

1. a rising pulse rate
2. increasing or spreading abdominal pain
3. increasing size of the mass
4. Vomiting or copious gastric aspirate.

COMPLICATIONS

Preoperative

1. perforation of appendix
2. generalised peritonitis
3. appendicular abscess

Postoperative

Early complications

1. paralytic ileus
2. wound infection – most common postoperative complication
 - residual abscess
 - paracaecal abscess
 - pelvic abscess
 - subphrenic abscess
3. hemorrhage
4. faecal fistula –external and internal type caused by
 - necrosis of caput caecae
 - erosion of caecal / ileal wall by drain
 - release of appendicular stump
 - retained foreign body

- regional enteritis
- ileocaecal tuberculosis
- iatrogenic

5. intestinal fistula

- appendiculo-vesical
- appendiculo-rectal
- appendiculo-vaginal

6. chest complications

- bronchogenic pneumonia
- atelectasis
- empyema

Late complications

1. adhesions causing bowel obstruction
2. ventral hernia
3. inguinal hernia

Histopathologic features

Macroscopic appearance

1. Grossly, an appendix with well-developed acute inflammation shows a fibrinous or purulent coating of the serosa, with engorgement of the vessels.
2. The mucosa shows areas of ulceration against a markedly hyperemic background.
3. Obstruction of the lumen by a fecalith or some other agent is found

in about one fourth to one third of the cases

Microscopic appearance

1. The changes range from minimal focal inflammation to total necrosis of the appendiceal wall, the degree of abnormalities being partially dependent on the interval between the onset of symptoms and the operation.
2. In early lesions, neutrophils appear at the base of the crypt adjacent to a small defect in the epithelium.
3. In late lesions the inflammatory process reaches the submucosa and spreads quickly to the remaining appendix.
4. In advanced stages, the mucosa is absent, and the wall is necrotic.
5. Thrombosed vessels are seen in one fourth of the cases.

Periappendicitis

- It refers to acute or chronic inflammation of the appendiceal serosa.
- It is invariably present in the advanced stages of appendicitis.
- It can be seen in the absence of a primary inflammation of this organ, as a result of spread of an inflammatory process from another site, such as the female adnexae.
- In the presence of periappendicitis, evidence of mucosal involvement should be thoroughly sought; if none is found, the diagnosis given should be that of periappendicitis rather than appendicitis, the implication being that the primary site of the inflammation is probably located elsewhere.

There is close correlation between the gross and microscopic findings in acute appendicitis. Therkelsen reviewed 154 organs with microscopic evidence of acute appendicitis; grossly, evidence of inflammation was evident in 125, equivocal in 25, and absent in 4.

OBSERVATIONS AND RESULTS

TABLE 1

Incidence of Acute Appendicitis in Govt. General Hospital, Chennai

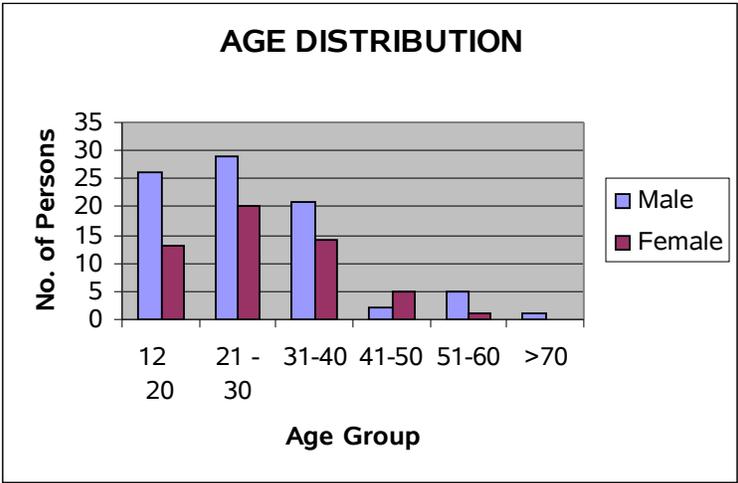
July 2004 – February 2006

Total No. of emergency surgeries performed	324
Total No. of emergency appendicectomies encountered	137

Nearly 44% of emergency surgeries performed in our unit during the study period were for the treatment of Acute Appendicitis.

Table 2

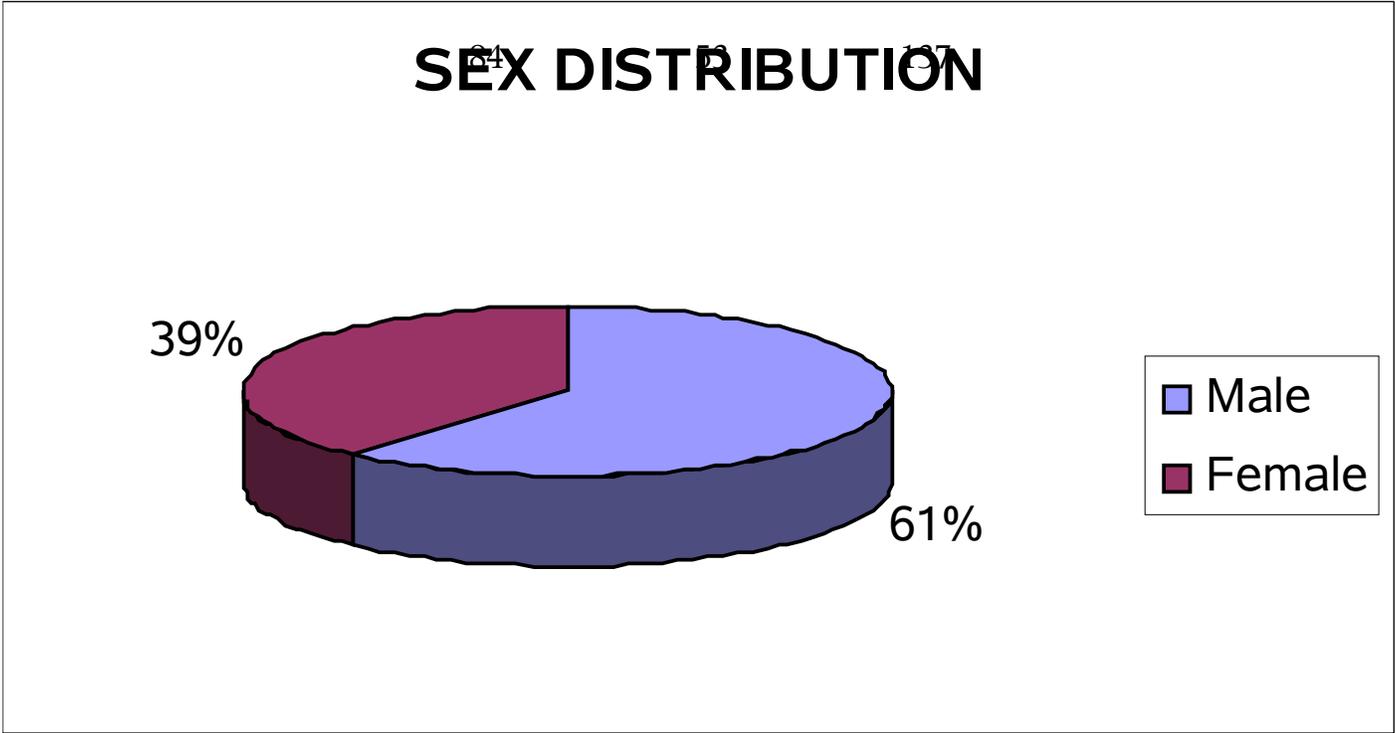
Age Group	Male	Female	Total
12 - 20	26	13	39
21 - 30	29	20	49
31-40	21	14	35
41-50	2	5	7
51-60	5	1	6
>70	1	0	1



The most common age group to be affected as per the study is third decade of life, closely followed by second decade of life. Oldest age of the patient recorded is 84 years. Males are more commonly affected by acute appendicitis in all decades of life.

Table 3

Male	Female	Total
------	--------	-------



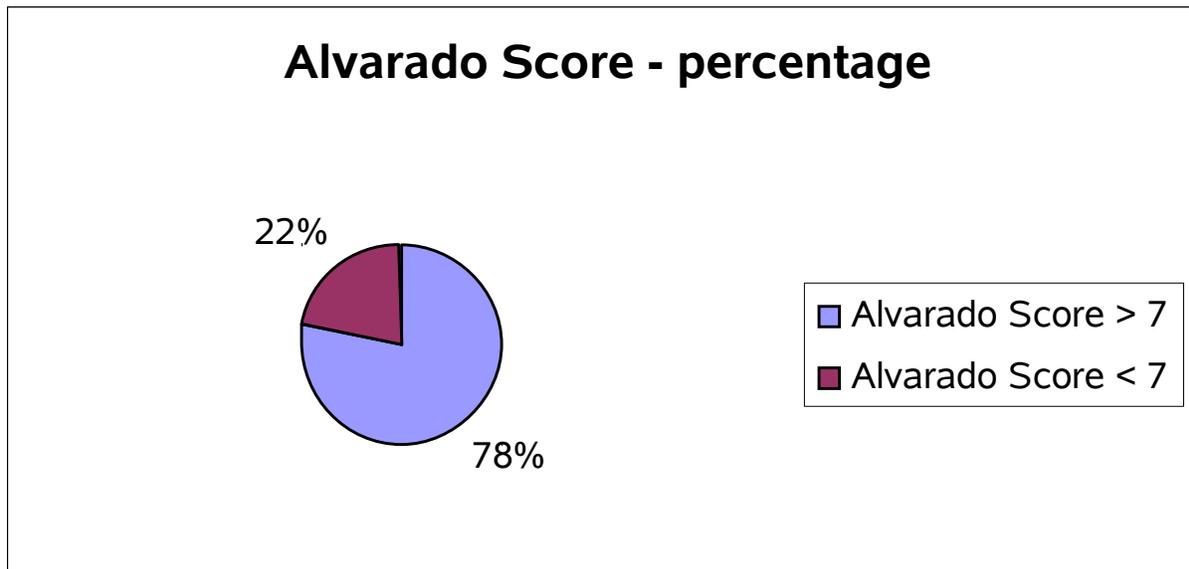
Male: female = 1.58: 1

Total number of patients	137
Right iliac fossa pain	134
Nausea /vomiting	124
Anorexia	74
Right iliac fossa tenderness	137
Rebound tenderness	132
Temperature	82
Leucocytosis	134

Right iliac fossa pain was the most common symptom (97.8%), followed by nausea / vomiting (90.5%). Anorexia is less common in adult population 54% as compared to 95% in paediatric population. Leucocytosis was present in 134 cases.

Table 4

Alvarado Score > 7	107
Alvarado Score < 7	30
Total	137



In the sample of the above patients studied, Alvarado score > 7 was recorded in 107 of the 137 which is around 78%. Remaining 30 patients had score < 7.

Table 5

	Alvarado Score > 7	Alvarado Score < 7
Male	67	17
Female	40	13
Total	107	30

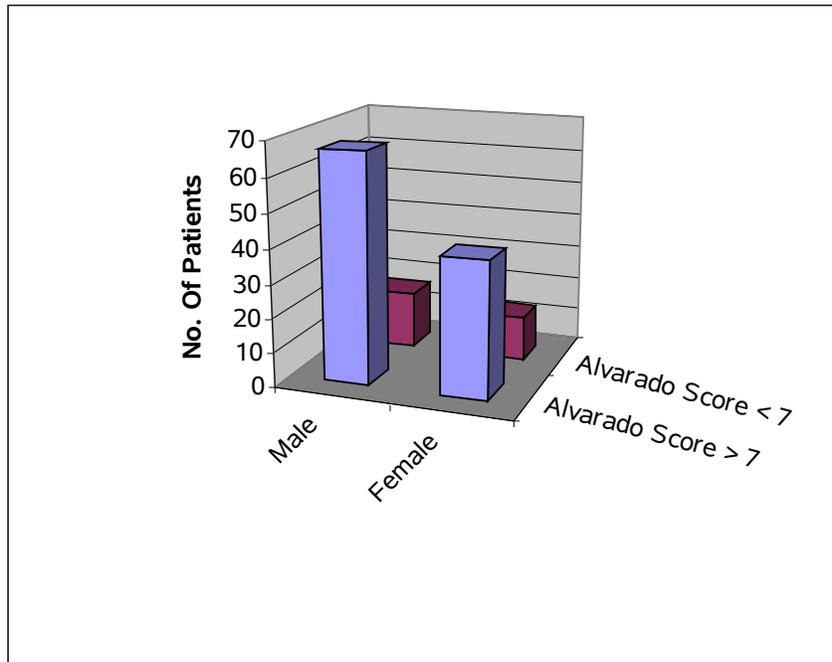
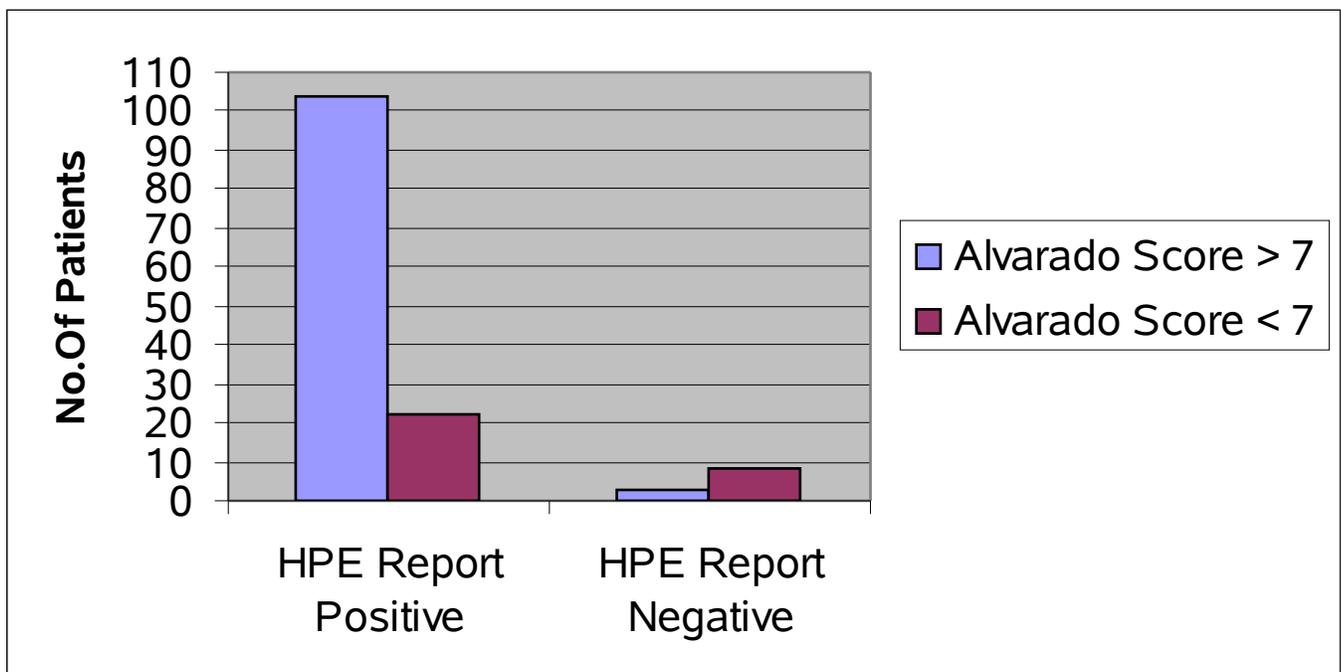


Table 5

	HPE Report	HPE Report
	Positive	Negative
Alvarado Score > 7	104	3
Alvarado Score < 7	22	8



Of the 107 patients with an Alavardo score > 7, 104 of them had biopsy reports confirming the diagnosis of acute appendicitis. This is around 97.1% of the sample. Only 3 cases with score > 7 had negative biopsies.

Of the patients with a score < 7 who were 30 in number, but were taken up for

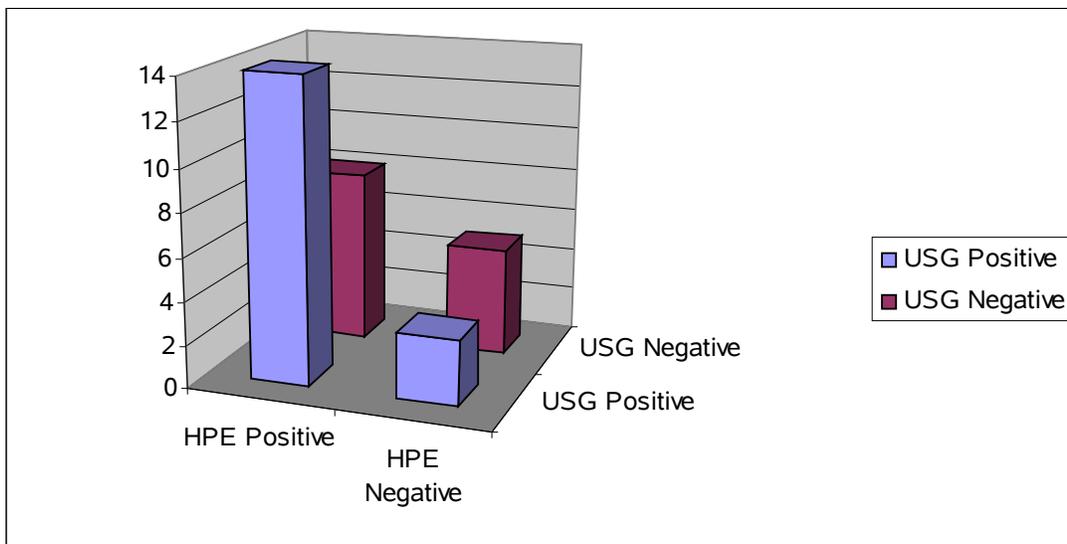
surgery based on other diagnostic means, 22 had proved to have acute appendicitis by histopathology.

In this study, Alvarado score is found to be 82.5% sensitive and 72.7% specific.

The positive predictive value is 97.1% and the negative predictive value is 26.6%.

Table 6

	HPE Positive	HPE Negative
USG Positive	14	3
USG Negative	8	5



The 30 patients who had Alvarado score < 7 were subjected to ultrasonogram.

Of the 17 patients with sonographic features of acute appendicitis 14 of them had a positive HPE report of acute appendicitis. Out of 13 subjects who had no sonographic features suggestive of acute appendicitis, but still taken up for surgery based on clinical judgment, 8 proved to have inflamed appendices on histopathology.

Per operative finding

Inflamed appendix	85
Appendicular perforation	24
Appendicular abscess	12
Normal appendix	16

Out of the 16 appendices that appeared to be normal on macroscopic examination 5(31.25%) were found to have features of acute appendicitis on histopathological examination.

SUMMARY AND CONCLUSION

This study was conducted on 137 patients who underwent emergency appendicectomy in our General Surgical unit in Govt. General Hospital, Chennai, from July 2004 to February 2006 and the following conclusions were made.

1. Acute appendicitis is the most common surgical abdominal emergency in our hospital.
2. Acute appendicitis is more common in males and the commonest age group affected is 21 – 30 years
3. Right iliac fossa pain is the most common presenting symptom followed by nausea / vomiting.
4. In diagnosis of acute appendicitis Alvarado score has a high diagnostic value (82.5%). Alvarado score is a noninvasive, safe diagnostic procedure, which is simple, fast, reliable and repeatable, it can be used in all conditions, without expensive and complicated supportive diagnostic methods. Alvarado score increases the diagnostic certainty of clinical examination in diagnosis of acute appendicitis.
5. Ultrasonogram done in patients with equivocal or low Alvarado score is useful in identifying the missed out cases thereby preventing diagnostic delay and its attendant complications viz, appendicular perforation and abscess formation.
6. Appendices that appear to be normal on macroscopic inspection may show features of acute appendicitis on histopathologic examination.

BIBLIOGRAPHY

1. Bailey & Love's Short Practice of Surgery – 24th edition (2004).
2. Maingot's Abdominal Operations – 10th edition (1997).
3. Shackelford's surgery of Alimentary Tract – 5th edition (2002)
4. Mastery of Surgery – 4th edition (2001).
5. Sabiston's textbook of surgery – 17th edition (2004).
6. Schwartz's Principles of Surgery- 8th edition (2005).
7. Diagnostic Radiology –by Grainger & Allison – 4th Edition (2001).
8. Gastrointestinal Radiology – by Ronald-L.Eisenberg – 4th edition (2003).
9. Essential surgical practice – by Sir Alfred Cuschieri – 4th edition (2002).
10. Hamilton Bailey's Emergency Surgery – 13th edition (2000).
11. American college of surgery principles and practice (2005).
12. ASI textbook of surgery- 1st edition (2003).
13. Current surgical diagnosis and Treatment – 11th edition (2003).
14. Imaging of the Acute Abdomen – Radiologic clinics of North America (Nov 2003).
15. Last's Anatomy – 10th edition (2001).
16. Lee McGregors synopsis of surgical anatomy – 12th edition (1999).
17. Skandalakis surgical anatomy (2004).
18. Harrisons' Principles of Internal medicine – 15th edition (2001).
19. Farquharson's Textbook of Operative Surgery – 8th edition (2000).
20. Ackermann's Surgical Pathology 8th edition
21. Alvarado A.: A practical score for the early diagnosis of acute appendicitis. Ann Emerg Med 1986; 15: 557-564
22. Ohmann C., Yang Q., Franke C.: Diagnostic scores for acute appendicitis. Abdominal pain study group. Eur J Surg 1995; 161:273-281
23. Puylaert J.B. Acute appendicitis: US evaluation using graded compression. Radiology 1986;158:355-360
24. Hoffmann J and Rasmussen O, Aids in the diagnosis of acute appendicitis. Br. J. Surg. 1989; 76: 774-779.

