"A ONE YEAR CROSS-SECTIONAL STUDY TO EVALUATE SPECIFICITY AND SENSITIVITY OF MODIFIED ALVARADO SCORE AND ULTRASONOGRAPHY IN ACUTE APPENDICITIS OF PATIENTS COMING TO K.L.E.S DR. PRABHAKAR KORE HOSPITAL, BELGAUM"

By

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Dissertation

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M.S. (GENERAL SURGERY)

Under the Guidance of

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LIST OF ABBREVIATIONS USED

CNS	:	Central Nervous System
CRP	:	C-reactive protein
CT	:	Computed tomography
CVS	:	Cardiovascular system
Hb	:	Haemoglobin
IP. No.	:	In patient number
IUCD	:	Intra uterine contraceptive device
MRI	:	Magnetic resonance imaging
No.	:	Number
PICKLE	:	Pallor Icterus Cyanosis Clubbing Lymphadenopathy Edema
R.L.Q	:	Right lower quadrant
R.S	:	Respiratory System
Rt.	:	Right
WBC	:	White Blood Cell Count

ABSTRACT

Background and objectives

Several diagnostic aids have been developed to improve diagnosis in suspected acute appendicitis. Modified Alvarado score includes signs and symptoms associated with ones degree of clinical suspicion. Ultrasonograpy is used in many institutions to aid the diagnosis of acute appendicitis, the following study evaluate and compare the diagnostic accuracy of the two modalities and examines value of using both modalities together. The aim of present study is to compare and evaluate diagnostic accuracy of modified Alvarado score and ultrasonography in co-relation to histopathology report for diagnosis of acute appendicitis.

Methods : A cross-sectional study of the patients who underwent appendectomy for suspected acute appendicitis at K.L.E.S. Dr. Prabhakar Kore Hospital and M.R.C Belgaum. The clinical, radiological and ultrasonograhic data of 75 patients with suspected appendicitis was collected these patients were evaluated by modified Alvarado score and ultrasonography, which was correlated with histopathological findings.

Results : Out of 75 patients, 29 patients (38.66%) had acute appendicitis. 30 patients (40%) had modified Alvarado score ≥ 7 and 29 patients (38.66%) were ultrasonographically positive. In the present study, modified Alvarado score has sensitivity of 75.86%, specificity 82.61%, positive predictive value 73.33%, negative predictive value 84.44%, diagnostic accuracy 80.0%, false positive error rate 17.39% and false negative error rate 24.11%.

Ultrasonography has sensitivity of 82.76%, specificity 89.13%, positive predictive value 82.76%, negative predictive value 89.13%, diagnostic accuracy 86.67%, false positive error rate 10.87% and false negative error rate 17.24%. When modified Alvarado score and ultrasonography were positive, 26 were true positive cases, and no false positive cases. The false negative cases modified Alvarado score were 7. When it was combined with ultrasonography the false negative cases reduced to three that is 57.14% reduction in false negative cases.

Conclusions : Modified Alvarado is useful tool in clinical decision making. When compared with ultrasonography, neither one is advantageous. However, additional information provided by ultrasonography improves diagnostic accuracy.

Key words : Modified Alvarado score, Ultrasonography, Acute appendicitis.

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INTRODUCTION

The acute surgical abdomen an important problem facing surgeons and radiologist alike. The wide range of cause and varied patient presentation pose a formidable diagnostic and therapeutic challenge. As with all new developments however, enthusiasm for the new and modern techniques has sometimes over whelmed good clinical judgment

Acute appendicitis is the most common cause of acute surgical abdomen with a life long risk of 7%.[1] Classic clinical and laboratory findings usually allow for prompt diagnosis and treatment However some patients have atypical and frequently confusing presentation leading to misdiagnosis.

The diagnosis may be easy but may also be very difficult. It is an often wrongly made as initial overlooked the formers leading to unnecessary surgery and long hospital stay. Diagnostic difficulties, in patients with atypical clinical finding has resulted in unnecessary appendectomies which have been variably between 15-30%.[2]

Equally distressing is the fact that perforation may occur up to 35% of cases.[3] So traditionally surgeons have accepted higher rate of unnecessary appendicectomies in order to decrease the incidence of perforation. This approach has been increasing questioned in today's era of cost effective health care. The goal of surgical treatment is removal of inflamed appendix before perforation with minimal number of negative appendectomies.

Diagnosis of Acute Appendicitis remains challenging despite improvement in history taking, clinical examination, new computer aided decision support system, clinical diagnostic sourcing and new imaging technique.

Diagnostic scores are useful and easy methods which help in surgical decision to reach. These scores make use of clinical, analytical and radiological findings to produce a rationalized model of clinical decision-making. Presently several such diagnostic scoring system have been proposed to aid diagnosis of acute appendicitis. The description of modified Alvarado scoring system was introduced in 1994 has greatly improved ability to diagnosis.[4]

Plain abdominal films and barium studies considered to be of limited value. New technology could lower the rate of delayed diagnosis. Graded compression ultrasonography in diagnosis of acute appendicitis has greatly improved the ability to diagnose acute appendicitis with ultrasound.[5] Ultrasonography is critically operator dependant, and care to be taken to avoid over interpreting a technically in adequate examination. Graded compression sonography plays an important role in reducing the number of negative surgical exploration for acute appendicitis. The accuracy offered by sonography should keep negative laprotomy ratio at approximately 10% which is improvement over the rate achieved by instinct alone.[6] CT scan is complimentary to sonography. However CT scan is associated with greater cost, exposure ionizing radiation and exposure to contrast agents.

In our hospital acute appendicitis remains one of the most common acute abdominal emergencies warranting surgery in patients presenting with atypical clinical finding. So diagnosis become difficult. Modified Alvarado scoring system

and ultrasonography play a definite role in diagnosis of acute appendicitis, because of its easy availability, cost effectiveness and radiation free. Till now in our hospital no one has done a study to evaluate diagnostic accuracy of modified Alvarado score and ultra sonography in adults, in acute appendicitis. Hence this study is undertaken.

OBJECTIVES

Primary Objective:

To compare and evaluate diagnostic accuracy of modified Alvarado score and ultrasonography in co-relation to histopathology report for diagnosis of acute appendicitis.

REVIEW OF LITERATURE

HISTORICAL REVIEW

Caludius Amyrand in 1736 performed first appendicetomy on a boy of 11 years of age who had right scrotal hernia accompanied by fistula (within the scrotum was found the appendix, perforated by pain). Heister in 1755 recognized that appendix might be sight of primary inflammation. Hamock in 1848 successfully drained an appendix abscesses in a pregnant female during her eight month of pregnancy. Lawson Tait in 1880 first abdominal appendicectomy. Reginald Fitz n 1886 first described acute appendicitis. He was also the first to use the term appendicitis. McBurney in 1889 advanced the act of diagnosis sufficiently to remove the first unruptured appendix and also devised the muscle splitting incision named after him.[7]

ANATOMY

The vermiform appendix is a narrow, vermian (worm shaped) tube, arising from posteromedial caecal wall, 2 cm or less below the end of the ileum. It can be found in any of the following position:

1. Retrocaecal (12 O'clock) position - directed upwards in the retrocaecal recess. If the length is greater it may be retrocolic on hepatic.
2. Right Paracaecal (11 O'clock) position: lies on right side of caecum.
3. Left Paracaecal (10 O'clock) position: lies on left side of caecum. It may be preileal or postileal.
4. Splenic (2 O'clock) position: directed towards spleen.

5. Promontoric (3 0' clock) position: directed towards sacral promontory.
6. Pelvic (4 to 5 O'clock) position: Crosses the pelvic brim and lies in true pelvis.
7. 6 O'clock position: Appendix in mid inguinal position.

The location of appendix as follows. [8]

Retrocaecal and retrocalic	:	74%
Pelvic	:	21%
Sub caecal	:	1.5%
Preileal	:	1%
Post ileal	:	0.5%

The length varies from 2 to 20 cm with an average of 9 cm. it is longer in children than adults. The diameter is about 5 mm. The lumen is quite narrow and may be obliterated after mid-adult life.

The appendicular orifice is situated at posteromedial aspect of the caecum 2 cms below the i1eocaecal orifice. The appendicular orifice is occasionally guarded by an indistinct semilunar fold of mucous membrane known as valve of Gerlach.

The appendix is suspended by a small triangular fold of peritoneum, called mesoappendix. The appendicular artery often runs in its free edge, but may run closer to the base of the appendix.

Blood supply

The caecum is supplied by the anterior and posterior caecal branches of the ileocolic artery which is a branch of superior mesenteric artery.

The appendicular artery, a branch of ileocolic artery reaches the appendix through the mesoappendix. There may be an accessory appendicular artery (artery of Seshachalam) arising from the posterior caecal artery. If the mesentery is incomplete, the artery lies on the wall of appendix in its distal part and may be thrombosed in acute appendicitis.[9]

Venous drainage

Venous drainage is brought about by the appendicular, ileocolic and superior mesenteric veins and is to the portal vein.

Lymphatic drainage

The lymph vessels from caecum and appendix terminate in ileocolic nodes situated close to the ileocolic artery. Small appendicular nodes usually lie close to the meso-appendix.

Nerve supply

A plexus of nerves consisting of both sympathetic and parasympathetic fibres accompany the arteries to reach the caecum and appendix. The plexus is an offshoot from the superior mesenteric plexus. The sympathetic fibres are derived from TI0 - TI1 segment of the cord and the parasympathetic fibres are derived from vagi.

Development

The caecum and appendix develop form the caecal bud of the midgut. Agensis of the appendix is extremely rare. A study reported an incidence of one in 1,00,000 laparotomies for suspected appendicitis. [10]

Histology

The structure of the appendix resembles that of large intestine. The lamina propria is extensively infiltrated with lymphocytes and the details of the mucosa are often obscured by the many lymphatic nodules that may fill the mucosa and submucosa.

This profusion of lymph tissue has promoted the description of "abdominal tonsil" for the appendix, and draws attention to this features as relevant to the causes of appendicitis.

Duplication of the appendix

Duplication of the appendix is an anomaly of extreme rarity, classified it into three types.

Type A: Partial duplication of the appendix on a single caecum.

Type B: Single caecum with two completely separate appendices.

B1 : Bird like appendix where there are two appendices symmetrically placed on either side of ileocaecal value.

B2 : Along with the usual appendix another rudimentary appendix arises from the caecum along the line of one of the teniae coli.

Type C: There are two caeca, each of which bears an appendix.

Tinkler described a unique case of a triple appendix, associated with double penis and ecoptia vesicae.[11]

PATHOLOGY

Inflammation in the right lower quadrant was considered a non surgical disease of the caecum (typhlitis or perityphilitis) until Reginald Heber Fitz recognized acute appendicitis as a distinct entity in 1886.

Aetiology and pathogenesis

The underlying facto in the development of acute appendicitis is believed to be obstruction of the appendiceal lumen, majority of cases demonstrating a fecolith.[8] Less commonly, a gallstone, tumour or parasites (Oxyuriasis vermicularis or round worms) is demonstrated. Continued secretion of mucinous fluid in the obstructed viscus leads to a progressive increase in intraluminar pressure sufficient to cause eventual collapse of the draining veins. Ischemic injury then favours bacterial proliferation with additional inflammatory edema and exudation, further embrassing the blood supply. A significant minority of inflamed appendices have no demonstrable luminal obstruction, and the pathogenesis of the inflammation remains unknown.

Fecolith

Fecolith is composed of inspissated fecal material, calcium and magnesium phosphates and carbonates, bacteria and epithelial debris. Rarely a foreign body is incorporated in the mass.

Distal obstruction of colon

Acute appendicitis can result form an obstructing colon carcinoma, usually of the right colon.

Bacteriology

Cultures from inflamed appendices usually reveal that the infection is mixed and there is hardly a pyogenic organism which has not been isolated from such specimens. The most common organisms are a mixture of Echerichia coli (85%), entercoci (30%), nonhemolytic streptococci, anaerobic streptococci, together with clostridium welchii (30%) and bacteroids. In most instances the infecting organisms are normal inhabitants of the lumen of the appendix. The foul odour of exudates associated with perforated appendix is caused by anaerobic streptococci or anaerobic bacilli and not by E.coli.[11]

Pathology

It is of great importance to recognize two types of acute appendicitis

a. Non-obstructive (catarrhal) acute appendicitis:

The inflammation usually commences in the mucous membranes, less often in the lymph follicles and can terminate in one of the following ways:

- Resolution
- Ulceration
- Suppuration
- Fibrosis
- Gangrene

Non-obstructive appendicitis may progress slowly and protective barriers form and the resulting peritonitis is localized. In many instances, the infection

never progresses beyond the mucous lining. But although the attack passes off, it is unlikely that a status quo ante is ever regained. Because the tip suffers most, fibrosis usually occurs therein and a shrunken tip is a classical finding in recurrent appendicitis.

b. Obstructive acute appendicitis

About two thirds of the cases belong to this group. The obstruction can be :

- In the lumen - fecolith, foreign body, parasites
- In the wall - inflammatory, direct occlusion by carcinoma of caecum.
- Outside the wall - adhesions and kinking.

Fecolith is the most common cause of all these. In obstructive appendicitis the inflammatory products pent up so that the inflammation proceeds more rapidly and more certainly to gangrene or perforation (usually 12 - 18 hours).[12]

Morphology

Initially the only sign is dilated vessels on the serosal aspect of the appendix. The distal segment then dilates and may contain purulent material. As inflammation spreads through the wall, a patchy purulent exudates appears on the serosal surface. The appendix later becomes soft violaceous and haemorrhagic with developing necrosis culminating in gangrene and perforation.[13]

Microscopy

This histologic criterion for the diagnosis of acute appendicitis is neutrophilic infiltration of the muscularis.[13]

- In the early stages there is only scant transmural infiltrate of neutrophils and a modest perivascular neutrophilic infiltrate. The inflammatory reaction transforms the normal glistening serous into a dull, granular, red membrane. This transformation signifies early acute appendicitis for an operating surgeon.
- At a late stage, a prominent neutrophilic exudates generates a fibrinopurulent reaction on the serosa. As the inflammatory process worsens, there is abscess formation within the wall along with ulcerations and foci of suppurative necrosis in the mucosa. This stage constitutes acute suppurative appendicitis.
- Further appendiceal compromise leads to large areas of haemorrhagic green ulceration of the mucosa and green black gangrenous necrosis. The necrosis extends through the wall into the serosa creating acute gangrenous appendicitis, which is quickly followed by rupture and suppurative peritonitis.

Complications

- Perforation of appendix leads to generalized peritonitis.
- Localized abscess formation.
- Abscesses may perforate into rectum or vagina.
- Fistula between the appendix and bladder or elsewhere in the gastrointestinal tract.
- In women the end-result of perforation of the appendix can be tubal adhesions and infertility.

- Occasionally, vessels in mesoappendix can become infected and thrombosed. The thrombosis may propogate into larger vessels and if infected clot reaches the liver, hepatic abscess ensues.

Chronic appendicitis

Chronic appendicitis is a controversial entity often referred to as a grumbling appendix. A small shrunken appendix with fibrous obliteration of the lumen and atrophy of the lymphoid tissue might suggest previous attacks of inflammation. But such findings are as common in symptom less population as well. Histology reveals lymphocytes and plasma cells throughout the wall, in the absence of neutrophil polymorphs. It is a rare finding.

Obstructive appendicopathy

Often there is a strong history of appendicular pam and a normal appendix. However, close inspection can reveal narrowing or obstruction of lumen by a fecolith or foreign body. Alternatively, the lumen may be distended by packed fecal material. Either of these features may be the cause of symptoms and subsequent colicky pain known as obstructive appendicopathy.

OTHER FORMS OF APPENDICITIS

1. **Tuberculous appendicitis :** This is seen as part of tuberculosis of the ileocaecal region. The pathology is similar to tuberculosis at any other site.

2. **Crohn's disease of appendix :** Crohn's disease limited to the appendix is rare, although it can predate disease at distant sites. It is a common finding as part of terminal ileal Crohn's disease. [14]
3. **Ulcerative colitis in the appendix :** The mucosa of the appendix is inflamed is about 50% of the cases with total colitis. As the disease is confined to the mucosa it is asymptomatic and none of the normal complications of appendicitis arise.
4. **Granulomatous appendicitis :** Occasionally granulomas are found In the resected appendix but of unknown aetiology.
5. **Miscellaneous forms of appendicitis :** Appendicitis can occur due to actinomycosis, yersiniosis, schistosomiasis. Appendicitis may be a complication of amoebic dysentery, strongyloidiasis, balantidium infection and pinworm infestation. A case of acute appendicitis due to foreign body migration i.e., IUCD migration was demonstrated in a study.[15]

Polyarteritis nodosa can present as acute appendicitis. In women, endometriosis may be found in conjunction with appendicitis.

CLINCIAL FEATURES

Age

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.[8] After middle age the risk of developing appendicitis in the future is quiet small.

Incidence

The incidence of appendicitis is equal amongst males and females before puberty. In teenagers and young adults the male: female ratio increases to 3 : 2 at the age of 25 years and thereafter the greater incidence in males declines. A study concluded that appendicitis is common with a life time occurrence of 7%.[1]

Distribution

Appendicitis is most frequently observed in North America. The British Isles, Australia, New Zealand and among white South Africans. It is rare in most of Asia, Central Africa and among and Eskimos. The distribution rather than genetically.

The classic history and physical findings of nonperforating appendicitis follow a reasonably consistent pattern. There is no other common situation where clinical features, accurate diagnosis and immediate decision are of such importance. The clinical features progress in the following manner.

1. Anorexia
2. Mild to moderate, poorly localized midabdominal pain.
3. Nausea and vomiting.
4. Pain migrating to right lower quadrant (RLQ)
5. Localised tenderness or guarding over the appendix.
6. Muscular rigidity or peritoneal signs in the RLQ.
7. Fever and leucocytosis which mayor may not occur

The events typically occur in this order in acute appendicitis. Murphy's syndrome: sequence of pain, vomiting, fever.

1. Anorexia

Anorexia has been stated by many authors to be essential in the diagnosis of appendicitis. Return of appetite is not a reliable sign in excluding the diagnosis of acute appendicitis.

2. Abdominal pain

Pain is the chief symptom of acute appendicitis and typically follows the anorexia. When the pain begins suddenly in the right lower quadrant (RLQ) and is severe, with signs of rebound pain at the onset, it is unlikely that appendicitis is the cause. Classically, the initial pain is centered over the mid abdomen. Over a variable period of time which can be as little as 4 to 6 hours to as long as 24 to 48 hours the pain migrates to the RLQ and remains there.[11] This shift in pain occurs when the inflammation has spread to the serosal coat of the appendix and local peritonitis is present. Knowledge of the most common anatomic positions of the appendix will lead to recognition in alterations of pain pattern and location.

3. Nausea and vomiting

Distension and obstruction of any luminal structure will produce nausea and vomiting. Nausea and vomiting are thought to occur less commonly with retrocaecal and retroileal appendicitis. Vomiting may be more prominent in children.

4. Constipation or diarrhea

As appendicitis progresses, an ileus may develop leading to constipation or at least decreased frequency of the normal bowel habit. Diarrhea in contradiction,

is not a common component, except in patients with missed appendicitis and postileal appendix. Diarrhoea may be more common in children than in older patients.[16]

5. Urinary symptoms

Dysuria can occur in pelvic appendicitis. An inflamed appendix in contact with the bladder may calise frequency of micturition.

6. Pyrexia

Fever is usually only 99°F and 100°F. Fever in excess of 102° F is usually but not always associated with perforated appendicitis. Usually it is associated with tachycardia.

Peritoneal signs

a. Pointing test

When patient is asked to point the site of pain, it usually corresponds with the site of localized tenderness in McBurney's point i.e., at the junction of lateral third with medial two thirds of the spino-umbilical line (McBurney' s sign)[17]

b. Rovsing's sign

Palpation in the left iliac fossa may produce pain in the right iliac fossa.[18]

c. *Dunphy's sign*

When the patients cough vigorously and hold his or her RLQ or refuses to cough because of pain, RLQ peritonitis is confirmed.

d. Blumberg's sign (Release sign)

Rebound tenderness in the RLQ suggests localized peritonitis.

e. Psoas test

A retrocaecal appendix lies on psoas major muscle. Inflammation of this causes irritation of psoas major which is concerned with flexion of hip joint. The patient is turned to the left and the right thing is extended. This initiates pain.

f. Cope's obturator test

Flexion and internal rotation of hip in a patient with pelvic appendicitis initiates pain as it lies over obturator internus muscle.

g. Baldwin's sign

A hand is placed over the right flank and patient is asked to raise the right lower limb with knee extended. In retrocaecal appendicitis this initiates pam.

h. Ligat's sign

Hyperesthesia in Sherren's triangle (this is formed by lines joining the umbilicus, right anterior superior iliac spine and symphysis pubis) is an occasional but inconstant accompaniment of gangrenous appendicitis.

Clinical outcome of acute appendicitis

1. Resolution
2. Gangrenous appendicitis

3. Perforation leading to generalized peritonitis
4. Appendicular mass or abscess formation
5. Fibrosis

SPECIAL FEATURES

A. According to positions

1. Retrocaecal appendicitis

Rigidity is often absent in retrocaecal appendicitis. Psoas test and Rovsing's sign are positive. This may produce flank or back pain.

2. Pelvic appendicitis

Irritation of bladder (strangury) and the rectum (passage of mucus per anum and tenesmus) can be present. Presence of Rovsing's sign and psoas test confirms the diagnosis. Rectal examination shows tenderness. Pain may be present in suprapubic region.

3. Post ileal

Although this is rare, it account for some of the cases of missed appendix. Pain may not shift, diarrhea is a feature, marked retching and tenderness is ill defined. May produce testicular pain.

4. Maldescended (subhepatic)

Tenderness is in the subhepatic region. It is sometimes mistaken for acute cholecystitis.

B. According to age

1. In infants

In infants under 36 months of age the incidence of perforation is over 80 per cent and mortality is higher. The constitutional disturbances are more. High fever, vomiting and diarrhea are the features. Rapid onset of diffuse peritonitis is due to the fact that greater omentun is comparatively short and underdeveloped.

2. In pregnancy

In pregnancy the appendix shifts to the upper abdomen, thus favouring peritonitis. Change in position occurs according to climatric of pregnancy.[19] As the pregnancy advances, the pain becomes higher and more lateral. Microscopic examination of urine specimens will help to exclude pyelonephritis. There is high risk of fetal death i.e. about 10 to 35% if perforation occurs.

3. In the obese

Obesity can obscure and diminish all the local signs. It is safe to operate in these cases rather than miss a gangrenous appendix.

4. In the elderly

Gangrene and perforation occur much more frequently in elderly patients. Elderly patients with lax abdominal wall or obesity may harbour a gangrenous appendix with little evidence of it[8] these features coupled with coincident medical conditions produce a much higher mortality for acute appendicitis in the elderly.

SCORING SYSTEMS FOR ACUTE APPENDICES

Despite advances in other diagnostic modalities, appendicitis remains a diagnosis based primarily on history and physical examination. A study evaluated the performance of 10 different diagnostic scoring systems for acute appendicitis.[20] The scoring system was applied to a data base of 1254 patients to compare the patients scoring result with published data. The author's believed that an adequate scoring system should fulfill the following criteria.

- A negative appendectomy rate less than 15%
- A perforated appendix rate less than 35%
- A missed perforation rate less than 15%
- A missed appendicitis rate less than 5%.

Alvarado followed up patients admitted to surgical unit at the Nazareth Hospital in Philadelphia with suspected acute, appendicitis until surgery confirmed or refuted diagnosis. Alvarado found that eight criteria had high diagnostic accuracy for acute appendicitis.[21] These criteria were grouped as :

1. Migration of pain
2. Anorexia
3. Nausea, vomiting
4. Tenderness right iliac fossa.
5. Rebound Pain
6. Raised temp. (≥37.3°C)
7. Leucocytosis
8. Shift to left in lecocyte count (neutrophil ≥ 75%)

Kalen M proposed modified Alvarado score and conducted a prospective study on evaluation of modified Alvarado score in diagnosis of acute appendicitis.[4]

The elements of modified Alvarado score were :

1. Migration of pain
2. Anorexia
3. Nausea/vomiting
4. Tenderness in right iliac fossa
5. Rebound tenderness
6. Temperature ≥ 37.3°C
7. WBC count ≥10x10 9/L

INVESTIGATIONS

Laboratory studies

Laboratory studies demonstrated acute phase reactants to be elevated secondary to acute inflammation.

- C-reactive protein (CRP)
- Total white blood cell (WBC) count
- Differential count

C-reactive protein has been studied and correlated with clinical and pathological findings. In general it is not a clinically useful laboratory study because it is non-specific.

The leucocyte count is usually elevated above 12,000 cells/mm^3 on differential count usually there is increase in percentage of neutrophils, the left shift with a normal leucocyte count supports clinical diagnosis of acute appendicitis. A completely normal leucocyte count and differential count is uncommon in patients with appendicitis, but it can be seen.[18]

Plain film radiography

Imaging of acute abdomen has traditionally begun with plain film radiography. However, the usefulness of routine plain films has been called into question.

Plain film findings become more distinctive after perforation, while clinical findings subside or simulate other disease. Abnormalities are seen in <50% of cases. In a study, three examples of pneumoperitoneum associated with a perforated appendix and found about 40 published reports of this condition.

The signs on plain film radiography are : [22]

1. Fluid levels localized to the caecum and to the terminal ileum.
2. Localized ileus with gas in the caecum, ascending colon or terminal ileum.
3. Increasing soft-tissue density in right lower quadrant.
4. Blurring of the right flank stripe.
5. Fecolith in the right lower quadrant in 7 to 15% of cases.
6. Blurring of psoas shadow on the right side.
7. A gas filled appendix.
8. Free intraperitoneal gas in 33% of perforations.
9. Deformity of the caecal gas shadow.

Barium enema

Smith and associates have enumerated the radiologic signs of appendicitis after barium enema as:[23]

1. Persistent non-visualization of the appendix.
2. Partial visualization of the appendix.
3. Pressure defect on the caecum.
4. Irritability of the caecum and terminal ileum on screening.

Imaging

The goal of an imaging study as a diagnostic aid in acute appendicitis should be to differentiate presence of disease in those with inflammation, without perforation and with equivocal clinical findings. In addition it should be quick, relatively noninvasive and accurate in those groups at highest risk of complication if perforation should occur. It should be free of interobservor variability, easily reproducible and easily obtained at any hour. Ideally, imaging should reveal inflammation of the appendix when it is located at an anatomically troublesome site to evaluate via clinical examination.

Ultrasonography

Graded compression ultrasonography was done using 3.5 MHz, 5MHz or 7.5 MHz linear array transducers according to the situation. Some investigations have reported seeing normal appendices on a sonogram.[24] The normal appendix is compressible with wall thickness of less than or equal to 3 mm. The size of an appendix can differentiate normal from an acutely inflamed appendix.

The sonographic hallmark of appendicitis is direct visualization of the inflamed appendix. The typical appearance is that of concentrically layered, almost incompressible, sausage like structure demonstrated at the site of maximum tenderness.[25] The usual findings are:

- Visualization of noncompressible appendix as a blind-ending tubular aperistaltic structure.
- Target appearance of ≥6mm in total diameter on cross section / maximal mural wall thickness ≥2mm.
- Diffuse hypoechogenecity (associated with higher incidence of perforation).
- Lumen may be distended with anechoic/hyperechoic material.
- Loss of wall layers.
- Visualization of appendicolith
- Localized peri appendiceal fluid collection
- Prominent hyperechoic mesoappendix / peri caecal fat.

If the inflamed appendix becomes non-tender on pressure, one should consider a diagnosis of spontaneous resolving appendicitis. Many clinical look alikes of appendicitis can be demonstrated reliably by ultrasound. The most frequently encountered is the newly described bacterial ileocaecitis caused by yersinea, campylobacter or salmonella. Second in frequency are gynaecological conditions such as ovarian cysts, ectopic pregnancy, adnexal torsion and tubo ovarian abscess. Other ultrasonically detectable alternative conditions are caecal and sigmoid diverticulitis, cholecystitis, perforated peptic ulcer, Crohn's disease, urological conditions, small bowel obstruction and caecal carcinoma.[26]

A false positive diagnosis is possible in patients with perforated peptic ulcer, sigmoid diverticulitis or Crohn's disease because in these conditions, the appendix may be relatively thickened due to adjacent extrinsic inflammatory disease.

Conversely recent radiotherapy, primary bacterial peritonitis and peritonitis secondary to peritoneal dialysis may render the appendix ultrasonically invisible.[27] The most important reason for a false negative ultrasound examination is overlooking the inflamed appendix. In experienced hands the inflamed appendix can be visualized in 90% of patients with non-perforated appendicitis, 85% of those with an appendiceal mass and in 55% of those with free perforation of the appendix. Peritonism preventing graded compression probably accounts for the limited success in patients with appendiceal perforation.[3] In addition air filled dilated bowel loops from adynamic ileus may hide the appendix from view.

Colour Doppler ultrasound findings

- Increased conspicuity (increase in size + number) of vessels in an around the appendix (hyperemia).
- Decreased resistance in arterial waveforms.
- Continuous/pulsatile venous flow.

A study has demonstrated that acute appendicitis is accompanied by inflammatory hypervascularity reflected as an increased number of colour signals and higher diastolic Doppler shifts as compared with those found in norma1.[28] No Doppler shifts are identified in areas of appendiceal ischemia.

Computed Tomography

If even after repeated examination, it is neither possible to confirm appendicitis nor to demonstrate an alternative condition, the result of the ultrasound examination is equivocal. In these cases computed tomography (CT) has been advocated as the imaging test of choice, especially if they are obese.[29] However, CT has its major importance in patients with suspected appendiceal mass.

In a study comparing CT with ultrasonography, Balthazar and colleagues concluded that CT is the test of choice except in children or women in their first trimester of pregnancy.[29] Higher sensitivity, accuracy and negative predictive value were seen with CT scan. However, CT scan is associated with greater cost, exposure to ionizing radiation and exposure to contrast agents.

Magnetic Resonance Imaging (MRI)

Although it is firmly established as the imaging modality of choice for the central nervous system and musculoskeletal system, MRI evaluation of the acute abdomen has not enjoyed similar widespread use. With the refinements in US and CT technique, MRI currently plays a negligible role in the workup of the acute abdomen. The lack of ready availability, high costs, substantial image degradation with bowel and respiratory motion and the presence of cardiac pacemaker have contributed to its lack of widespread use.

A study on 60 patients have found that MR imaging is superior to sonography in revealing suspected acute appendicitis.[30] Also they have concluded that MR imaging can be used after suboptimal or non-diagnostic sonography is cases of suspected acute appendicitis.

Diagnostic Laparoscopy

Although directly visualizing the appendix might be a valid method of determining acute appendicitis, patients with a normal appendix would be exposed to the risks and costs of general anaesthesia and diagnostic laparoscopy. For this reason, it is not preferred as a diagnostic tool. During diagnostic laparoscopy for suspected acute appendicitis, if no other pathology is identified, the appendix is removed regardless of gross appearance. This both rules out inflammation by pathological examination and makes the diagnosis of acute appendicitis unlikely if the patient complains of similar pain in the future.

Radioactive isotope imaging

Patient's leukocytes can be labeled or tagged with a radioactive isotope. After reinjection, these leucocytes can be detected in an inflamed appendix on scanning. Technetium - 99 and Indium - 11 have been used.[31] The method was shown to be unreliable in diagnosing appendicitis in women. So it may need to be supplemented with an ultrasound scan to exclude gynaecological disease.

Although advancements have been made in laboratory analysis as well as imaging via ultrasonography and CT, nothing can replace careful evaluation by an experienced surgeon. Appendicitis remains a diagnosis based primarily on history and physical examination. Further studies are useful adjuncts in atypical cases which are more likely to occur in the very young or very old and most cost effective when ordered by the surgical consultant.

Acute appendicitis is most common cause of acute abdomen, although many patients have a classical presentation as described by Fitz, allowing prompt diagnosis and treatment some patients have typical and confusing presentations leading to misdiagnosis.

In a study Julien Pylaert described the value of grades compression sonography for examination of appendix. [5]

A study, experience with diagnostic ultrasonogrphy in 525 patients with suspected acute appendicitis was analysed.[32] They found that ultrasonography has higher accuracy and also reduces the number of negative appendectomies. The study has emphasized that ultrasonography does not replace the clinical diagnosis, but compliments it.

A comparative study of clinical judgment and diagnostic ultrasonography in diagnosis of acute appendicitis; experience with a score aided diagnosis was carried out on 148 patients.[33] They found that clinical judgment of junior surgeons was disappointing and diagnostic ultrasonography performed poorly as a routine procedure. So they suggest that an up to date scoring system might help in diagnosis of acute appendicitis.

Diagnostic scores are useful and easy methods which help in surgical decision. Their objective is to reduce a number of negative appendectomy. A study which evaluated ultrasonography and clinical diagnostic scoring in suspected appendicitis, stated that ultrasonography performed by trained radiologist is a valuable aid in differential diagnosis of appendicitis and when used with a classical scoring system it improves the results.[34] The reliability and non-invasive nature of ultrasonography argues that it should be taken in to account in computer-aided decision supports system to be designed in future.

The Alvarado score was described in 1986 which later on modified to modified Alvarado score. In a comparative study of ultrasound and Alvarado score for diagnosis of acute appendicitis the author found that neither one is significantly advantageous.[35] But additional information provided by ultrasonography is useful.

In a randomized controlled trial of ultrasonography in diagnosis of acute appendicitis; in cooperating Alvarado score, the author suggested diagnostic protocol incorporating the Alvarado score was, if anything, safer, faster, more accurate than graded compression sonography alone.[36]

A study, continuing diagnostic challenge of acute appendicitis, evaluation though modified Alvarado score carried out on 106 patients and they found that high scores in men and children were an easy and satisfactory aid in the early diagnosis of acute appendicitis.[37]

In a study, Prospective evaluation of modified Alvarado score for diagnosis of acute appendicitis the author concluded that high modified Alvarado score is a dependable aid in early diagnosis in men and children.[38] The selective sue of ultrasonography especially in female reduce the number of negative appendectomies.

The study was conducted for appraisal of modified Alvarado score for acute appendicitis in adults, this study was a retrospective study.[39] The author found modified Alvarado scoring system not sufficiently sensitive mode of diagnosis of acute appendicitis in adults further requirements needed to improve sensitivity and specificity.

One more retrospective study done for comparison of clinical judgment vs the modified Alvarado score in acute appendicitis.[40] The author found clinical judgment of accident emergency doctors superior to use for modified Alvarado score. But the author also suggested the need of a prospective study to evaluate modified Alvarado score.

DIFFERENTIAL DIAGNOSIS

A consideration of other causes of right lower quadrant pain and their subtle differentiation from appendicitis is helpful.

Acute appendicitis can mimic virtually any intra-abdominal process and therefore to know acute appendicitis is to know well the diagnosis of acute abdominal pain. Familiarity with the following disease entities directs the surgeon during questioning and examination.

I. Systemic conditions or infectious conditions

1. Influenza.
2. Diaphragmatic pleurisy.
3. Spinal disease (eg. Osteomyelitis)
4. Typhoid.
5. Acute porphyria.

II. Minor abdominal disturbances

1. Gastritis.
2. Bilious attack.
3. Indigestion.
4. Colic.

III. Common abdominal or retroperitoneal conditions

When the local signs and symptoms of the appendicitis are well developed (pain, tenderness, hyperaesthesia, rigidity) there are very many conditions for which it may be mistaken, and which have to be excluded.

To catalogue the disease which may simulate or be simulated by appendicitis is to enumerate all the chief acute abdominal diseases. This is obviously of little practical value. It will be better therefore, to give only the more common conditions causing misdiagnosis and to group them according to the position of the appendix.

1. **The ascending appendix (retrocaecal or paracaecal)**
    - ❖ Cholecystitis
    - ❖ Pyonephrosis
    - ❖ Inflamed duodenal ulcer
    - ❖ Pyelitis
    - ❖ Perforated gallbladder
    - ❖ Stone in the right kidney.
    - ❖ Hydronephrosis
    - ❖ Torsion of the omentum
    - ❖ Perinephric abscess
2. **Iliac position of appendix**
    - ❖ Leaking duodenal ulcer
    - ❖ Inflamed Meckel’s diverticulum
    - ❖ Crohn's disease
    - ❖ Psoas abscess

- ❖ Caecal or ileocaecal carcinoma
- ❖ Tuberculous hip disease
- ❖ Tubercular ileocaecal glands
- ❖ Rupture of rectus muscle
- ❖ Stone in ureter
- ❖ Simple ulcer of the caecum
- ❖ Yersinia infections.

3. Pelvic position of appendix

- ❖ Intestinal obstruction
- ❖ Perforation of a typhoid ulcer
- ❖ Diverticulitis with abscess
- ❖ Gastroenteritis

In Women

- ❖ Ectopic gestation
- ❖ Salpingitis
- ❖ Twisted pedicle of an ovarian cyst or of a hydrosalpinx
- ❖ Ruptured follicular cyst (Mittelschmerz)
- ❖ Rupture of a pyosalpinx
- ❖ Ruptured corpus luteum cyst

Before diagnosing appendicitis in tropical countries one would also have to exclude:

- ❖ Amoebic typhilitis
- ❖ Leaking liver abscess
- ❖ Hepatitis
- ❖ Malaria

When the local manifestations have spread widely and the patients first comes under observation with generalized peritonitis, it is necessary to distinguish the condition from all the various causes which may lead to such a pathological picture.

Late cases with extensive peritonitis must be distinguished from :

1. Acute intestinal obstruction
2. Thrombosis or embolism or mesenteric vessels.
3. Acute pancreatitis.
4. Pneumococcal peritonitis.
5. Pylephlebitis.
6. General peritonitis (perforated gastric, duodenal, typhoid ulcers)

Disorders of the male reproductive tract

The physician must remember to perform a thorough genital examination and search for hernias on the disrobed patient.

a. Seminal vesiculitis:

Seminal vesiculitis may produce diffuse lower abdominal pain but typically, without localization. Nausea, vomiting and a high fever and chills may be noted. Rectal examination reveals marked tenderness in the areas of the prostate.

b. Torsion of the testes

Testicular torsion leads to severe pain; similar to renal colic. Vomiting often occurs. When this diagnosis is missed, it is generally because of omission of the testicular examination. Contusion or tumour of the testicle can present with apparent RLQ pain, but the physical examination should quickly sort out the real cause.

c. Epididymitis

The hemiscrotum is usually very tender and the inflamed epididymis can readily be palpated.

Malingering

A malingering patient often presents with recurrent vague or even localized abdominal pain. The symptoms tend to be chronic and recurrent. Subtle maneuvers to elicit true RLQ tenderness (like the use of the palpatory stethoscope, mentioned above) may uncover the malingerer. Recurrent abdominal pain in the child may be a vexing problem and in the absence of objective findings or laboratory analysis, a search for a social problem is appropriate.

SPECIAL SITUATIONS

Appendicitis in the very young

Fewer than 2% of all children treated for appendicitis are younger than 3 years old. In this group, appendicitis is a more serious disease than in adolescents because the perforation rate is high.[41] Since gastroenteritis is also common, loose stools add confusion to the picture. The best assessment of tenderness is revealed in the child's face rather than thorough palpation and repetitively asking where it hurts most.

Localized RLQ tenderness is often not ascertainable. Children commonly have diffuse abdominal pain without the appendix being perforated. Rectal examination in children tends to be traumatic and usually does not offer much in diagnostic yield.

Abdominal plain radiographs may be helpful in the young child and infant. If a fecolith is identified in the proper clinical setting, it is generally pathognomonic. Free air associated with perforative appendicitis is a rarity (reported 0% to 7%) and should not be sought.

Appendicitis in the elderly

Appendicitis in the elderly is a more serious disorder when compared to other age groups. Fortunately, the prevalence of the disease among the aged is low and is about 5% in persons greater than 60 years of age. Recollection for the details in the history may be impaired because of failing memory. Often the patients ascribe their symptoms to chronic disease .The elderly, for a variety of reasons may have a blunted response to infection, resulting in lack of fever or leukocytosis. Radiographs often disclose an ileus or obstructive pattern. The surgeon faced with indolent, atypical symptoms in patients with other medial problems is hesitant to intervene. The barium enema and especially ultrasonogrpahy may have their greatest use in these perplexing patients.

Appendicitis in pregnant women

Acute appendicitis is the most common extra uterine surgical emergency with a reported incidence of 0.38 and 1.41 per 1000 pregnancies; however, the actual incidence of appendicitis is not increased. Diagnosis is more difficult, especially after the first trimester. The diagnosis of acute appendicitis in pregnancy is further complicated by the alteration in location of the caecum and appendix. After the third months of gestation the appendix begins to be displaced above McBurney's point. In general, there is a counterclockwise rotation, with the

tip of the appendix being displaced cephalad. A useful sign may be to roll the patient on her left side. If the pain shifts, it is more likely to be appendicitis.

The best rule is to treat the patient as if she were not pregnant. Once perforation occurs, labor may ensue, resulting in prematurity or fetal demise. Peritonitis leads to increased fetal loss.[42]

Postoperative Appendicitis

Acute appendicitis, which occurs within a short period of time after another abdominal operation, is rare and difficult to diagnose. Normally administered narcotics may alter pain recognition. Antibiotics may inhibit the inflammatory response. Because of these difficulties in diagnosis, some surgeons advocate routine incidental appendicectomy.

Chronic appendicitis

Appendiceal luminal obstruction resulting from a soft fecolith or lymphoid hypertrophy may resolve spontaneously. Whether this occurs and leads to chronic or recurrent appendicitis is controversial. In these situations the history may be atypical, the physical findings mild and improving, and laboratory data normal. These patients are often discharged with a diagnosis of mesenteric adenitis or a viral syndrome. Weeks, months, or years later the symptoms may recur. The temptation to remove the appendix for the reason of chronic appendicitis should be resisted. Some patient's conditions are improved by appendicectomy, and pathologic examination of the organ reveals fibrosis and chronic inflammation. No clear guidelines are available for the management of patients who fall into this category. Mucoceles of the appendix, on the other hand, will often present with a vague history of chronic lower abdominal pain. This process with a vague history

of chronic lower abdominal pain. This process is characterized by accumulated mucous in a distended appendix. Mucosal hyperplasia can lead to mucocele formation, with obstruction of the lumen and distention of the appendix and resultant pain. Pressure within the lumen then may overcome the obstruction leading to discharge of the mucus into the colonic lumen with relief of pain. Mucoceles are often palpable or easily demonstrated with ultrasonography.

Missed appendicitis

Perforation may occur as soon as 6 hours after the onset of the symptoms of appendicitis, but it usually occurs 24 to 48 hours after symptoms begin. If peritonitis occurs, the patient presents with an acute abdomen. However, the appendix can perforate and be contained by omentum, loops of small intestine, or the retro peritoneum. Typically these patients will present with an obscure history, often having been evaluated in an emergency department and sent home with a diagnosis of gastroenteritis or urinary tract infection.

Confirming the diagnosis is the first task. In these confusing situations ultrasonography, barium enema, and CT may be helpful. If an abscess is identified, management is controversial, and the trend is toward percutaneous drainage and interval appendectomy. This decision is obviously based upon the patient's clinical condition.

ULTRASONOGRAPHY FOR SURGEONS

Diagnostic medical ultrasound may have a brief history, but its roots date back to the early nineteenth century. Over the past 40 years, ultrasound has become an important diagnostic modality.

Ultrasound Physics and Instrumentation

Ultrasound is the sound that has a frequency above the range of human hearing, which is about 20,000 cycles per second or 20 KHz. Diagnostic ultrasound is generated by a vibrating source in a transducer, called the piezoelectric crystal, which is placed on the surface of the skin. The transducer causes molecules in the medium (tissue) also to vibrate. These vibrations are a series of rhythmic mechanical compressions (high pressure regions) and rarefaction (low-pressure region or area of decreased density) moving away from the transducer into the tissue. They are commonly referred to as ultrasound waves. When the ultrasound waves contact an interface of two different media, part of the signal is reflected back and the remainder of the wave continues to propagate deeper into the tissue. By finding the period that has elapsed between the ultrasound production and the echo-reception, the distance from the reflector may be calculated and image formed.

Ultrasound physics terminology

Ultrasound: Mechanised energy transmitted through a medium.

Frequency: It is the number of cycles per second.

106 cycles/second = 1 MHz

Increasing the frequency improves resolution.

Diagnostic ultrasound: 1 to 30 MHz

Essential Principles of Physics

Principle I

Piezoelectric effect

Piezoelectric crystals expand and contract to interconvert electrical and mechanical energy.

Principle II

Pulse - Echo principle

When an ultrasound wave contacts a tissue, some of the signal is reflected back and some is transmitted into the tissue. These waves are then reflected back to the crystals within the transducer, generating an electrical impulse comparable to the strength of the returning wave.

Principle III

Acoustic impedence

Acoustic impedance = Density of tissue x speed of sound in the tissue.

The strength of the returning echo depends on the difference in density between the two structures imaged. Structures of different acoustic impedance (gall bladder and gallstone) are easier to distinguish from each other than those of similar acoustic impedance (liver and kidney).

Ultrasound Terminology

1. Echogenecity
2. Window
3. After shadow

Typical frequencies for various ultrasound applications	
Transducer	**Application**
2.25 MHz	Deep abdominal structures, obese patients, renal arteries
3.5 MHz	General abdominal, obstetrics
5.0 MHz	Neonates, paediatric patients, peripheral vessels
7.5 MHz	Cerebrovascular, breast, testicle.
10 MHz	Ocular imaging, vein mapping, superficial soft tissue.

Mechanical, linear and phased sector array transducers

The mechanical sector transducer is relatively inexpensive and provides excellent image quality. But because of the rapid and constant mechanical sweeping, depreciation occurs more quickly. Currently linear array transducers are more frequently used and have greater longevity. These transducers use in single slab of piezoelectric crystal that is cut into a linear collection of separate pieces called elements.

In contrast, phased array transducers fire all the crystals at nearly the same time. By using a series of delays in the housing, the image may be steered electronically to obtain a sector image. Phased - array transducers are commonly used for cardiac and transcutaneous Doppler imaging.

Doppler ultrasound

During the past 30 years, Doppler ultrasound has developed dramatically from simple hand - held devices to sophisticated color Doppler imaging systems.

Doppler ultrasound is now used to evaluate almost every accessible blood vessel in the body including cerebral, coronary, abdominal visceral and peripheral. Duplex imaging simultaneously provides anatomic information while the Doppler component assesses the function.

Knowledge of the principles of ultrasound physics and instrumentation allows the surgeon to maintain proper ultrasound techniques and obtain the best possible image. Furthermore, when these principles are understood, artifacts and pitfalls of imaging are avoided.

TREATMENT

The correct treatment of appendicitis in all its aspects is one of the most important subjects in abdominal surgery because it is the most common major abdominal condition calling for emergency operation.

The treatment of acute appendicitis is appendicectomy and the sooner it is done, the better.[18] There are four exceptions to this excellent rule :

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

Modalities of treatment

1. Open appendicectomy
2. Laparoscopic appendicectomy.
3. Conservative management.
4. Management of complications.

Incisions for appendicectomy

1. McBurneys: Oblique, muscle splitting incision.
2. Lanz: 4 - 7 cm incision along the lines of Langer's about the level of anterior superior iliac spine.
3. Lower abdominal vertical incisions: Paramedian/midline
4. Pararectus: Disadvantage is that it cuts too much of nerve supply to the rectus muscle.
5. Kammerer or Battle: A short pararectal incision 6 - 8 cm just above ASIS and 1 cm medial to lateral edge of rectus muscle.
6. Davis - Rockey: A transverse right lower quadrant skin incision.
7. Rutherford Morison's incision: An oblique muscle cutting incision which can be extended obliquely upwards and laterally as necessary.

   Useful if the appendix is paracaecel or retrocaecal and fixed.

Procedure of appendicectomy

Abdomen is opened by a grid-iron incision. Caecum is withdrawn and appendix is delivered. Base of mesoappendix is clamped in a hemostat, tied and severed. Base of appendix is crushed and ligated and divided above this. The stump may be invaginated by using the purse string or Z stitch.[43] Many surgeons believe that invaginating the stump is not usually necessary but can cause an abscess to form.

Methods in special circumstances

1. When the caecal wall is edematous, the purse string is in danger of cutting out. So better not to attempt invagination.
2. When the appendix is retrocaecal and adherent, it is an advantage to do retrograde appendicectomy.
3. Drainage of peritoneal cavity if there is considerable retrocaecal space or if there is persistent oozing.
4. A normal appendix found demands careful intraoperative exclusion of all other possible diagnosis, especially Meckel's diverticulitis.
5. An appendicular carcinoid or adenocarcinoma can be found. Small tumours less than 2.0cm in diameter can be removed by appendicectomy whereas larger tumours should be treated by a right hemicolectomy.[44]

Management of a appendix mass

The standard modem treatment IS conservative, I.e. the Ochsner - Scherren regimen.

Conservative management is not merely a postponement of operation nor a substitute for operation but, it is an elective non-operative treatment to be undertaken in special circumstances.[45]

1. Charts: Temperature and pulse rate hourly.
2. Diet: Fluids initially, 30ml by mouth.
3. IV fluids: With fluid balance chart.
4. Drugs: In the initial stages of observation no analgesics are given.

5. Antibiotic therapy: Parenteral ampicillin, gentamycin and metronidazole are given.
6. Bowels: A glycerin suppository if bowels have not opened after 4 to 5 days. No purgatives of any kind.
7. Antithrombo-embolic therapy: Prophylaxis against thrombosis of the pelvic and leg veins should be given with compression stockings and low dose heparin.
8. Mapping the mass and daily assessment.

Criteria to stop conservative therapy

- ❖ Rising pulse rate.
- ❖ Vomiting or copious constant gastric aspirate.
- ❖ Increasing or spreading abdominal pain.
- ❖ Increasing size of the abscess

Laparoscopic appendicectomy

Especially if the organ is normal or only mildly inflamed appendix can be removed laparoscopically.[46] It should not be used when there is peritonitis, or if the diagnosis is in doubt. In skilled hands this may be the procedure of choice for early appendicitis.

Complications of Appendicectomy

Postoperative complications following appendicectomy are relatively uncommon and reflect the degree of peritonitis that was present at the time of operation and intercurrent disease that may predispose to complications. Complications can be immediate or delayed.

Immediate

1. Wound infection occurs in 5 to 10% of cases.
2. Pelvic abscess is likely after removal of a perforated pelvic appendix.
3. Paralytic ileus for a brief period is to be expected.
4. Faecal fistula from the appendicular stump rarely occurs.
5. Pylephlebitis is a rare but very serious complication of gangrenous appendicitis.
6. Venous thrombosis and embolism can occur in elderly and women taking oral contraceptive pill.

Delayed

1. Intestinal obstruction due to a local adhesive band.
2. Right inguinal hernia due to injury to the iliohypogastric nerve.

Appendix Abscess

Failure of resolution of an appendix mass or continued spiking pyrexia indicates that there is pus within the phlegmonous appendix mass. Ultrasound or abdominal CT scan may identify an area suitable for insertion of a percutaneous drain.[47] Should this prove unsuccessful. Laparotomy through a midline incision is indicated.

METHODOLOGY

The present study was conducted in the Department of Surgery, KL.E.S. Dr. Prabhakar Kore Hospital and Medical Research Centre during the period of January 2008 to December 2008.

Study Design

A cross sectional study.

Source of Data

Patients with age group 15-50 years, suspected clinically acute appendicitis and undergone appendicectomy in KL.E.S. Dr. Prabhakar Kore Hospital and MRC Belgaum were selected for the study.

Sample size

75 eligible patients having acute appendicitis who underwent modified Alvarado score evaluation and ultrasonography at K.L.E.S. Dr.Prabhakar Kore Hospital & Medical Research Center Belgaum were selected for the study.

Inclusion Criteria

1) All the patients undergoing appendectomies in KL.E.S Dr. Prabhakar Kore Hospital, Belgaum.
2) Patients in age group between 15 to 50 years

Exclusion Criteria

1) Patients with right iliac fossa mass (Appendicular mass managed conservatively)
2) All patients previously operated for appendicitis.
3) Patients with referred pain to right iliac fossa.
4) Patients with presentation of urological, gynaecological or other surgical problems associated with mass in the right iliac fossa were excluded from the study.
5) Patients who are already enrolled in another study conducted in the hospital during same time period.

Method of collection data

The patients, who were admitted and operated depending on clinical suspicion of acute appendicitis and operated i.e. appendicectomy. The clinical diagnosis of acute appendicitis was done by consultants of Department of Surgery, K.L.E.S. Dr. Prabhakar Kore Hospital and Medical Research Centre, Belgaum based on clinical signs and symptoms.

The patients suspected of acute appendicitis undergo thorough evaluation clinical details, investigation and ultrasonography. Then depending on the clinical details and investigation, they were allotted modified Alvarado score which is as follows.[38]

MODIFIED ALVARADO SCORE	**SCORE**
SYMPTOMS	
Migratory Rt. Iliac fossa pain	1
Anorexia	1
Nausea/Vomiting	1
SIGNS	
Tenderness Rt. Lower quad.	2
Rebound Tenderness Rt. Iliac Fossa	1
Pyrexia >37.3^{0}C	1
INVESTIGATIONS	
Leucocytosis >l0X 10^9/L	2
TOTAL	**9**

Modified Alvarado score more than or equal to 7 are considered acute appendicitis i.e. positive and scores less than or equal to 6 are considered negative. The ultrasonography findings are noted depending upon the findings they were divided in two groups. One is ultrasonography positive and ultrasonography negative.

The appendix specimen is sent for histopathology report and the report is noted. Histopathological diagnosis is considered as final. The modified Alvarado score and ultrasonography findings are compared to histopathology report.

When a positive modified Alvarado score case has histopathological positive report, the cases are considered as true positive and the modified Alvarado score negative cases are considered as true negative.

Histologically negative cases among modified Alvarado score positive cases are false positive and histologically positive cases among modified Alvarado score negative are false negative cases.

From above data sensitivity, specificity, positive predictive value, diagnostic accuracy false negative rates are calculated.

When ultrasonographically positive cases have histopathologically positive report, the cases are true positive and the ultrasonography negative cases with histologically negative cases are considered as true negative.

Histopathologically negative cases among ultrasonography positively cases are false positive cases and histologically positive cases among ultrasonography negative cases are false negative cases.

From above data the sensitivity, specificity positive predictive value, diagnostic accuracy false negative rate are calculated and then compared with that of modified Alvarado score data.

Investigation

The routine pre-operation investigation chart, X-ray, electrocardiogram (ECG) wherever indicated ultrasonography in all the patients.

Hospital ethical committee clearance was obtained before undertaking this study.

The evaluation of modified Alvarado score in diagnosis of acute appendicitis was done below.

Modified Alvarado Score	**HPR (Acute Appendicitis)**	
	Positive	**Negative**
Positive	a (True positive)	b (False positive)
Negative	c (False negative)	d (True negative)

Evaluation of ultrasonography in diagnosis of acute appendicitis was done as below.

Ultrasonography	**HPR (Acute Appendicitis)**	
	Positive	**Negative**
Positive	a (True positive)	b (False positive)
Negative	c (False negative)	d (True negative)

'Diagnostic sensitivity = $\frac{a}{a + c}$ x 100

Diagnostic specificity = $\frac{d}{b + d}$ x 100

Positive Predictive value Test = $\frac{a}{a + b}$ x 100

Negative Predictive value Test = $\frac{d}{c + d}$ x 100

Diagnostic accuracy = $\frac{a + d}{a+b+c+d}$ x 100

False positive error rate = $\frac{b}{b + d}$ x 100

False negative error rate = $\frac{c}{a + c}$ x 100

RESULTS

The present study was conducted in the Department of Surgery during the period of January 2008 to December 2008 on the patients undergoing appendicectomies in K.L.E.S. Dr. Prabhakar Kore Hospital and M.R.C., Belgaum. The observations and results are analysed as below.

Before analysis of data certain assumption were made.

1) Histopathological diagnosis was accepted as the final confirmation of the diagnosis.
2) Ultrasonography was done by radiologist of KLES Dr. Prabhakar Kore Hospital, no significance was attached to inter-observer variations as all radiologist had equally good experience with ultrasonography.
3) Though large number of consultants were involved in clinical diagnosis of acute appendicitis, no significance was attached to the inter observer variation.

Table No. 1 : Sex distribution

Gender	No. of Patients	Percentage
Male	45	60%
Female	30	40%

Total number of cases in this study were 75. Out of 75 patients, 45(60%) were male and 30 (40%) were females.

Graph 1 : Sex Distribution

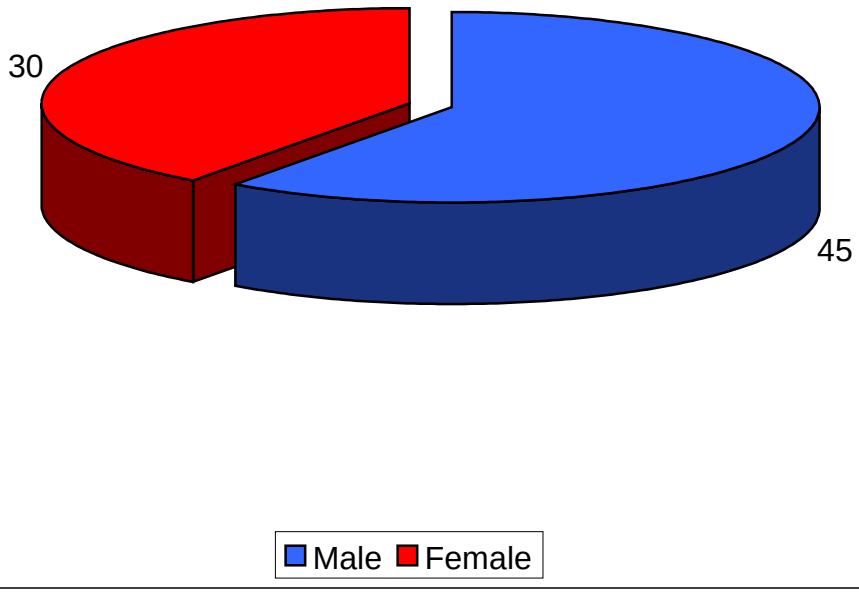


Table No. 2 : Age Distribution

Age in Years	No. of Patients	Percentage
15 to 20	10	13.33%
20 to 30	38	50.66%
30 to 40	24	32%
40 to 50	3	4%
Total	75	100%

In the present study 13.33% patients belonged to 15 to 20years age group. Others were 50.66% patients in 20 to 30 years, 32% in 30 to 40years and 4% patients were in 40 to 50 years each.

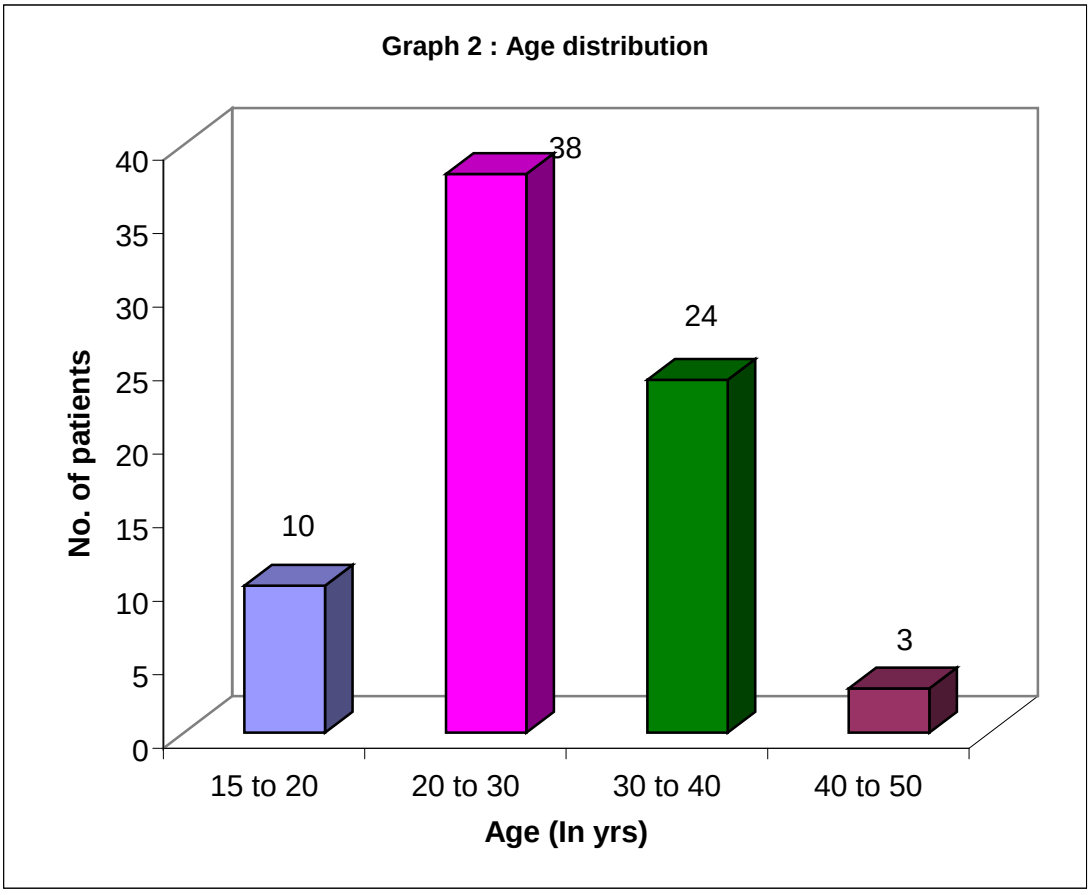


Table No. 3 : Histopathological Findings

Histopathological findings	No. of Patients	Percentage
Positive	29	38.66%
Negative	46	61.33%

Out of all the patients undergone appendectomy, 29 (38.66%) were histologically positive for acute appendicitis and 46 (61.33%) were histologically negative.

Table No. 4 : Modified Alvarado score

Modified Alvarado Score	No. of Patients	Percentage
≥ 7 (Positive)	30	40%
≤ 6 (Negative)	45	60%

All the 75 patients were assigned modified Alvarado score among which 40.00% were positive (≥ 7) and 60.00% were negative (≤ 6).

Table No. 5 : Evaluation of modified Alvarado score

Modified Alvarado Score	Histopathological findings					
	Positive		Negative		Total	
	No.	%	No.	%	No.	%
ñ **7 (Positive)**	22	73.33%	8	26.66%	30	100%
á **6 (Negative)**	7	15.55%	38	84.44%	45	1005

In the present study, out of 30 modified Alvarado score positive cases 22 (73.33%) were histologically positive and 8 (26.66%) were negative. In the remaining 45 modified Alvarado score negative cases 7 (15.55%) were histologically positive and 38 (84.44 %) were negative.

Table No. 6 : Analysis of modified Alvarado score in diagnosis of acute appendicitis

	Percentage
Sensitivity	75.86%
Specificity	82.61%
Positive predictive value	73.33%
Negative predictive value	84.44%
Diagnostic accuracy	80.00%
False positive error rate	17.39%
False negative error rate	24.11%

In the present study modified Alvarado score has sensitivity of 75.86%, specificity 82.61%, positive predictive value 73.33%, negative predictive value 84.44%, diagnostic accuracy 80.00% false positive error rate 17.39% and false negative error rate 24.11%.

Graph 3 : Analysis of modified Alvarado score in diagnosis of acute apendicitis

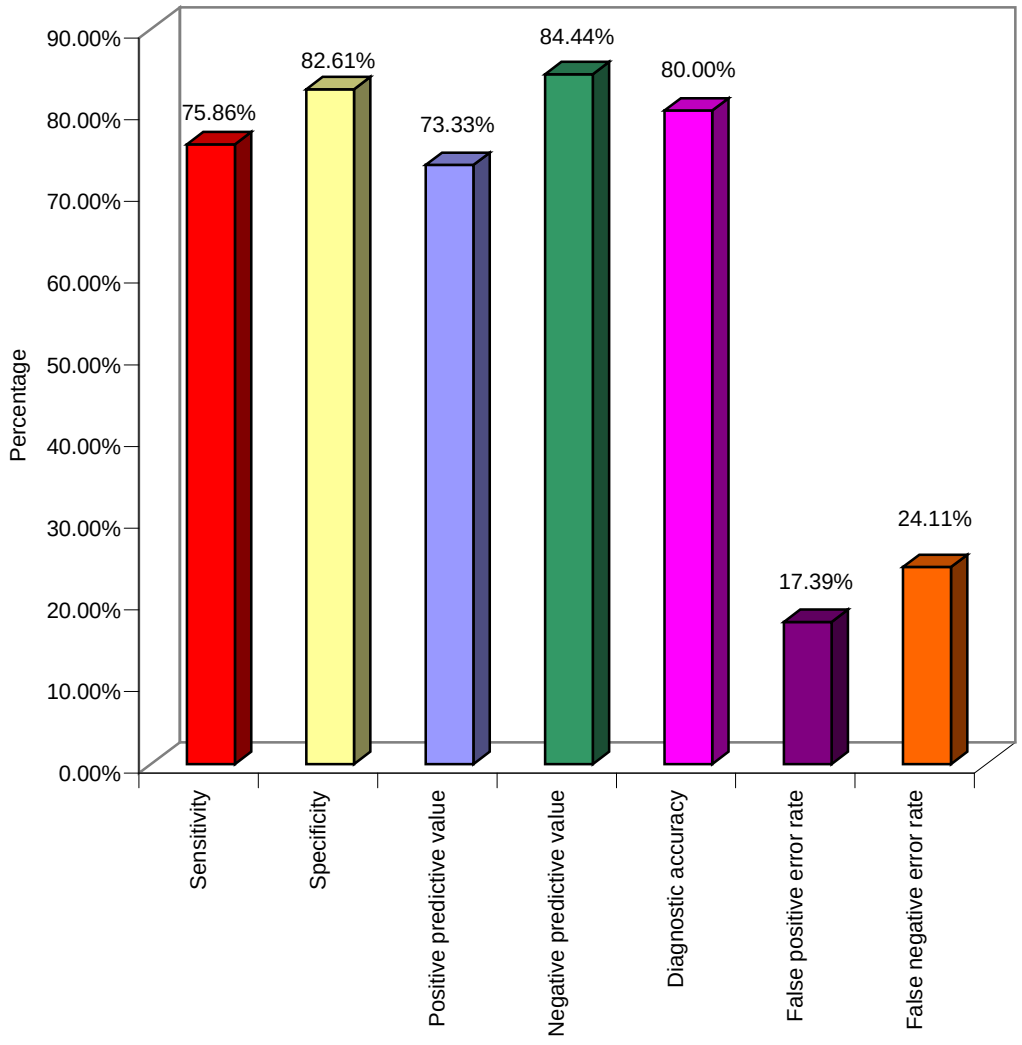


Table No. 7 : Ultrasonography

Ultrasonography	No. of Patients	Percentage
Positive	29	38.66%
Negative	46	61.33%

In the present study all the patients were undergone for ultrasonography. Out of which 29 (38.66%) were sonographically positive cases and 46 (61.33%) were sonographically negative cases.

Table No. 8 : Evaluation of ultrasonography

Ultrasonography	Histopathological findings					
	Positive		Negative		Total	
	No.	%	No.	%	No.	%
Positive	24	82.75%	5	17.24%	29	100%
Negative	5	10.86%	41	89.13%	46	100%

In the present study out of 29 sonographically positive cases, 24 (82.75%) were histologically positive and 05 (17.24%) were negative. In the remaining 46 sonographically negative cases 05 (10.86%) were histologically positive and 41 (89.13%) were negative.

Table No. 9 : Analysis of ultrasonography in diagnosis of acute appendicitis

	Percentage
Sensitivity	82.76%
Specificity	89.13%
Positive predictive value	82.76%
Negative predictive value	89.13%
Diagnostic accuracy	86.67%
False positive error rate	10.87%
False negative error rate	17.24%

In the present study ultra sonography had sensitivity of 82.76%, specificity of 89.13%, positive predictive value of 82.76%, negative predictive value of 89.13%. Diagnostic accuracy of 86.67%, false positive error rate of 10.87%, false negative error rate of 17.24%.

Graph 4 : Analysis of ultrasonography in diagnosis of acute appendicitis

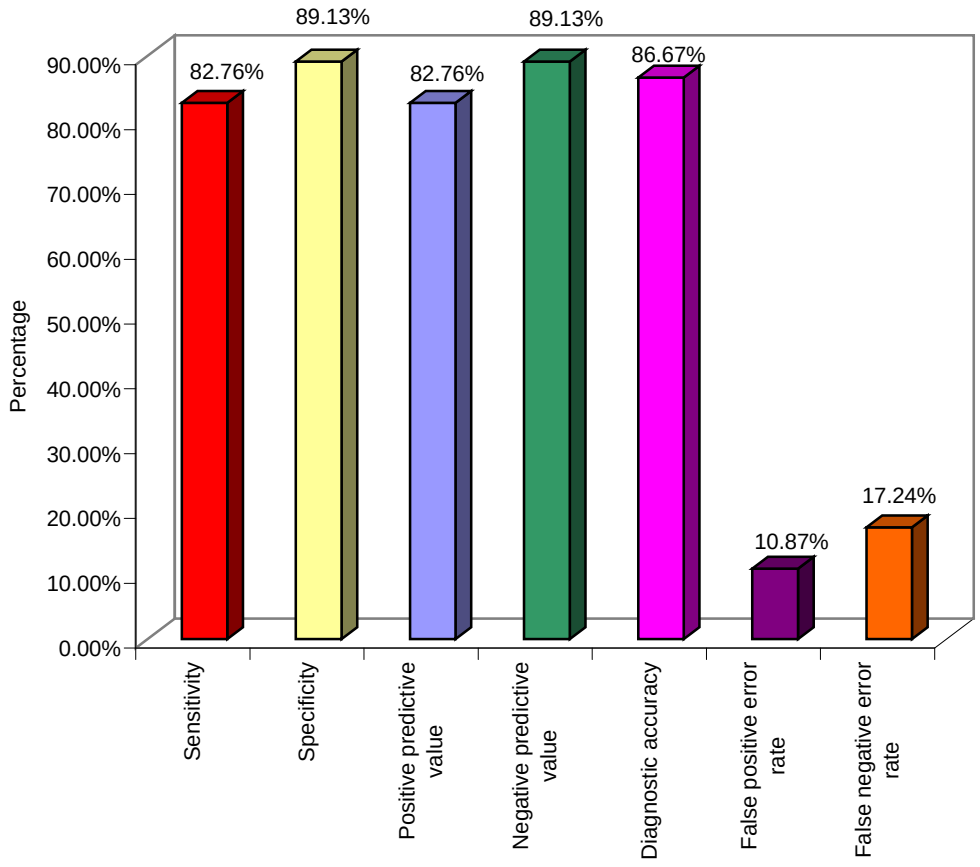
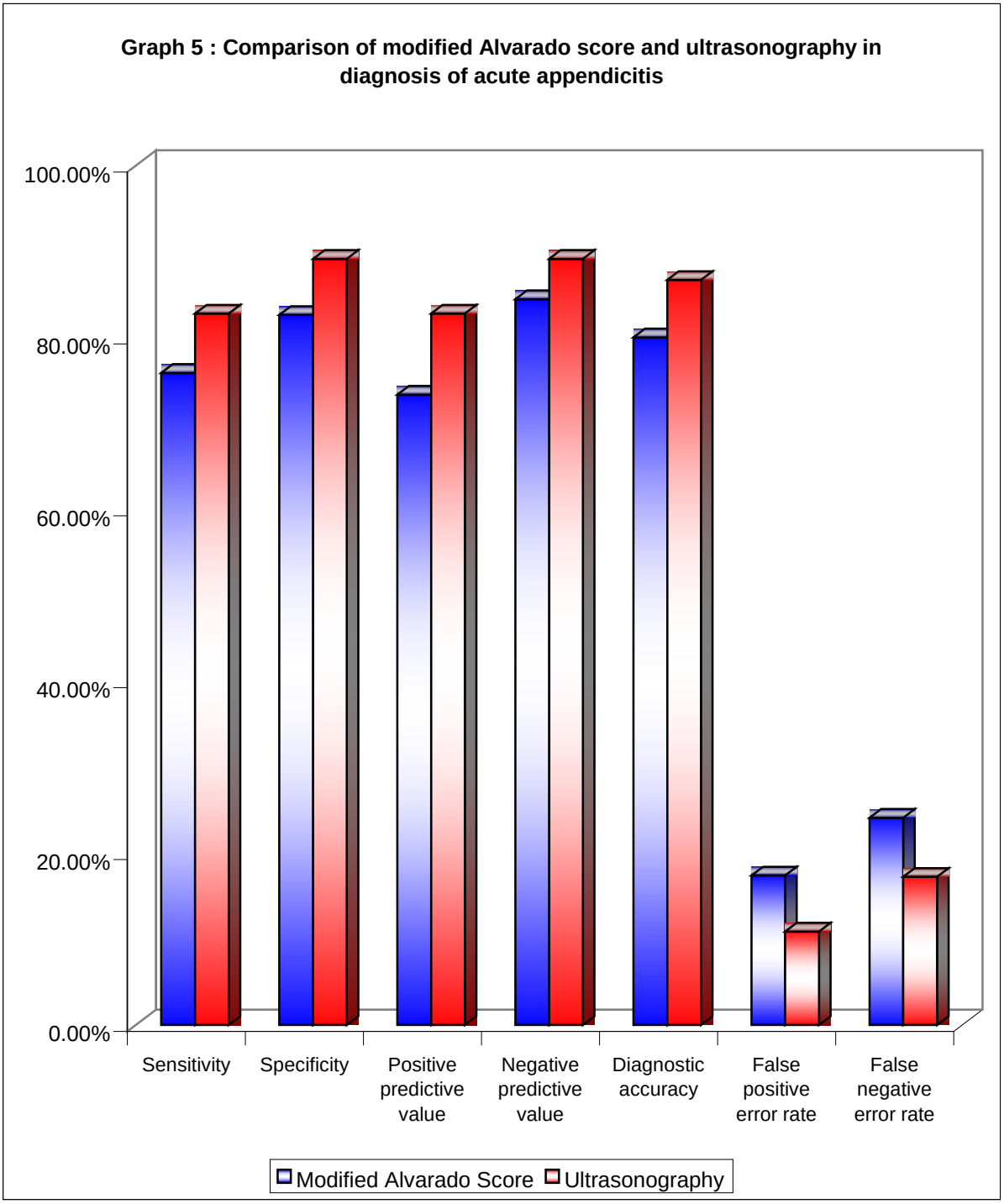


Table No. 10 : Comparison of modified Alvarado score and ultrasonography in diagnosis of acute appendicitis

	Modified Alvarado Score	**Ultrasonography**
Sensitivity	75.86%	82.76%
Specificity	82.61%	89.13%
Positive predictive value	73.33%	82.76%
Negative predictive value	84.44%	89.13%
Diagnostic accuracy	80.00%	86.67%
False positive error rate	17.39%	10.87%
False negative error rate	24.11%	17.24%

In the present study, modified Alvarado score has sensitivity of 75.86%, specificity 82.61%, positive predictive value 73.33%, negative predictive value 84.44%, diagnostic accuracy 80.00% false positive error rate 16.22% and false negative error rate 21.74%. Ultrasonography had sensitivity of 82.76%, specificity of 89.13%, positive predictive value of 82.76%, negative predictive value of 89.13%. Diagnostic accuracy of 86.67%, false positive error rate of 10.87%, false negative error rate of 17.24%. When modified Alvarado score and ultrasonography were positive, 26 true positive cases and no false positive cases. The false negative cases in modified Alvarado score were 7. When it was combined with ultrasonography the false negative cases reduced to three that is 57.14% reduction in false negative cases.

Graph 5 : Comparison of modified Alvarado score and ultrasonography in diagnosis of acute appendicitis



DISCUSSION

The diagnosis of acute appendicitis continues to be difficult due to variable presentation of the disease and lack of reliable diagnostic test. History and clinical examination provide useful information regarding diagnosis but even than different possibilities are there. These days the diagnosis of appendicitis is mainly clinical.

The surgeon is the best person who decides the best management in cost effective manner, of course the more experienced the surgeon is more will be the diagnostic accuracy. But the junior surgeon has to make the initial assessment and decision to operate or no. Thus there is need of a complementary aid in difficult decision. Different diagnostic aids have appeared recently and among these laparoscopy and ultrasonography have shown good results, but they also have limitation and drawback.[2]

Clinical scoring systems have proved useful in management of number of surgical condition. In past few years various scores have been developed to aid the diagnosis of acute appendicitis. The Alvarado score is simple scoring system that can be instituted easily the Alvarado score was modified by Kalen and proposed modified Alvarado score.

When the results of present study are compared with standard studies[18,38,39,40] we observed that sensitivity, specificity, positive predictive value and negative predictive value are comparable with these standard studies.

Where as when compared to other studies[39,40] which have shown low sensitivity as these studies were retrospective studies.

The present study has shown better sensitivity, as it is a cross sectional study and short comings of retrospective study are ruled out like good documentation is needed, lack of recording of modified Alvarado score may indicate in complete recording in case notes of some patients rather than true absence of modified Alvarado score finding.

Modified Alvarado scoring system is a dynamic one allowing observation and critical evaluation of the clinical picture. Its application improved diagnostic accuracy and reduces negative exploration and complication rates.

The graded compression ultrasonographic technique for diagnosis of acute appendicitis was described in 1986, since then several studies have proved its high efficiency. A metaanalysis showed high sensitivity and specificity of ultrasonography in diagnosis of acute appendicitis.[48] Results of the present study are compared to other standard studies, sensitivity, specificity, positive predictive value and diagnostic accuracy of the present study is almost comparable with that of standard studies.[49,50,51]

The sensitivity of ultrasonography is less than specificity, because of number of false negatives, some of which cannot be controlled (poor tolerance by the patient, obesity, presence of gas and unusual location of appendix).

These difficulties can be reduced by employing high resolution real time imaging and by improving the graded compression technique the high specificity is useful for differential diagnosis of associated pathology.

When Modified Alvarado score and ultrasonography were compared in terms of sensitivity, specificity, positive predictive value, diagnostic accuracy and false negative cases the results are almost same. Neither one is significantly advantageous.

When both modalities were positive there were no false positive cases. The cases were modified Alvarado score was negative or equivocal. The addition of ultrasonography decreased false negative rate by 57.14%.

Thus modified Alvarado score is a useful tool in clinical decision making especially when ultrasonography is unavailable. As imaging technique are considered to be expensive in India, Scoring system should be used in selection of patients for further work-up. Ultrasound is unnecessary when ones degree of clinical suspicious is high. However the additional information provided by ultrasound does improve diagnostic accuracy in case of negative or equivocal Modified Alvarado score.

Thus this study goes on to prove ultrasonography adjunct value in suspected cases of acute appendicitis.

The use of ultrasonography along with modified Alvarado score will be most useful in increasing the diagnostic accuracy of acute appendicitis. It would be interesting to compare the assessment of these patients using modified Alvarado score one group and another group as modified Alvarado score combined with ultrasonography in future study.

CONCLUSION

Acute appendicitis is the most common acute abdominal condition necessitating surgery. There is high prevalence among young age in adults. Diagnosis of acute appendicitis remains challenge.

Although ultrasonography is method used frequently for diagnosis of acute appendicitis, using modified Alvarado score is a useful tool in clinical decision-making. As modified Alvarado score is simple, easily applicable in peripheral hospitals where back up facilities are sparse. It can be useful for junior doctors in patients of abdominal emergencies.

As there is no advantage of ultrasonography over modified Alvarado score for diagnosis of acute appendicitis. Ultrasonography is unnecessary when ones degree of clinical suspicion is high. However the additional information provided by ultrasonography does improve diagnostic accuracy in cases of negative or equivocal modified Alvarado score.

Thus we conclude that establishing diagnosis in cases of suspected acute appendicitis might require a combination of different diagnostic tools such as modified Alvarado score, investigative modalities such as ultrasonography and the indispensible clinical judgement.

SUMMARY

Acute appendicitis is the most common disease leading to emergency abdominal surgery. Pre-operative diagnosis of acute appendicitis remains challenging despite improvement in history taking and clinical examination, new computed aided decision support system, clinical diagnostic scores and new imaging techniques such as ultrasonography and computed tomography.

Diagnostic scores are useful and easy methods which help in surgical decision to be reached their objective is to reduce the number of negative appendectomies, these scores make use of clinical, analytical, and radiological finding to produce a rationalized model of clinical decision making.

Presently many scoring system have been proposed to aid diagnosis of acute appendicitis. One of them is modified Alvarado scoring system which is cheap, easily available cost effective.

Graded compression ultrasonography is useful in diagnosis of appendicitis. It has become a routine investigation in patients with pain in right lower abdomen.

Thus modified Alvarado score is a useful tool in decision making because it is simple and easily applicable. When compared with ultrasonogrphy, neither one is significantly advantageous. But the additional information provided by ultrasonography does improve diagnostic accuracy when combined with modified Alvarado score.

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ANNEXURE I

PROFORMA

Patient Name: I.P number:

Age: Sex:

Date of admission: Date of discharge:

Address:

SYMPTOMS:

1) Pain:
2) Fever:
3) Vomiting /Nausea:
4) Anorexia:
5) Bowel habits:
6) Micturation:

PERSONAL HISTORY:

IN FEMALES; Menstrual history:

PAST HISTORY:

PHYSICAL EXAMINATION:

General condition:

Temperature:

Pulse

Blood pressure:

P I C K L E

SYSTEMIC EXAMINATION (SIGNS):

ABDOMEN:

Inspection:

Palpation: Tenderness over right iliac fossa:

Rebound tenderness over right iliac fossa:

Rigidity: Tenderness:

Organomegaly:

Percussion:

Auscultation:

Special tests: 1) Rovsigns sign:

2) Psoas sign:

C.V.S:

R.S:

C.N.S:

LABORATORY INVESTIGATIONS:

Hb:

W.B.C:

Urine routine:

X -ray abdomen:

ULTRASONOGRAPHY FINDING:

MODIFIED ALVARADO SCORE:

MODIFIED ALVERADO SCORE	**SCORE**
SYMPTOMS	
Migratory Rt. Iliac fossa pain	1
Anorexia	1
Nausea/Vomiting	1
SIGNS	
Tenderness Rt. Lower quad.	2
Rebound Tenderness Rt. Iliac Fossa	1
Pyrexia $\geq 37.5^0$	1
INVESTIGATIONS	
Leucocytosis	2
TOTAL	**9**

HISTOPATHOLOGY REPORT:

ANNEXURE - II

CONSENT FOR PARTICIPATION IN RESEARCH

Mr./Mrs. _____we are requesting you to enroll yourself in study titled **"A ONE YEAR CROSS SECTIONAL STUDY TO EVALUATE SPECIFICITY AND SENSITIVITY OF MODIFIED ALVARADO SCORE AND ULTRASONOGRAPHY IN ACUTE APPENDICITIS OF PATIENTS COMINGTO THE K.L.E.S DR. PRABHAKAR KORE HOSPITAL BELGAUM"** conducted by **DR. SUSHANTH. KULKARNI, Post Graduate** Student in **M.S. (Gen Surgery)** under the guidance of **DR. SHASHI. M. UPPIN** at J. N. Medical College, Belgaum under K.L.E.UNIVERSITY BELGAUM.

You have been requested to participate in research because you are fitting into the study group. During the study you will be asked some questions and you are supposed to answer to the best of your knowledge ability.

Your participation in research is voluntary. Your decision whether or not participate will bit affect your relationship with the J.N.M.C. If you decide to participate you are free to withdraw at any time without affecting the relationship.

The purpose of research is, To evaluate and compare modified alvarado scoring with ultrasonography in diagnosis of acute appendicitis, Outcome after combining scoring and ultrasonography and how to reduce negative appendectomies.

PROCEDURE INVOLVED:

Pre-operative evaluation by scoring and USG of patients suspected appendicitis and comparing with post-operative histopathology report.

RISKS AND BENEFITS:

There are no extra risks involved and benefits to be evaluated.

ALTERNATIVES:

You can decline the participation, then also you will get the routine line of management.

PRIVACY AND CONFIDENTIALITY:

The only people will know that you are a research subject are members of the research team. No information about you or provided by you during research will be disclosed to others without your written permission except.

1. In emergency to protect your rights and welfare.
2. If required by law.

AUTHORIZATION TO PUBLISH RESULTS:

When the result of research are published or discussed, in conference, no information will be displaced that would disclose your identity. Any information that is obtained in connection with this study and that can be identified with you will remain confidential and will be disclosed with your permission, or if required by law.

INSTITUTAITONAL/SPONSORS POLICY

In the event injury related to this research study, treatment will be made available through K.L.E.S.Dr.Prabhakar kore Hospital and M.R.C., Belgaum. There is no compensation or payment for such medical treatment from K.L.E.S.H and M.R.C. by law.

FINANCIAL INCENTIVES FOR P ARTICIPATION:

You will not be paid/offered any free gifts for participating in the research. There will not be any remunerations for participating in the research.

You will not be reimbursed for expenses.

CONSENT STATEMENT

I undersigned _____ have been explained in my vernacular language about the study and the participation in the study is voluntary. If I want I can withdraw at any time also have been given enough time to clear my doubts and rights as a study participant.

If in case you have questions about the study you can contact at **Dr. Sushanth. Kulkarni.** If in case you have questions about my rights as a study participant you can contact at Dr. V. D. Patil (Phone No. 0831-2471350)

Signature or the left thumbprint of Participant or legally authorized representative

Participants Name _____ Signature _____

Witness Name _____ Signature _____

Experimenters Name _____ Signature _____

Date : _____

PHOTOGRAPHS

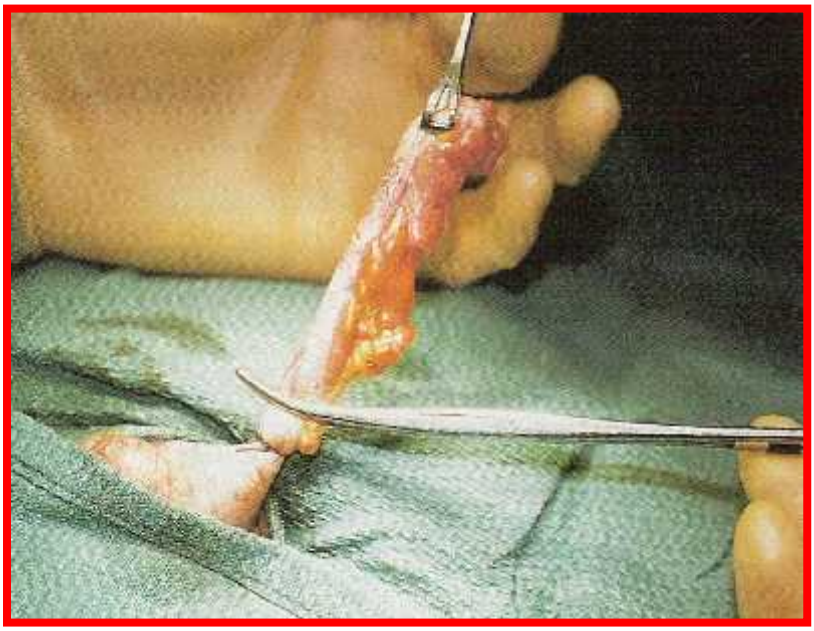

Fig. 1 : Mesoappendix divided between hemostats and ligated

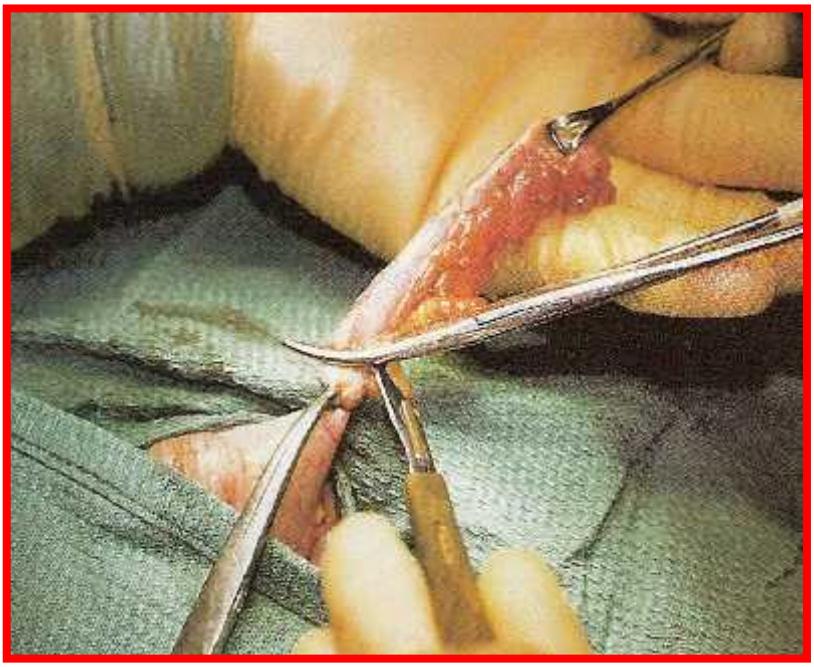

Fig. 2 : Appendix crushed and ligated at its base

Fig. 3 : Appendiceal stump inverted, the Z suture having been tied

Fig. 4 : Histology of acute appendicitis

Fig. 5 : Ultrasonography Machine

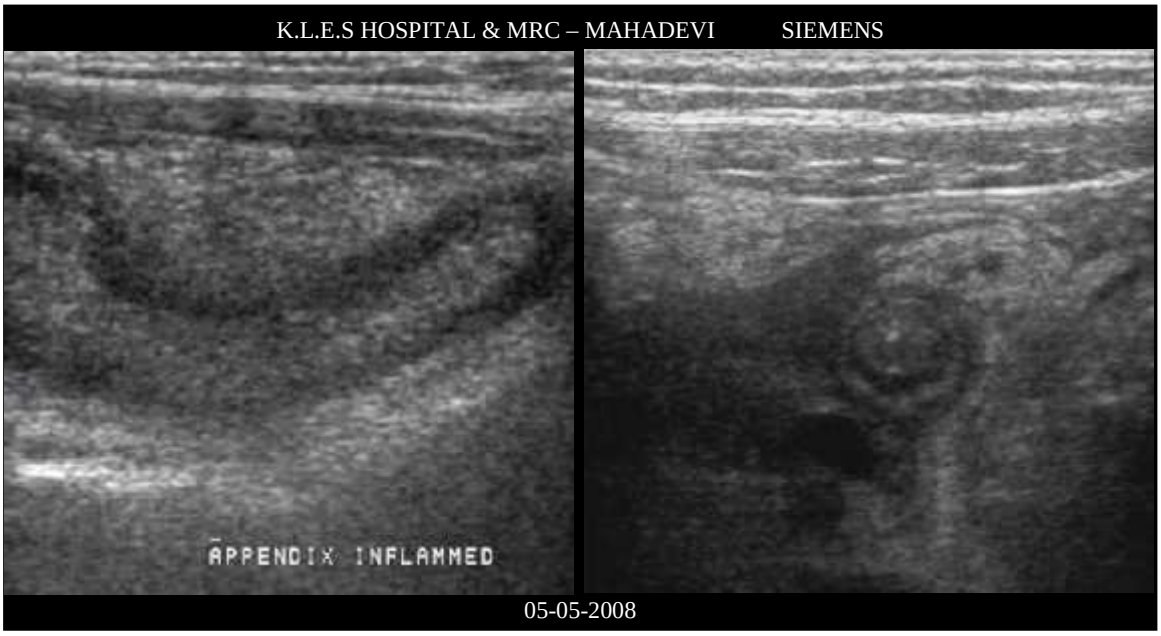

Fig. 6 : Ultrasonography findings acute appendicitis

ANNEXURE - III

MASTER CHART

Sl No	Name	Age	Sex	I.P.NO	Migration of Pain to RIF (1)	Anorexia (1)	Nausea / Vomiting (1)	Tenderness over RIF (2)	Rebound-Tenderness over RIF (1)	Elevated Temp > 37.3 deg. C (1)	Lecocytosis (2)	**Modified alvarado score**	HPR Findings
1	Lakkawa	48	F	253216	+	+	+	+	+	-	+	8	AA
2	Imran	25	M	258671	+	-	+	+	+	-	+	7	AA
3	Tahera	19	F	259714	+	+	-	+	+	-	+	5	CA
4	Pooja	30	F	260808	+	+	+	+	+	-	+	8	AA
5	Manjunath	23	M	261373	-	-	-	+	-	-	+	4	CA
6	Vasanthi	40	F	260826	+	+	-	+	+	-	+	6	CA
7	Shrikanth	40	M	262038	+	-	+	+	-	-	-	4	CA
8	Vikram	29	M	262103	+	+	+	+	-	-	+	7	AA
9	Basawant	28	M	262929	+	+	-	+	-	-	+	6	CA
10	Nisha	35	F	262881	+	+	+	+	-	-	-	5	CA
11	Chandan	32	M	267805	+	+	-	+	+	-	+	8	AA
12	Shakuntala	38	F	270735	+	-	+	+	-	-	+	6	CA
13	Mahadevi	30	F	272041	+	+	+	+	+	+	-	8	AA
14	Girija	35	F	273681	+	+	+	+	+	+	+	9	AA
15	Mahadevi.patil	48	F	274568	+	+	+	+	-	-	-	5	CA
16	Tamanna	22	F	274568	+	+	+	+	-	-	+	7	AA
17	Rizwan	28	M	251560	+	-	+	-	-	+	+	5	CA
18	Shivappa	25	M	275828	+	+	+	+	-	-	+	7	AA

Sl No	Name	Age	Sex	I.P.NO	Migration of Pain to RIF (1)	Anorexia (1)	Nausea / Vomiting (1)	Tenderness over RIF (2)	Rebound-Tenderness over RIF (1)	Elevated Temp > 37.3 deg. C (1)	Lecocytosis (2)	**Modified alvarado score**	HPR Findings
19	Rajshekar	16	M	249375	+	-	+	+	+	-	+	5	CA
20	Sunil	25	M	250350	+	-	-	+	-	-	-	3	CA
21	Nagappa	28	M	270029	+	+	-	+	+	+	+	8	AA
22	Sangeetha	18	F	270268	+	+	-	+	-	-	-	4	CA
23	Lata	16	F	274208	+	-	+	+	-	-	-	4	CA
24	Hussein	42	M	267864	+	-	+	+	-	-	-	4	AA
25	Srishail	38	M	266291	+	-	+	-	-	-	-	3	AA
26	Manik	26	M	253301	+	+	+	+	-	-	+	7	CA
27	Basavaraj	22	M	254462	+	+	-	+	+	+	-	7	CA
28	Swapna	18	F	254965	+	+	+	-	-	+	-	5	AA
29	Shwetha	28	F	255275	+	+	-	+	+	+	+	8	CA
30	Renuka	24	F	266062	+	-	+	+	+	+	+	8	CA
31	Vandana	32	F	257070	+	-	+	+	-	-	-	4	CA
32	Chandrakala	26	F	267412	+	-	+	-	-	-	+	4	CA
33	Rajaram	34	M	254216	+	+	+	+	-	-	-	5	CA
34	Arif	19	M	255317	+	-	-	+	-	+	+	6	CA
35	Lakshman	17	M	258901	+	-	+	+	+	+	-	6	CA
36	Mahaveer	29	M	258448		-	+	+	+	+	-	4	CA
37	Mallesh	22	m	258448	+	+	-	+	-	+	+	8	AA
38	Abdul	37	M	278987	+	+	+	+	-	-	+	6	CA

Sl No	Name	Age	Sex	I.P.NO	Migration of Pain to RIF (1)	Anorexia (1)	Nausea / Vomiting (1)	Tenderness over RIF (2)	Rebound-Tenderness over RIF (1)	Elevated Temp > 37.3 deg. C (1)	Lecocytosis (2)	**Modified alvarado score**	HPR Findings
39	Laxmi	30	F	252902	+	+	+	-	+	+	-	5	CA
40	Yesu	18	M	255779	+	-	+	+	-	+	+	7	CA
41	Kalavathi	28	F	265502	+	+	+	+	-	-	-	5	CA
42	Akash	24	M	265868	+	+	+	+	-	-	-	5	AA
43	Sagar	20	M	272791	+	-	-	+	-	-	-	4	CA
44	Jaganath	34	M	278127	+	-	-	+	-	-	+	5	AA
45	Shilpa	26	F	278231	+	+	+	+	-	+	+	7	CA
46	Anjum	29	F	278374	+	+	+	+	+	+	+	9	AA
47	Uttam	32	M	271768	-	-	+	+	+	-	+	5	AA
48	Sunitha	23	F	271787	+	+	+	+	-	+	+	8	AA
49	Ganga	30	F	277989	+	-	+	+	-	+	+	7	CA
50	Omkar	40	M	273973	+	+	-	+	-	+	+	8	AA
51	Vijay	29	M	265750	+	+	-	+	-	+	+	5	CA
52	Siddaling	36	M	276491	+	+	+	-	-	+	+	6	CA
53	Umera	27	F	266590	+	+	+	+	+	-	+	8	CA
54	Dastigir	32	M	260168	-	-	-	+	-	-	+	4	AA
55	Manish	16	M	250191	+	+	+	+	-	+	-	6	CA
56	Anitha	35	M	251010	+	+	-	-	-	-	+	4	AA
57	Maya	29	F	261417	+	+	+	+	-	-	-	4	CA
58	Mantur	30	M	251946	+	-	-	+	+	-	+	6	AA

Sl No	Name	Age	Sex	I.P.NO	Migration of Pain to RIF (1)	Anorexia (1)	Nausea / Vomiting (1)	Tenderness over RIF (2)	Rebound-Tenderness over RIF (1)	Elevated Temp > 37.3 deg. C (1)	Lecocytosis (2)	**Modified alvarado score**	HPR Findings
59	P.vijay	28	M	261949	+	+	+	+	-	+	+	8	AA
60	Arun	18	M	277390	+	-	+	+	-	+	-	6	AA
61	Ratna	32	F	259930	+	+	+	+	+	-	+	8	AA
62	Sanjana	29	F	261759	+	+	-	+	-	-	+	7	AA
63	Savitha	27	F	272019	+	-	+	+	+	-	+	6	AA
64	Meena	36	F	263207	+	-	+	+	-	+	+	6	CA
65	Nirmala	31	F	267748	+	+	-	+	+	+	-	6	CA
66	Rafiq	20	M	277749	+	-	-	+	+	+	-	5	CA
67	MD.gous	38	M	257804	+	+	-	+	+	+	-	6	CA
68	Sanjay.k	36	M	267748	+	+	+	-	-	+	+	6	CA
69	Sayyed	27	M	262804	+	+	+	+	-	+	+	8	CA
70	Husain	24	M	279381	+	-	+	+	-	+	-	6	CA
71	Ayush	16	M	261620	+	+	+	+	+	-	+	7	CA
72	Sumith	24	M	251541	+	+	+	+	-	+	+	8	CA
73	Pundalik	39	M	276492	+	+	+	+	+	+	+	9	CA
74	Shridhar	22	M	258573	+	+	+	+	+	+	+	9	AA
75	Shalini	26	F	259220	+	-	-	+	+	+	-	5	CA

USG Findings
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USG Findings
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Age Distribution of the Study Group

Age (Years)	No of Cases
010-019	29 (48)
20-29	15 (25)
30-39	9 (15)
40-49	5 (8)
50-59	2 (3)

Figures in the parenthesis indicate percentage

Sex Distribution of Study Group

Sex	No of Cases
Male	33 (55)
Female	27 (45)

Symptoms

Symptoms	No of Cases
Migration of Pain to Right Iliac	54 (90)
Anorexia	46 (77)
Nausea/ Vomiting	47 (78)

Signs

Signs	No of Cases
Tenderness over right iliac f	60 (100)
Rebound tenderness over right il	47 (78)
Temperature >37.3^{0} C	46 (77)

Lecocytosis

Lecocytosis	53 (88)

Total modified Alvarado score

Total modified Alvarado sc	Total	Positive	Negative
7	29	21 (72)	8 (28)
8	16	14 (88)	2 (12)
9	15	13 (87)	2 (13)

X2 = 2.02 P>0.05 Not Significant

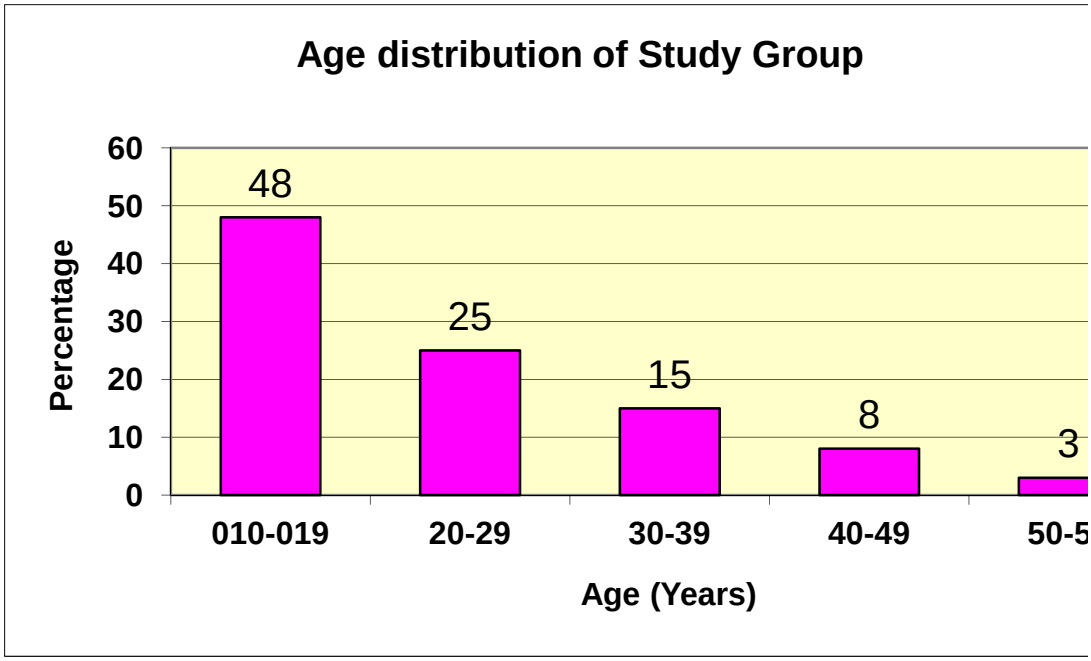
Study Groups	Positive	Negative
Male (n=20)	18 (90)	2 (10)
Female (n=20)	14 (70)	6 (30)
Children (n=20)	16 (80)	4 (20)

X2 = 5.21 P>0.05 Not Significant

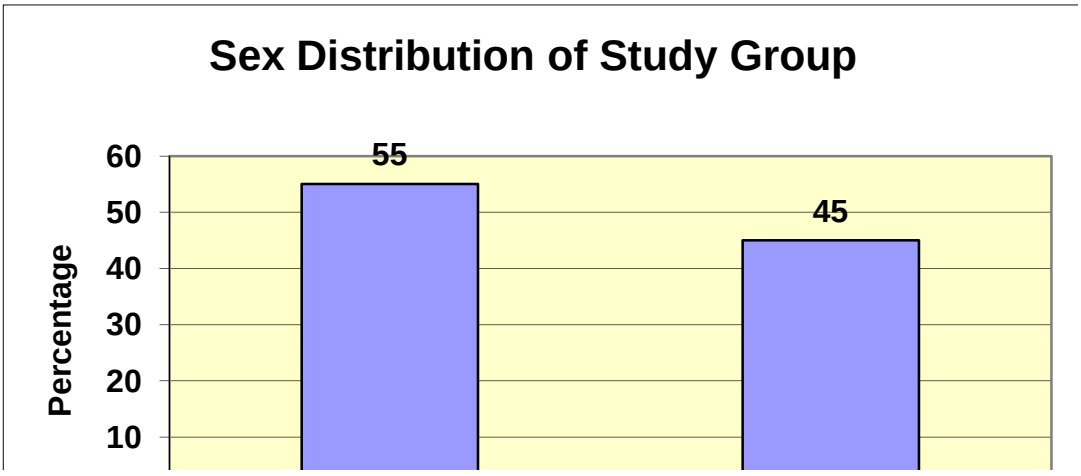
No of Cases Operated	ith Histopathologut Histopath		Sensitivity
Male (n=20)	18	2	90%
Female (n=20)	14	6	70%
Children (n=20)	16	4	80%

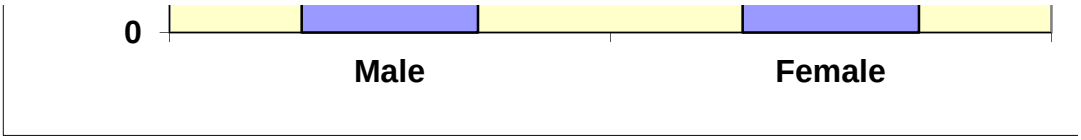
Histopathologic Appendici	No of cases
Positive	48 (80)
Negative	12 (20)

Age (Years	No of Cases
010-019	48
20-29	25
30-39	15
40-49	8
50-59	3

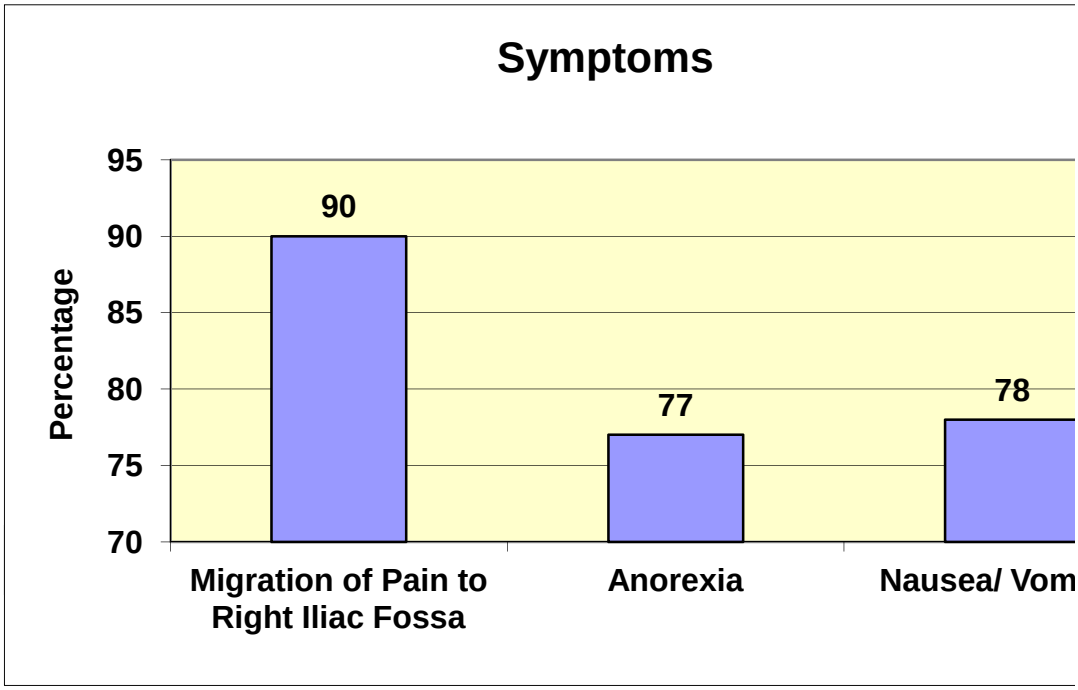


Sex	No of Cases
Male	55
Female	45

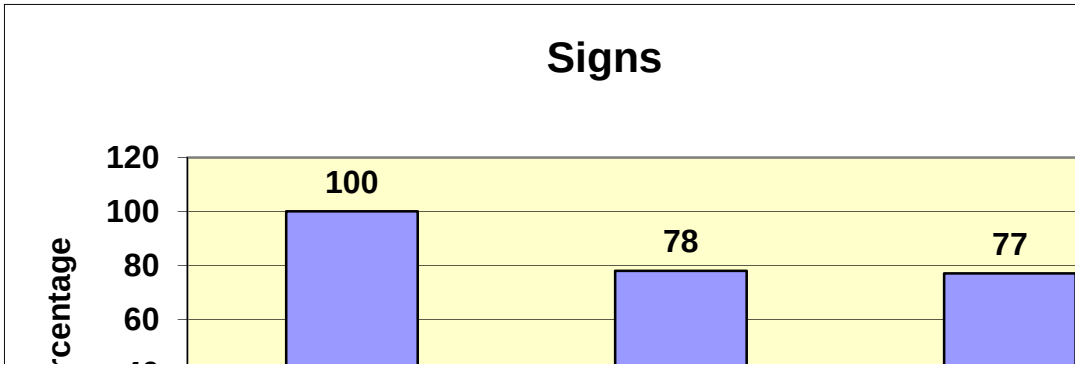


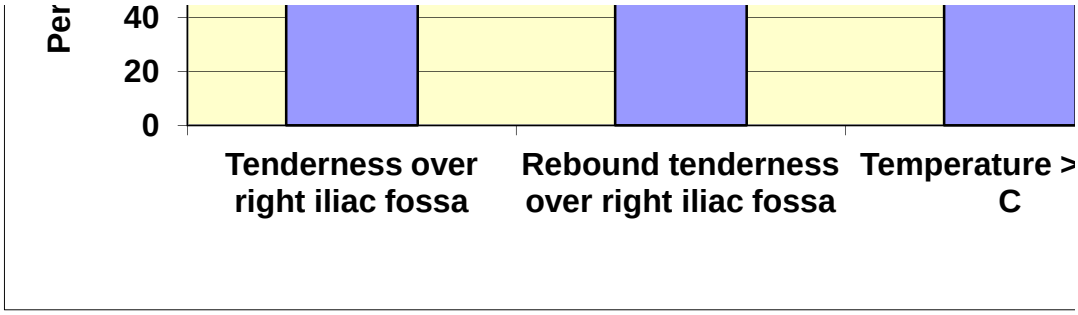


Symptoms	No of Cases
Migration of Pain to Righ	90
Anorexia	77
Nausea/ Vomi	78

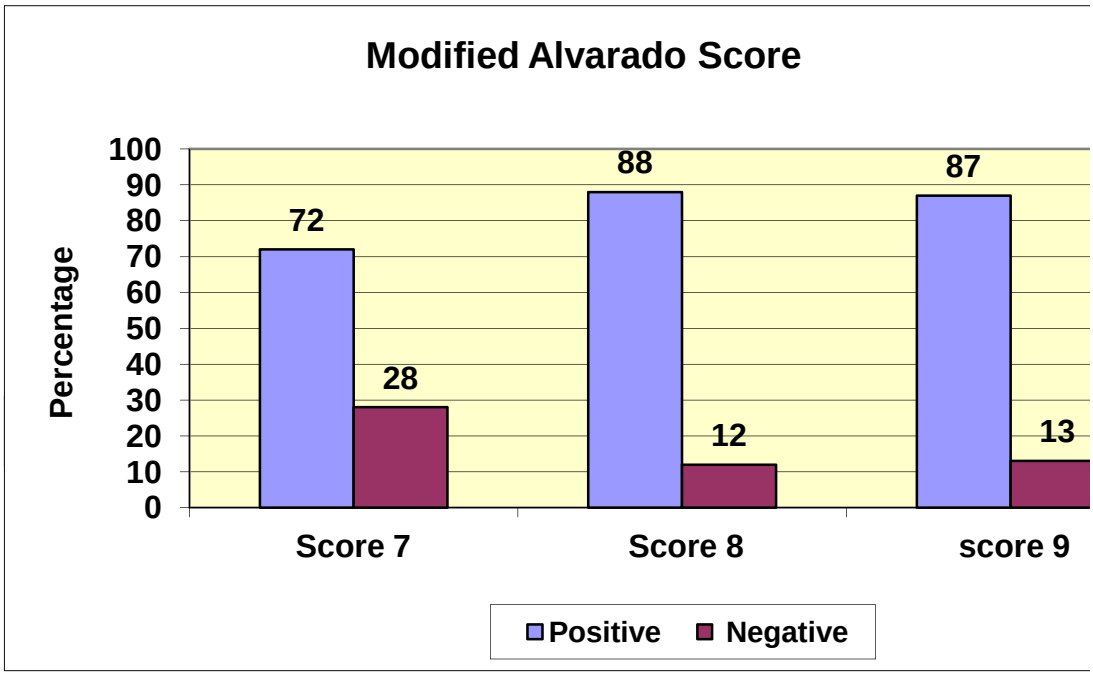


Signs	No of Cases
Tenderness over right	100
ound tenderness over	78
Temperature >37	77

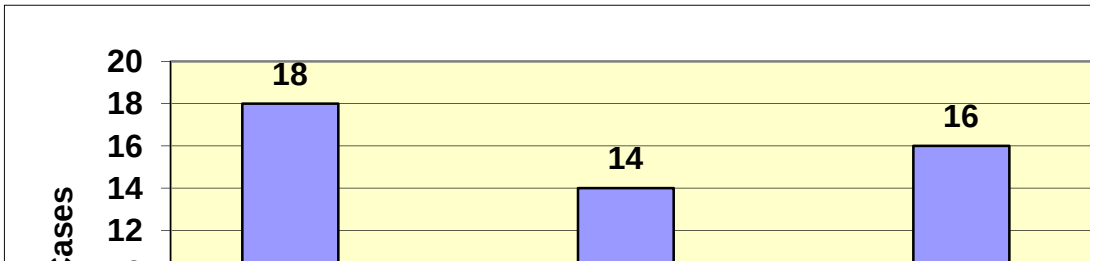


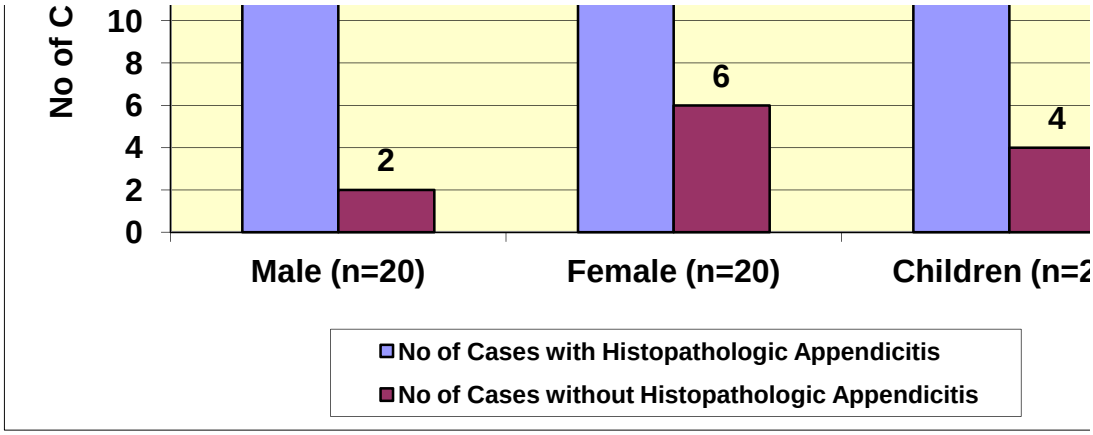


Total modified Alvara	Positive	Negative
Score 7	72	28
Score 8	88	12
score 9	87	13

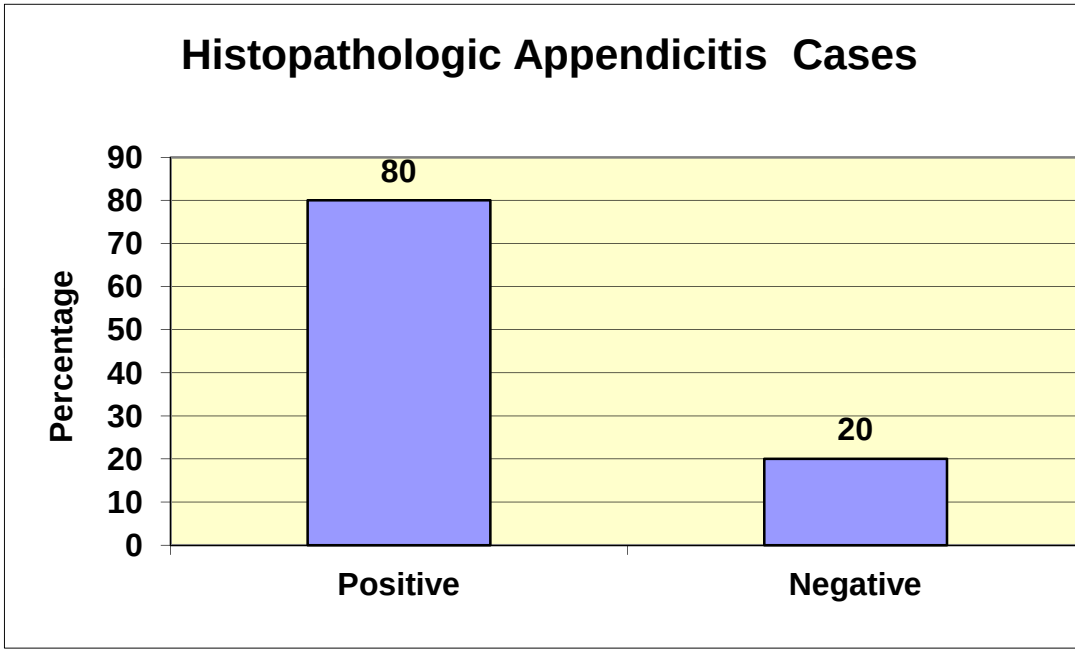


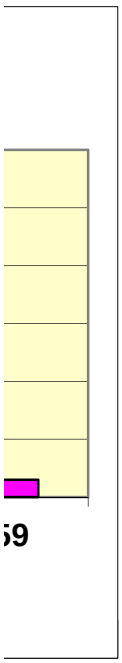
No of Cases Ope	Histopathout	Histopathologic Appendicitis
Male (n=20	18	2
Female (n=2	14	6
Children (n=2	16	4





Histopathologic App	No of cases
Positive	80
Negative	20

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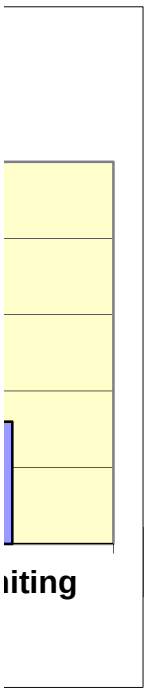
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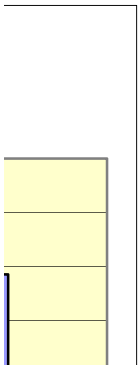

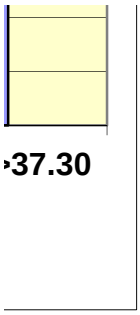
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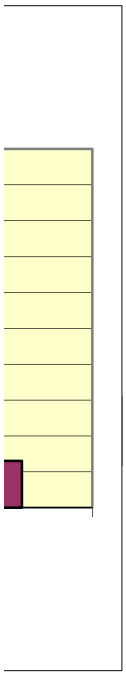

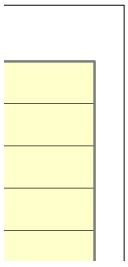

20)

KEY TO MASTER CHART

+	:	Present
-	:	Absent
AA	:	Acute Appendicitis
CA	:	Chronic Appendicitis
M	:	Male
F	:	Female
N	:	Normal
P	:	Positive