A CORRELATIVE STUDY OF ACUTE APPENDICITIS AND IS OVER NIGHT SURGICAL DELAY IMPORTANT ?

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M.S. DEGREE IN GENERAL SURGERY

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CERTIFICATE

Certified that this is the bonafide dissertation done by **Dr G Ravi Shankar** and submitted in partial fulfillment of the requirements for the Degree of M.S, General Surgery, Branch I of The Tamilnadu Dr. M.G.R.Medical University, Chennai.

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DECLARATION

I solemnly declare that the dissertation titled **A CORRELATIVE STUDY OF ACUTE APPENDICITIS AND IS OVER NIGHT SURGICAL DELAY IMPORTANT ?** was done by me from may 2009 to August 2011 under the guidance and supervision of Professor **D.N. Renganathan. M.S.** This dissertation is submitted to the Tamilnadu Dr. MGR Medical University towards the partial fulfillment of the requirement for the award of MS Degree in General Surgery (Branch I).

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LIST OF ABBREVIATIONS USED

BP - Blood pressure ,

CRP- C- Reactive protein,

^{o} C – Degree Centigrade ,

CT – Computed Tomography,

DM - Diabetes Mellitus ,

ECG – Electrocardiogram,

F - Frequency,

GP - General Practitioner,

Hb - Haemoglobin ,

HBsAg - Hepatitis B Antigen,

HIV - Human Immunodeficiency Virus,

HTN - Hypertension ,

IHD - Ischaemic heart disease ,

MRI – Magnetic Resonance of Image,

NSAP – Non specific Abdominal Pain

P - Probability ,

PR - Pulse Rate ,

RBS - Random Blood Sugar ,

RIF – Right Iliac Fossa,

Str work - Strenous work ,

t - P-value ,

TB - Tuberculosis ,

USG – Ultrasonogram.

ABSTRACT

Appendicitis is the most common acute surgical condition of the abdomen. Despite technologic advances, the diagnosis of appendicitis is still based primarily on the patient's history and the physical examination. Prompt diagnosis and surgery may reduce the risk of perforation and prevent complications. The rate of normal appendices unnecessarily removed remains high (15-30%) [33] despite several techniques and investigations applied to improve the diagnostic accuracy. Many studies investigated the role of raised WBC[45] count and C-reactive protein (CRP)[50] with pulse > 90 beats /min[67] and temperature > 37.5^{o} c[67] correlated with Ultrasonagram abdomen[44] in improving the diagnosis of acute appendicitis . A Retrospective and Comparative study was conducted in Coimbatore Medical College Hospital. Blood for the measurement of WBC and serum CRP was collected preoperatively from 50 patients just before appendicectomy and Ultrasonagram abdomen was done for all 50 patients before surgery. In this for 25 patients Ultrsonogram Abdomen was done with a delay of Overnight . In the retrospective study the histopathology of the 50 appendices was grouped into two categories: . The histopathology of the 50 appendices was grouped into two categories, positive (acute appendicitis) and negative (normal appendix) explorations. White blood count, serum CRP levels , with Ultrasonagram abdomen , and the histopathology findings were correlated. In patients with histopathologically proven acute appendicitis, both the WBC count and serum CRP level were significantly raised ($p<0.0005$) along with pulse and temperature[67] and USG Abdomen showed Appendicular pathology in 39 patients out of 41 patients of positive explorations . In the comparative study, the patients was divided into two categories. One - the patients who under gone

immediate surgery and Two - the patients who under gone surgery with a delay of overnight (12 hrs) and the Post operative complications were compared[67] .Overnight delay is important in arriving the diagnostic accuracy in Females[67] . In patients with histopathologically proven acute appendicitis, WBC count and serum CRP level were significantly raised ($p<0.0005$) along with pulse and temperature , compared to the patients with normal appendix. Ultrasonogram showed positive pathology in 39 out of 41 positive explorations. The sensitivity and specificity of serum CRP and WBC was 97.5% and 88.8 %, and in Ultrsonogram was 95 % and 80 % respectively. The mean value of the pulse and temperature of positive appendectomies are 100 beats /min , and 38.1^{o} c respectively . The mean value of the pulse and temperature of negative appendectomies are 87.7 beats/min and 37.6 c respectively. A normal preoperative WBC, serum CRP , Pulse rate ,Temperature and Ultrasonogram in patients with suspected acute appendicitis is most likely associated with a normal appendix. Deferring surgery in this group of patients would probably reduce the rate of negative appendectomies. The overnight delay in doing Ultrasonagram (especially in females) will not increase post operative complications[67] .This study shows the impact of a normal (rather than raised) WBC, serum CRP, Pulse rate ,Temperature and Ultrasonogram in reducing the rate of negative explorations with a very high sensitivity and specificity.

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CHAPTERS

1. INTRODUCTION AND OBJECTIVES OF THE STUDY

Acute appendicitis is a common surgical emergency, which is usually diagnosed by history, clinical examination, and leucocytosis. Many inflammatory and non-inflammatory conditions may mimic the presence of appendicitis. This is especially seen in females and in extremes of age. A simple appendicitis can progress to perforation, which is associated with more morbidity and mortality. Therefore surgeons have been inclined to operate when the diagnosis is probable, rather to wait until it is certain. This resulted in relatively high rate (15-30%)[51] of negative appendicitis. The reported morbidity of negative[30] exploration is between 5 and 15%.

It has been claimed that accurate diagnostic methods can reduce the number of negative appendectomies, the number of perforations, and the time spent in the hospital. The methods advocated to assist in the diagnosis of appendicitis include: scoring systems, laparoscopy, computed tomography (CT), and magnetic resonance imaging (MRI). Most of the above mentioned methods are relative expensive; and are not so easily available.

White blood count, serum CRP levels, pulse > 90 beats /min and temperature > 37.5^{o} c with Ultrasonagram could be used as a diagnostic tool in detecting acute appendicitis. Several Studies have investigated the value of elevated WBC[45] and serum CRP[50,60] along with increased pulse rate > 90 beats/ min and temperature > 37.5^{o} c in the diagnosis of acute appendicitis.

All the patients with symptoms <20 hours ,central pain radiating to RIF and with the signs of right iliac fossa tenderness ,and rebound tenderness in the Mc burneys point were taken for surgerys.

The objective of the present work was to find out the diagnostic accuracy of WBC and C-reactive protein in acute appendicitis in combination with pulse , temperature and positive Ultra sonogram . And an overnight delay in doing Ultra sonogram abdomen (the cause of delay is the lack of Ultrasonogram in the night) will not increase the post operative complications. In this study, pulse > 90 beats /min, temperature > 37.5^{o}c, white cell count, serum CRP and Ultra sonogram abdomen were correlated with the operative findings and histopathology of the removed appendix. Patients proven to have an inflamed appendix on pathological report were divided into 2 groups .In retrospective study the patients was divided into two groups, one with positive appendectomies and other with negative appendectomies are correlated with histopathology report with WBC ,CRP, Pulse ,Temperature and Ultrasonogram abdomen in arriving the diagnostic accuracy .In comparative study the patients were divided ino two groups .The early group comprised patients who under gone appendectomies without delay including patients with generalized sepsis. The late group comprised who had undergone appendectomies after an overnight delay .

2. REVIEW OF LITERATURE

1. History

The first descriptions of the appendix date to the sixteenth century.[1–3] Although first sketched in the anatomic notebooks of Leonardo da Vinci around 1500, the appendix was not formally described until 1524 by da Capri[4] and 1543 by Vesalius.[5] Perhaps the first description of a case of appendicitis was by Fernel in 1554,[6] in which a 7-year-old girl with diarrhea was treated with a large quince. Soon thereafter she developed severe abdominal pain and died. Autopsy showed that the quince had obstructed the appendiceal lumen, resulting in appendiceal necrosis and perforation. For the next few centuries, such cases of appendicitis were typically diagnosed at autopsy.

Amyand is credited with the first Appendectomy in 1736, when he operated on a boy with an enterocutaneous fistula within an inguinal hernia.[7] On exploration of the hernia sac, he discovered the appendix, which had been perforated by a pin resulting in a fecal fistula. As a result of his original description, an inguinal hernia containing the appendix carries Amyand's eponym to this day.[8] Nearly 150 years passed until Lawson Tait in London presented the first successful transabdominal Appendectomy for gangrenous appendix in 1880.[9] Less than a decade later, in 1886, Reginald Fitz of Harvard Medical School first described the natural history of the inflamed appendix, coining the term "appendicitis."[10] In 1889, Charles McBurney of the Columbia College of Physicians and Surgeons in New York presented his series of cases of surgically-treated appendicitis and in so doing described the anatomic landmark that now bears his name. McBurney's point is the location of maximal tenderness "very exactly between an inch and a half and two inches from the anterior

spinous process of the ileum on a straight line drawn from that process to the umbilicus."[11] In the 1890s, Sir Frederick Treves of London Hospital advocated conservative management of acute appendicitis followed by Appendectomy after the infection had subsided;[12] unfortunately, his youngest daughter developed perforated appendicitis and died from such treatment.

Numerous advances in the diagnosis and treatment of appendicitis have emerged in the past 125 years. Nonetheless, acute appendicitis continues to challenge surgeons to this day.

2. Anatomy of Appendix

Appendix develops from the caecal bud and its length varies from 2 to 2.5 cm. It opens into the posteromedial wall of caecum 2 cm below the ileo caecal value. The base of the appendix is at the point of convergence of three taenia coli on the positero medial wall of caecum and on the surface of the abdomen it is noted over the Mcburney's point. Tip of the appendix varies in position. Various positions of appendix are; retrocaecal (74%), pelvic (21%), paracaecal (2%), subcaecal (1.5%), preileal (1%) and postileal (0.5%) (FIG B). Appendix is suspended by meso appendix, a triangular fold of peritoneum. It is the continuation of inferior layer of mesentery of terminal ileum. Blood is supplied no appendix by appendicular artery, which is a branch of posterior caecal artery. It runs first in the free margin of the meso appendix and then close to appendicular wall. Inflammatory swelling of the distal part of the organ may obstruct the vessel, leading to ischaemic necrosis and rupture of the appendix (McMinn 1994; Bailey and Love, 2004)

Fig .1. Anatomy

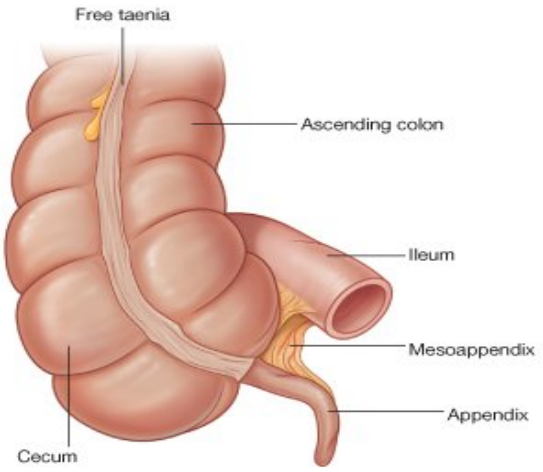


Fig.2. Blood Supply of Appendix

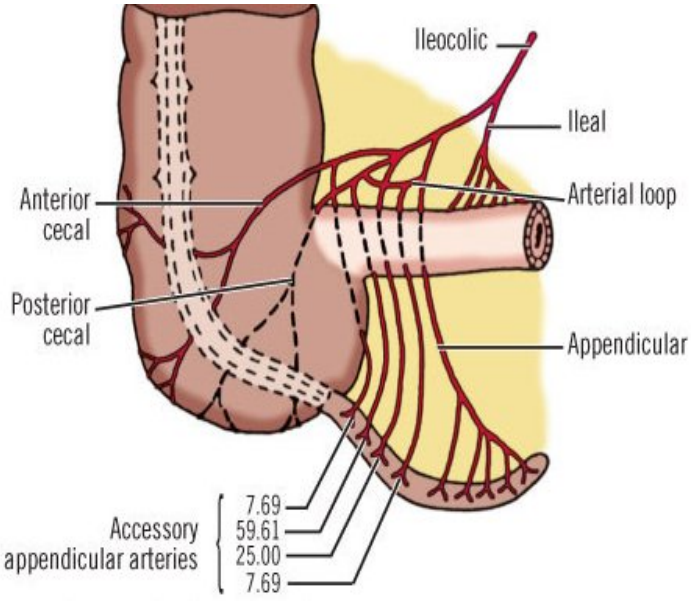
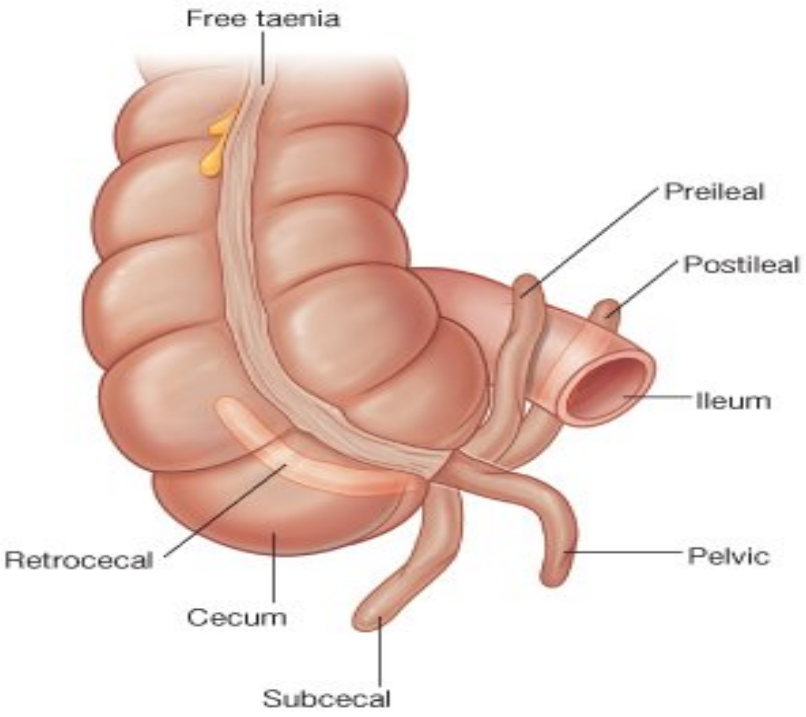


Fig.3. Various Positions of Appendix



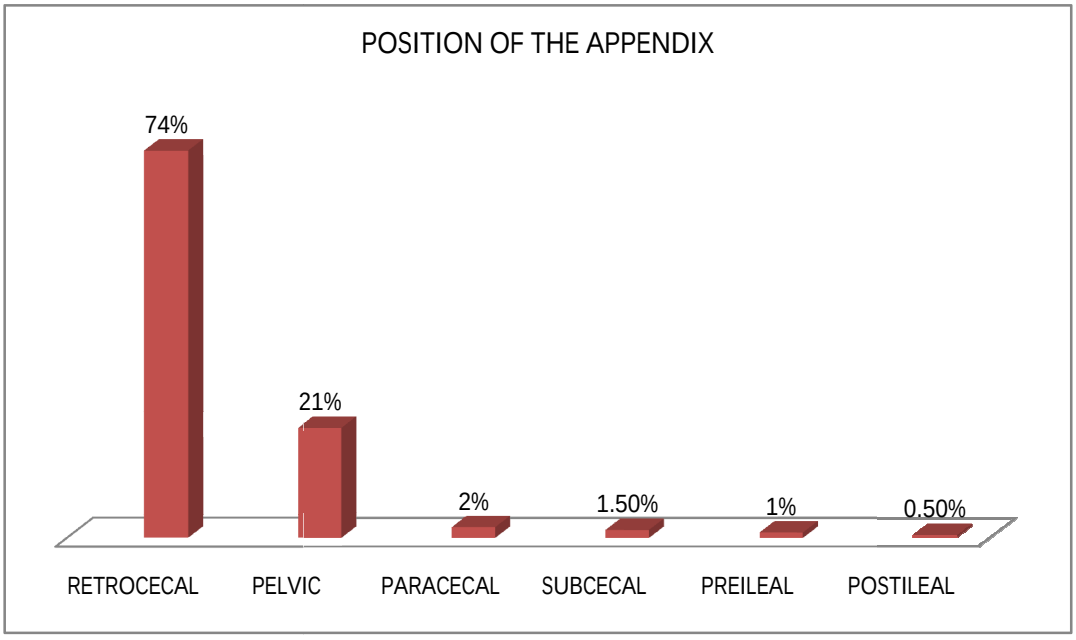


Fig .4.

2.1. Acute Appendicitis

Appendicitis is the most common acute surgical condition of the abdomen (pieper et al., 1982; Liu and McFadden, 1997), Approximately 7% of the population will have appendicitis in their lifetime (Hardin, 1999) with the peak incidence occurring between the ages of 10 and 30 years (Schwartz, 1994). Despite technologic advances, the diagnosis of appendicitis is still based primarily on the patient's history and the physical examination (Wagner et al., 1996; Hardin, 1999). Prompt diagnosis and surgery may reduce the risk of perforation and prevent complications (Vilcox and Traverso, 1997). The mortality rate in nonperforated appendicitis is less than 1% , but it may be as high as 5% or more in young and elderly patients, in whom diagnosis may often be delayed, thus making perforation more likely (Liu and McFadden, 1997).

2.2. Pathogenesis of Acute Appendicitis

The epithelial lining of appendix is interspersed with lymphoid follicles (Schwartz, 1994). Most of the time, The appendix has an intraperitoneal location (either anterior or retrocecal) and, thus, may come in contact with the anterior parietal peritoneum when it is inflamed. Up to 30% of the time, the appendix may be "hidden" from the anterior peritoneum by being in a pelvic, retroileal or retrocolic (retroperitoneal retrocecal) position (Guidry and Poole, 1994). The "hidden" position of the appendix notably changes the clinical manifestations of appendicitis.

Obstruction of the narrow appendical lumen initiates the clinica; illness oe acute appendicitis. Obstruction has multiple causes, including lymphoid hyperplasia (related to viral illnesses, including upper respiratory infection, mononucleosis and

gastroenteritis), fecaliths, parasites, foreign bodies, Crohn's disease , primary or metastatic cancer, and carcinoid syndrome. Lymphoid hyperplasia is more common in children and young adults, accounting for the increased incidence of appendicitis in these age groups (Graffeo and Counselman, 1996). Mucus secretion and inflammatory exudation increase the intraluminal pressure. Lymphatic drainage gets obstructed and mucosa ulcerates. Bacterial translocation into submucosa occurs. Resolution may occur at this point. If inflammation progresses, further edema, ischemia, bacterial invasion into the muscle layer occurs, resulting in acute appendicitis. Finally ischemic of the appendicular wall results in gangrenous appendicitis with peritonitis. Alternatively greater omentum and coils of intestine become adherent to inflamed appendix and resulting in phlegmonous mass or abscess (Bailey and Love, 2004).

2.3 Clinical Presentation of Acute Appendicitis

2.3.1. Symptoms and Signs.

Abdominal pain is the most common symptom of appendicitis (Schwartz, 1994). In multiple studies (Graffeo and Counselman, 1996; Schwartz, 1994; Wilcox and Traverso, 1997) specific characteristics of the abdominal pain and other associated symptoms have proved to reliable indicators of acute appendicitis (Table 1). A thorough review of the history of the history of the abdominal pain and of the patient's recent genitourinary, gynecologic, and pulmonary history should be obtained

Table 1. Common symptom of Acute Appendicitis (Schwartz, 1994).

Common Symptoms *	Frequency (%)
Abdominal pain	100
Anorexia	100
Nausea	90
Vomiting	75
Pain migration	50
Classic symptom sequence (Vague periumbilical pain to Anorexia/nausea/ unsustained Vomiting to migration of pain to right lower quadrant to low-grade fever)	50

*Onset of symptoms typically within past 24 to 36 hours.

Common symptoms of acute appendicitis.

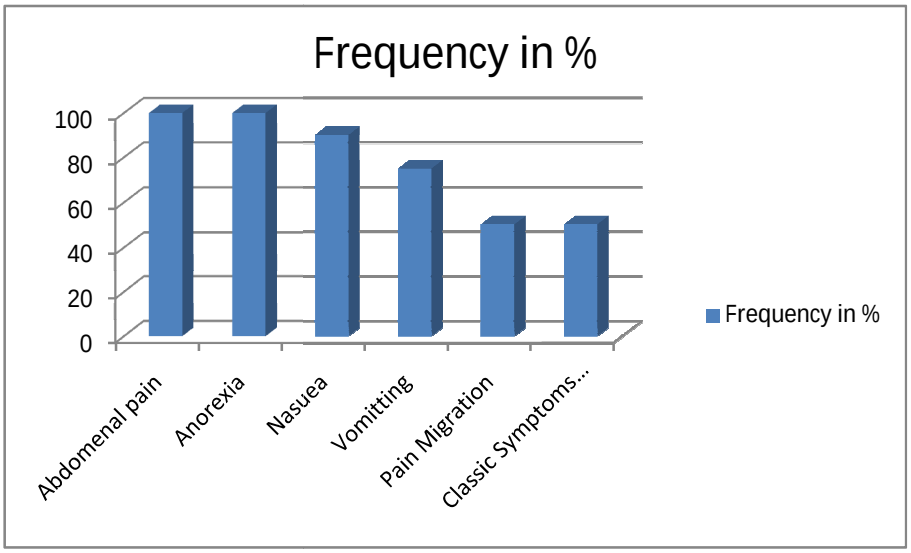


Fig .5

The classic history of pain beginning in the periumbilical region and migrating to the right lower Quadrant occurs in only 50% of patients (Liu and McFadden, 1997).

Duration of symptoms exceeding 24 to 36 hours is uncommon in nonperforated appendicitis (Liu and McFadden, 1997).

A careful, systematic examination of the abdomen is essential. While right lower quadrant tenderness to palpation is the most important physical examination finding, other signs may help confirm the diagnosis (Table 2). The abdominal examination should begin with inspection followed by auscultation, gentle palpation (beginning at a site distant from the pain) and, finally, abdominal percussion. The rebound tenderness that is associated with peritoneal irritation has been shown to be more accurately identified by percussion of the abdomen than by palpation with quick release (Liu and McFadden, 1997).

As previously noted, the location of the appendix varies. When the appendix is hidden from the anterior peritoneum, the usual symptoms and signs of acute appendicitis may not be present. Pain and tenderness can occur in a location other than the right lower quadrant (Guidry and Poole, 1994). A retrocecal appendix in a retroperitoneal location may cause flank pain. In this case, stretching the iliopsoas muscle can elicit pain. The psoas sign is elicited in this manner: the patient lies on the left side while the examiner extends the patient's right thigh. In contrast, a patient with a pelvic appendix may show no abdominal signs, but the rectal examination may elicit tenderness in the cul-de-sac. In addition, on obturator sign (Pain on passive internal rotation of the flexed right thigh) may be present in a patient with a pelvic appendix (Guidry and Poole, 1994).

Table 2. Common signs of appendicitis (Graffeo and Counsel man, 1996;Schwartz,1994; Wilcox and Traverso, 1997).

Common Signs of Appendicitis
• Right lower quadrant pain on palpation (the single most important sign) • Low-grade fever (38oC [or 100.4oF])-absence of fever or high fever can occur • Peritoneal signs • Localized tenderness to percussion • Guarding • Other confirmatory peritoneal sighs (absence of these signs does not exclude appendicitis) • Psoas sign-pain on extension of right thigh (retroperitoneal retrocecal appendix) • Obturator sign-pain on internal rotation of right thigh (pelvic appendix) • Rovsing's sign-pain in right lower quadrant with palpation of left lower quadrant • Dunphy's sign-increased pain with coughing. • Flank tenderness in right lower quadrant (retroperitoneal retrocecal appendix) • Patient maintains hip flexion with knees drawn up for comfort.

The psoas sign. Pain on passive extension of the right thigh. Patient lies on left side. Examiner extends patient's right thigh while applying counter resistance to the right hip *(asterisk).*

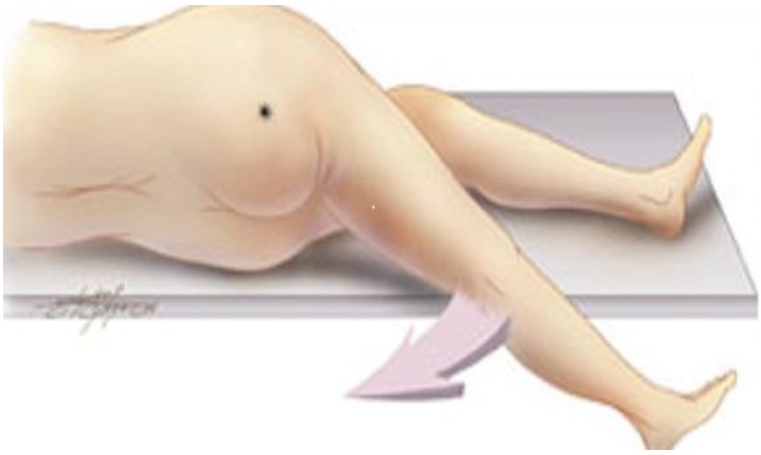


Fig .6

Anatomic basis for the psoas sign: inflamed appendix is in a retroperitoneal location in contact with the psoas muscle, which is stretched by this maneuver.

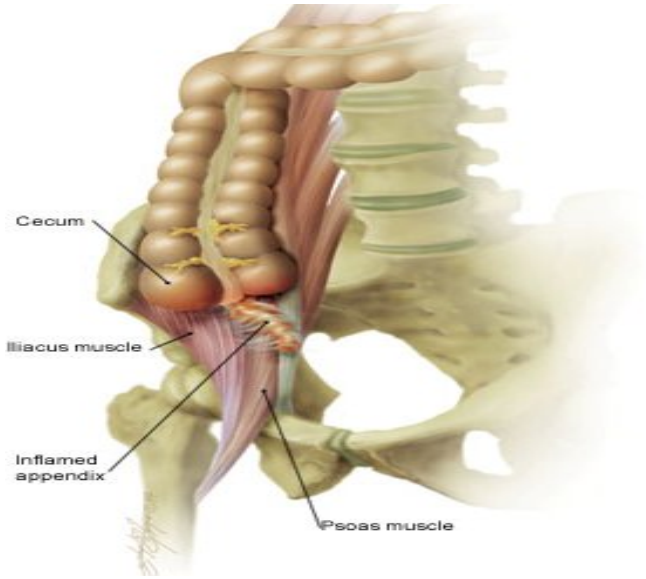


Fig.7

The obturator sign. Pain on passive internal rotation of the flexed thigh. Examiner moves lower leg laterally while applying resistance to the lateral side of the knee *(asterisk)* resulting in internal rotation of the femur

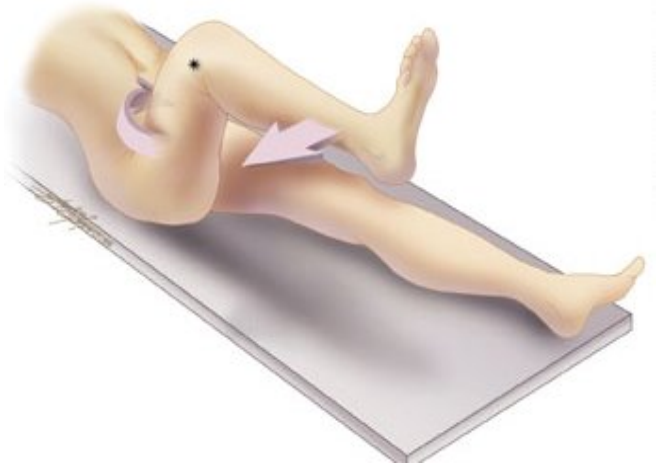


Fig.8 Anatomic basis for the obturator sign: inflamed appendix in the pelvis is in contact with the obturator internus muscle, which is stretched by this maneuver

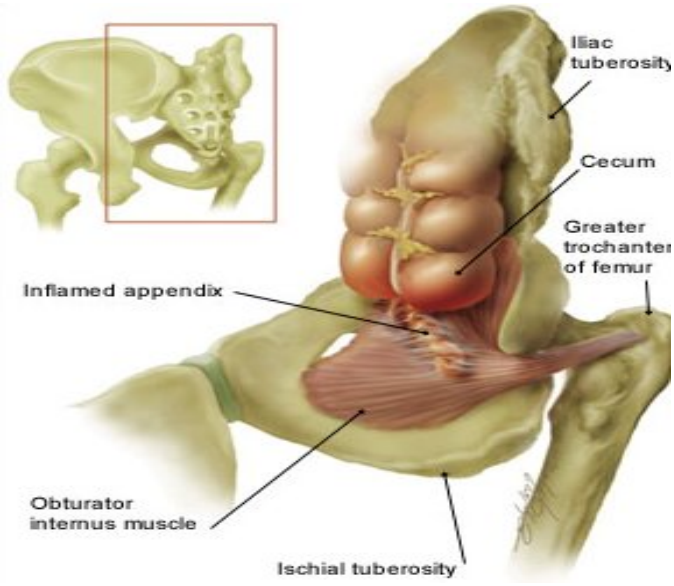


Fig . 9

2.4. Differential Diagnosis of Acute Appendicitis

The differential diagnosis of acute appendicitis is broad, but the patient's history and the remainder of the physical examination may clarify the diagnosis (Table 3.). Differential diagnosis of appendicitis for various age groups (Bailey and Love, 2004) is also briefly discussed in this section (2.10.1-2.10.4). Because many gynecologic conditions can mimic appendicitis, a pelvic examination should be performed on all women with abdominal pain. Given the breadth of the differential, diagnosis, the pulmonary, genitourinary, and rectal examinations are equally important. Studies have shown, however, that the rectal examination provides useful information only when the diagnosis is unclear and, thus, can be reserved for use in such cases (Graffeo and Counsel man, 1996).

Table 3. Differential diagnosis of acute appendicitis (Graffeo and Counsel man, 1996)

Diiferential Diagnosis of Acute Appendicitis		
Gastrointestinal	**Gynecologic**	**Pulmonary**
Abdominal pain(Cause	Ectopic pregnancy	Pleuritis
Unknown)	Endometriosis	Pneumomia
Cholecystitis	Ovarian torsion	(basilar) Pulmonary
Crohn's disease	Pelvic inflammatory Disease	Infarction
Diverticulitis	Ruptured ovarian cyst	**Genitourinary**
Duodenal ulcer	(follicular, corpus	Kidney stone
Gastroenteritis	Luteum)	Prostatitis
Intestinal Obstruction	Tubo-ovarian	Pyelonephritis

Intussusception Meckel's Diverticulitis Mesenteric Lymphadenitis Necrotizing Enter colitis Neoplasm (carainoid, Carcinoma, Lymphoma) Omental Torsion Pancreatitis Perforated viscus Volvulus	**Systemic** Diabetic Ketoacidosis Porphyria Sickle cell disease Henoch-Schonlein Purpura	Testicula Torsion Urinary tract Infection Wilms' tumor **Other** Parasitic infection Psoas abscess Rentus sheath Hematoma

2.4.1 Children

Acute gastroenteritis

There is intestinal colic together with loose stools and vomiting but lolcalized tenderness does not occur. Other family members may also be affected. Postileal appendicitis may mimic this condition.

Mesenteric lymphadenitis

Pain is colicky in nature and pain free interval between attacks noted. Shifting tenderness gives a clue to the diagnosis.

Meckel's diverticulitis

It is clinically indistinguishable from acute appendicitis. The pain is similar and andominal signs may be central or left sided. Occasionally, there is a history of antecedent abdominal pain or intermittent lower gastrointestinal bleeding.

Henoch - schonlein purpura

It is often preceded by sore throat or respiratory infection. Abdominal pain can be severe. Echymotic rash is seen over extensor surface of limbs and buttocks. Platelet counts and bleeding time are within normal limits. Microscopic hematuria is common.

Lobar pneumonia

Lobar pneumonia and pleurisy, especially at the right base, may give rise to right sided abdominal pain and mimic appendicitis. Abdominal signs are minimal, pyrexia is marked and chest examination may reveal plural friction rub or altered breath sounds on auscultation. Chest radiograph is diagnosis.

2.4.2 Adults: Male

Terminal ileitis

It is clinically indistinguishable from appendicitis unless a doughy mass of inflamed ileum is felt. An antecedent history of abdominal cramp, weight loss, and diarrhea may suggest regional rather than appendicitis.

Ureteric colic

The character and radiation of pain differs from that of appendicitis. Urine analysis should be performed; and the presence of red cells should prompt a supine abdominal radiograph.

Right sided acute pyelonephritis

The leading features are lion tenderness, fever and possibly with rigors and pyuria.

Perforated peptic ulcer

Perforated peptic ulcer with duodenal contents passing into right paracolic gutter mimics appendicitis. There is a history of dyspepsia and sudden onset of pain that starts in the epigastrium and passes down the right paracolic gutter is noted in perforated peptic ulcer. Rigidity and tenderness in right iliac fossa are present in both perforated peptic ulcer and appendicitis; more upper abdominal signs give the clue to the diagnosis of perforated peptic ulcer. An erect chest radiograph will show gas under diaphragm in perforated peptic ulser.

Torsion testis

In testicular torsion the pain may be referred to right iliac fossa. Careful examination of scrotum will clench the diagnosis.

Rectus sheath hematoma

It usually presents with acute pain and localized tenderness in right iliac fossa, often after an episode of strenuous exercise. Pain is not associated with gastrointestinal symptoms.

2.4.3. Adults: Female

Pelvic inflammatory disease

It comprise a spectrum of diseases that include salphingitis, endometritis, and tub ovarian sepsis. Pain is lower than in appendicitis and is bilateral. A history of vaginal discharge, dysmenorrhoea and burning pain during micturation is a helpful differential diagnostic point. Adenixal and cervical tenderness may be found in vaginal examination.

Mittelschmerz

Mid cycle rupture of follicular cyst with bleeding produces lower abdominal and pelvic pain. Symptoms usually subside within hours.

Torsion or hemorrhage of ovarian cyst.

It is very difficult to differentiate, tender mass be felt in vaginal examination.

Ectopic pregnancy

Ruptured ectopic pregnancy is associated with signs of haemoperitoneum. Right sided tubal pregnancy may be confused with appendicitis. Usually, there is history of missed menstrual period and urinary pregnancy test may be positive. Severe pain is felt when cervix is moved in vaginal examination.

2.4.4. Elderly

Diverticulitis

In patients with long sigmoid loop, the colon lies to the right side of midline and it may be difficult to differentiate between diverticulitis and appendicitis.

Carcinoma of caecum

The obstructed or perforated carcinoma of caecum may mimic appendicitis. A history of antecedent discomfort, altered bowl habit or unexplained anemia should raise the suspicion. A mass may be palpable.

2.5. Scoring for Acute Appendicitis

A number of clinical and laboratory based scoring system have been devised to assist diagnosing acute appendicitis. The most widely used is the Alvarado score (Table 4). A score of 7 or more is predictive of acute appendicitis (Alvarado, 1986). Kalan et al. (1994) omitted the parameter left shift of neutrophil maturation, which is

routinely available in many laboratories and produced the Modified Alvarado score. The total score is 9; and a score of 7 to 9 is predictive of acute appendicitis (Kalan et al., 1994).

Table 4. Alvarado Scoring System for acute appendicitis (Alvarado, 1986).

Symptoms	**Score**
Migratory RIF Pain	**1**
Anorexia	**1**
Nausea and Vomiting	**1**
Signs	
Tenderness (RIF)	**2**
Rebound Tenderness	**1**
Elevated Temperature	**1**
Laboratory	
Leucocytosis	**2**
Shift to left	**1**
Total	**10**

2.6. Laboratory Evaluation

White Blood Cell

The purpose of white blood cells is to protect the body from the threat of foreign agents, such as bacteria. All blood cells, including white blood cells, red blood cells, and platelets, originate from a common stem cell. Blood cell differentiation takes place in the bone marrow. This differentiation results in the development of the phagocytic white blood cells and the immune white blood cells.

The phagocytic white blood cells, which include granulocytes and monocytes, play an important role in the process of phagocytosis, the digestion of cellular debris. The granulocytes are so named because of their granular appearance. They are also called polymorphonuclear leukocytes (polys) because of their multilobed nucleus. The three types of granulocytes are neutrophils, eosinophils, and basophils. Monocytes, along with lymphocytes, are considered mononuclear leukocytes,since their nuclei are not multilobed. They are also called nongranulocytes. Neutrophils are the first white blood cells to arrive at an area of inflammation.

They begin working to clear the area of cellular debris through the process of phagocytosis. Neutrophils have a lifespan of approximately 4 days. Mature neutrophils are distinguishable by their segmented appearance, thus they are often called “segs.” Immature neutrophils, which are nonsegmented, are known as “bands” or “stabs.” In the case of an acute infectious process like acute appendicitis , the body reacts quickly by releasing the neutrophils before they have reached maturity. When this increase in bands is found, it is known as a shift to the left. As the infection or inflammation resolves and the immature neutrophils are replaced with mature cells, the return to normal is called a shift to the right. This term is also used to mean that the cells have more than the usual number of nuclear segments. This may be seen in liver disease, pernicious anemia, megaloblastic anemia, and Down syndrome.

Eosinophils play an important role in the defense against parasitic infections. They also phagocytize cell debris, but to a lesser degree than neutrophils, and do

so in the later stages of inflammation. They are also active in allergic reactions. Basophils release histamine, bradykinin, and serotonin when activated by injury or infection. These substances are important to the inflammatory process since they

increase capillary permeability and thus increase the blood flow to the affected area. Basophils are also involved in producing allergic responses. In addition, the granules on the surface of basophils secrete the natural anticoagulating substance, heparin. This provides some balance to the clotting and coagulation pathways.

Monocytes, which live months or even years, are not considered phagocytic cells when they are in the circulating blood. However, after they are present in the tissues for several hours, monocytes mature into macrophages, which are phagocytic cells. The immune white blood cells, which include the T lymphocytes, or T cells, and the B lymphocytes, or B cells, mature in lymphoid tissue and migrate between the blood and lymph. They play an integral part in the antibody response to antigens.

The lymphocytes have a lifespan of days or years, depending on their type. (See Lymphocyte Immunophenotyping) The white blood cell count and differential test, which is included in a complete blood count, includes two components. The "white blood cell count" denotes the total number of white blood cells (leukocytes) in 1 mm3 of blood. The "differential"denotes the percentage of basophils, eosinophils, lymphocytes, monocytes, and neutrophils within a sample of 100 white blood cells. Since the differential percentages always equal 100%, an increase in the *percentage* of one type of white blood cell causes a mandatory decrease in the *percentage* of at least one other type of white blood cell. Also included are the absolute values for normal counts of each of the five types of white blood cell.

Normal Values

White blood cell count

Adult: 4500–10,500/mm3 or 4.5–10.5 × 109/L (SI units)

Child 6–12 years: 4500–13,500/mm3 or 4.5–13.5 ×109/L (SI units)

Child 2–6 years: 5000–15,500/mm3 or 5.0–15.5 × 109/L (SI units)

Child < 2 weeks: 5000–21,000/mm3 or 5.0–21.0 × 109/L (SI units)

Newborn: 9000–30,000/mm3 or 5.0–21.0 × 109/L (SI units)

Differential *Percentages Absolute Counts*

Basophils 0.5–1% 15–100 cells/mm3

Eosinophils 1–4% <450 cells/mm3

Lymphocytes 20–40% 1000–4000 cells/mm3

Monocytes 2–8% <850 cells/mm3

Segmented Neutrophils 40–60% 3000–7000 cells/mm3

Band Neutrophils 0–3% <350 cells/mm3

In case of acute appendicitis , increase in Neutrophils occur.

Causes for

Increased (Neutrophilia)	**Decreased (Neutropenia)**
Acidosis	Anaphylactic shock
Acute Appendicitis	Anorexia nervosa
Acute pyogenic infections	Aplastic anemia
Cancer of liver, GI tract, bone marrow	Hypersplenism
Eclampsia	Irradiation
Emotional/physical stress	Leukemia
(exercise, labor)	Pernicious anemia
Gout	Rheumatoid arthritis

Hemorrhage	Rickettsial infection
Myeloproliferative diseases	Septicemia
Poisoning (chemicals, drugs, venom)	SLE
Rheumatic fever	Viral infection
Septicemia	
Stress	
Thyroid storm	
Tissue necrosis (surgery, burns, myocardial infarction)	
Uremia	
Vasculitis	

The white blood cell (WBC) count is elevated (greater than 10,000/mm3) in 80% of all cases of acute appendicitis (Elangovan, 1996). Unfortunately, the WBC is elevated in up to 70% of patients with other causes of right lower quadrant pain (Calder and Gajraj, 1995). Thus, an elevated WBC has low predictive value. Serial WBC measurements (over 4 to 8 hours) in suspected cases may increase the specificity, as the WBC count often increases in acute appendicitis (except in cases of perforation, in which it may initially fall) (Graffeo and Counselman, 1996).

2.7. C Reactive Protein History

C Reactive protein (CRP) was first described by Tillet and Francis in 1930 in the sera of the patient suffered from acute pneumococcal pneumonia. It was so named so named because of the ability to precipitate the C-polysaccharide of Pneumococcus. Acute inflammatory conditions, both infectious and non infectious, tissue damage, and certain malignancies result in raise of C-reactive protein as a non specific phenomenon. Highly sensitive and standardized quantitative tests made CRP

estimation as a valuable diagnostic tool. However, CRP values have to be correlated with other clinical and pathological results (Pepys and Hirschfield, 2003)

2.7.1 Acute Phase Response

C Reactive protein (CRP) is glycoprotein synthesized by hepatocytes during acute inflammation. It rapidly declines when the inflammation subsides. Its detection signifies the current inflammation. The synthesis of CRP by hepatoytes is mediated by the cytokines released from the site of tissue damage. Interleukin lb, interleukin 6, and tumor necrosis factor are important cytokines in stimulating the synthesis of CRP (Deodhare, 2001)

The acute –phase response comprised the nonspecific physiological and biochemical responses of endothermic animals to most forms of tissue damage, infection, Inflammation, and malignant neoplasia. In particular, the synthesis of a number of proteins is rapidly up regulated, principally inhepatocytes, under the control of cytokines originating at the site of pathology. Other acute-phase proteins include proteinase inhibitors and coagulation, complement, and transport proteins, but the only molecule that displays sensiticvity, response speed, and dynamic range comparable to those of CRP is serum amyloid A protein (SAA) (Pepys and Hirschfield, 2003)

2.8 Structure

CRP is a pentameric protein composed of five identical non-glycosylated polypeptides as subunits (23 kDa), each containing 206 amino acids arranged in a doughnut polymer. The molecular weight of CRP is 1,15,135. It belongs to the Pentraxin family of Calcium-dependent ligand binding plasma protein, the other

member of which in humans is serum amyloid P component (SAP) (Thompson et al., 1999).

The protomers are noncovalently associated in an annular configuration with cyclic pentameric symmetry. Each protomer has the characteristic “lectin fold”, composed of a two-layered B- sheet with flattened jellyroll topology. The ligandbinding site, composed of loops with two calcium ions bound 4 A apart by protein side-chains, is located on the concave face. The other face carries a single a-helix.

Molecular structure and morphology of human CRP. (a) Negatively stained electron micrograph showing the typical pentameric disc-like structure faceon and side-on (arrows). (b) Ribbon diagram of the crystal structure, showing the lectin fold and the two calcium atoms (spheres) in the ligand-binding site of each protomer (c) Space-filling model of the CRP molecule, showing a single phosphocholine molecule located in the ligand-binding site of each protomer Thompson et al., 1999.

2.9. Biological Role of CRP

Human CRP binds with highest affinity to phosphocholine residues, but it also binds to a variety of other autologous and extrinsic ligands, and it aggregates or precipitates the cellular, particulate, or molecular structures bearing these ligands. Autologous ligands include native and modified plasma lipoproteins, damaged cell membranes, a number of different phospholipids and related compounds, small nuclear ribonucleoprotein particles, and apoptotic cells. Extrinsic ligands include many glycan, phospholipids, and other constituents of microorganisms, such as capsular and somatic components of bacteria, fungi , and parasites, as well as plant products. When aggregated or bound to macromolecular ligands, human CRP is

recognized by Clq and potently activates the classical complement pathway , engaging C3, the main adhesion molecule of the complement system, and the terminal membrane attack C5-C9. Bound CRP may also provide secondary binding sites for factor H and thereby regulate alternative-pathway amplification and C5 convertases (Pepys and Hirschfield, 2009; Thompson et al., 1999).

The secondary effects of CRP that follow ligand binding resemble some of the key properties of antibodies, suggesting that under various circumstances CRP may contribute to host defense against infection, function as a pro-inflammatory mediator and participate in physiological and pathophysiological handling of autologous constituents. Evidence of CRP functioning in these various roles is available from experimental animal models, but there is no rigorous information from physiological isologous systems. The absence of any known deficiency or protein polymorphism of human CRP, and the phylogenetic conservation of CRP structure and its ligandbinding specificity for phosphocholine and related substances, suggest that this protein must have had survival value. Microbial infection is a major driving force of change during evolution, and CRP has many features compatible with a role in innate immunity. In addition, the impaired CRP response in active systematic lupus and the marked spontaneous antinuclear autoimmunity of SAP knockout mice are compatible with the possibility that pentraxins function to prevent autoimmunity (Pepys and Hirschfield, 2003; Thompson et al., 1999).

Phosphocholine is a component of many prokaryotes and is almost universally present in eukaryotes and a substantial proportion of germline- encoded, highly conserved natural antibodies resemble CRP in specifically recognizing

Phosphocholine. The capacity to bind these residues may thus be important for both host defense and handling of autologous constituents including necrotic and apoptotic cells. Activation of complement by human CRP may then opsonize and enhance phagocytosis of these various ligands but could also mediate proinflammatory pathophysiological effects. Intriguingly, the spectrum of autologous ligands recognized by CRP overlaps that of anti-phospholipid autoantibodies that are associated with premature cardiovascular disease in autoimmune syndromes(Pepys Hirschfield, 2003).

2.10.1. Circulating CRP Concentration

The CRP concentration in healthy persons is 8 mg/L or less. The CRP concentration rises within 4 to 6 hours of the onset of inflammation and tissue injury. Closely parallels with the acute response, doubling in every 8 hours. A peak value of 350 to 400 mg/L or more occurs after 36 to 50 hours. It remains elevated with the ongoing inflammation and declines rapidly with the resolution of inflammation by virtue of its short half-life of 4 to 7 hours. It returns to normal within 3 to 7 days. Serum CRP is a reliable and sensitive indicator of inflammation than Erythrocyte Sedimentation Rate (ESR) and Leukocyte count. Serial measurement can be used to asses the progress of the disease process (Deodhare, 2001).

In addition, 95% of patients have neutrophilia (Liu and McFadden, 1997);and in the elberly, an elevated band count greater than 6% has been shown to have a high predictive value for appendicitis (Elangovan,1996). In general,however,the WBC count are only moderately helpful in confirming the diagnosis of appendicitis because of their low specificities. A more recently suggested laboratory evaluation is determination of the C-reactive protein level.

An elevated C-reactive protein level (greater than 0.8 m/gdl) is common in appendicitis. But studies disagree in its sensitivity and specificity (Graffeo and counselman, 1996). An elevated C-reactive protein level in combination with an elevated WBC count and neutrophilia are highly sensitive (97 to 100%).Therefore, if all three of these findings are absent, the chance of appendicitis is low (Graffeo and counselman,1996;Wilcox and Traverso,1997).In patients with appendicitis, a urinalysis may demonstrate changes such as mild pyuria,proteinuria,and hematuria (Liu and McFadden,1997); but, the test serves more to exclude urinary tract causes of abdominal pain than to diagnose appendicitis.

2.11. Ultrasonogram

Ultrasonogram is helpful in evaluating patients with suspected appendicitis (Hardin, 1999). Ultrasonogram is appropriate in patients in whom the diagnosis is equivocal by history and physical examination. It is especially well suited in evaluating right lower quadrant or pelvic pain in pediatric and female patients' normal appendix (6 mm or less in diameter) must be identified to rule out appendicitis. An inflamed appendix usually measures greater than 6 mm in diameter, is noncompressible and tender with focal compression. Other right lower quadrant condition such as inflammatory bowel disease, cecal diverticulitis, Meckel's diverticulum, endometriosis and pelvic inflammatory disease can cause false positive ultrasononogram result (Hardin,1999).

Ultrasonogram is a noninvasive method of diagnostic testing in which ultrasound waves are sent into the body with a small transducer pressed against the skin. The transducer then receives any returning sound waves, which are deflected back as they bounce off various structures. The transducer converts the returning

sound waves into electric signals that are then transformed by a computer into a visual display on a monitor.

Ultra sonogram finding of Inflamed Appendix.

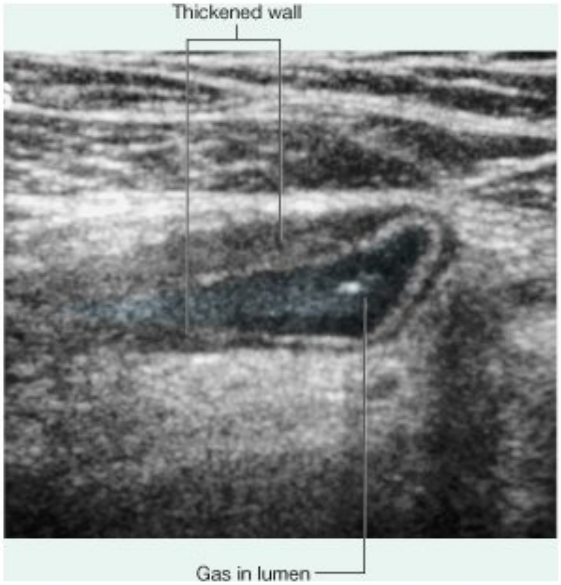


Fig. 10

2.12. Treatment for appendicitis .

2.12.1 .Nonoperative Management

Appendectomy was one of the first intra-abdominal operations performed, and appendicitis has long been a surgically treated disease. Rare descriptions of nonsurgical management dot the surgical literature, however. Treves was an advocate of early nonoperative management of acute appendicitis, even prior to the advent of antibiotics. In the post-antibiotic era, Coldrey presented his retrospective series of 471 patients with appendicitis treated with antibiotics. This treatment failed in at least 57 patients, with 48 requiring appendectomy and 9 requiring drainage of an appendiceal abscess. Only one randomized controlled trial, performed by Eriksson and associates,

addresses this issue. Their results show a high rate of recurrence of appendicitis treated nonsurgically. The authors randomized 40 adults with presumed appendicitis to appendectomy or 10 days of intravenous and oral antibiotics. Eight (40%) of the 20 patients in the antibiotic group required appendectomy within 1 year: one patient for perforation within 12 hours of randomization, and another 7 for recurrent appendicitis (one of whom had perforation). Based on the high rate of failure with antibiotics alone, nonoperative management of acute appendicitis cannot be recommended. Antibiotic treatment may be a useful temporizing measure, however, in environments with no surgical capabilities such as in space flight and submarine travel.

2.12.2.Preoperative Preparation

When the decision is made to perform an appendectomy for acute appendicitis, the patient should proceed to the operating room with little delay to minimize the chance of progression to perforation. Such occurrences are rare, however, as most cases of appendiceal perforation occur prior to surgical evaluation.[23,24] Patients with appendicitis may be dehydrated from fever and poor oral intake, so intravenous fluids should be begun, and pulse, blood pressure, and urine output should be closely monitored. Markedly dehydrated patients may require a Foley catheter to ensure adequate urine output. Severe electrolyte abnormalities are uncommon with nonperforated appendicitis, as vomiting and fever have typically been present for 24 hours or less, but may be significant in cases of perforation. Any electrolyte deficiencies should be corrected prior to the induction of general anesthesia.

Intravenous antibiotics have been shown to reduce significantly the incidence of postoperative wound infection and intra-abdominal abscess. Antibiotics should be

administered 30 minutes prior to incision to achieve adequate tissue levels. The typical flora of the appendix resembles that of the colon and includes gram-negative aerobes (primarily Escherichia coli) and anaerobes (Bacteroides spp.). No standardized antibiotic regimen exists. Acceptable options include a second-generation cephalosporin or a combination of antibiotics directed at gram-negatives and anaerobes. In nonperforated appendicitis, a single preoperative dose of cefoxitin suffices. In cases of perforation, an extended course of at least 5 days of antibiotics is advocated.

2.12.3. Open Appendectomy

If open appendectomy is chosen, the surgeon must then decide on the location and type of incision. Prior to incision, a single dose of antibiotics should be administered, typically a second-generation cephalosporin.[64] The patient should be re-examined after the induction of general anesthesia, which enables deep palpation of the abdomen. If a mass representing the inflamed appendix can be palpated, the incision can be centered at that location. If no appendiceal mass is detected, the incision should be centered over McBurney's point, one-third of the distance from the anterior superior iliac spine to the umbilicus. A curvilinear incision, now known as a McBurney's incision, is made in a natural skin fold. It is important not to make the incision too medial or too lateral. An incision placed too medial opens onto the anterior rectus sheath, rather than the desired oblique muscles, while an incision placed too lateral may be lateral to the abdominal cavity.

2.12.4. Laparoscopic Appendectomy

Laparoscopic Appendectomy can be done by a three-port technique, with one umbilical and one suprapubic port. Although the third port can be placed in either the left or right lower quadrant, we prefer the left lower quadrant. This follows the laparoscopic principle of triangulation, such that the port locations direct the camera and instruments toward the right lower quadrant for optimal visualization of the appendix.

Table 5. Laparoscopic versus Open Appendectomy.

Favors Laparoscopy	**Favors Open**
Diagnosis of other conditions	
Decreased pain and lower narcotic requirement	Shorter operating room time
Reduced length of stay	Lower operating room costs
Fewer wound infections	Fewer intra-abdominal abscesses
Quicker return to usual activities	Lower hospital costs
Lower societal cost	

2.12.5 Postoperative Care

Patients with nonperforated appendicitis typically require a 24- to 48-hour hospital stay. Postoperative care for both the laparoscopic and open approaches is similar. Patients can be started on a clear liquid diet immediately, and their diet can be advanced as tolerated. No postoperative doses of antibiotics are required. Patients can be discharged when they tolerate a regular diet and oral analgesics.

2.12.6. Perforated Appendicitis

When appendicitis progresses to perforation, management depends on the nature of the perforation. If the perforation is contained, a solid or semisolid periappendiceal mass of inflammatory tissue can form, referred to as a phlegmon. In other cases, contained perforation may result in a pus-filled abscess cavity. Finally, free perforation can occur, causing intraperitoneal dissemination of pus and fecal material. In the case of free perforation, the patient is typically quite ill and perhaps septic. Urgent laparotomy is necessary for appendectomy and irrigation and drainage of the peritoneal cavity. If the diagnosis of perforated appendicitis is known, the appendectomy can be performed through a right lower quadrant incision, and the technique follows that previously described for open appendectomy . Sometimes patients with free perforation present with an acute abdomen and generalized peritonitis, and the decision to perform a laparotomy is made without a definitive diagnosis. In such instances, a midline incision is prudent. Once perforated appendicitis is discovered, appendectomy again proceeds as described above. Peritoneal drains are not necessary, as they do not reduce the incidence of wound infection or abscess after appendectomy for perforated appendicitis.[84,85] The final operative decision is whether or not to close the incision. Because of wound infection rates ranging from 30–50% with primary closure of grossly contaminated wounds, many advocate delayed primary or secondary closure.[82,86] However, a cost-utility analysis of contaminated appendectomy wounds showed primary closure to be the most cost-effective method of wound management.[87] Our technique of skin closure is interrupted permanent sutures or staples every 2 cm with loose wound packing in between. Removal of the packing in 48 hours often leaves an excellent cosmetic result with an acceptable incidence of wound infection. Patients are often continued on

broad-spectrum antibiotics for 5–7 days and should remain in the hospital until afebrile and tolerating a regular diet.

If the patient does not have signs of generalized peritonitis, but an abscess or phlegmon is suspected by history and physical exam, a CT scan can be particularly helpful to solidify the diagnosis. A solid, inflammatory mass in the right lower quadrant without evidence of a fluid-filled abscess cavity suggests a phlegmon. In such instances, appendectomy can be difficult due to dense adhesions and inflammation. Ileocecectomy may be necessary if the inflammation extends to the wall of the cecum. Complications such as inadvertent enterotomy, postoperative abscess, or enterocutaneous fistula may ensue. Because of these potential complications, many support an initially nonoperative approach. Such an approach is only advisable if the patient is not ill-appearing. Nonoperative management includes intravenous antibiotics and fluids as well as bowel rest. Patients should be closely monitored in the hospital during this time. Treatment failure, as evidenced by bowel obstruction, sepsis, or persistent pain, fever, or leukocytosis, requires immediate appendectomy. If fever, tenderness, and leukocytosis improve, diet can be slowly advanced, usually within 3–5 days. Patients are discharged home when clinical parameters have normalized. Using this approach, more than 80% of patients can be spared an appendectomy at the time of initial presentation.

If imaging studies demonstrate an abscess cavity, CT- or ultrasound-guided drainage can often be performed percutaneously or transrectally. Studies suggest that this approach to appendiceal abscesses results in fewer complications and shorter overall length of stay. Again, following drainage the patient is closely monitored in the hospital and is placed on bowel rest with intravenous antibiotics and fluids. Advancement of diet and hospital discharge progress as clinically indicated.

3. RESEARCH METHODOLOGY

3.1 Patients and Methods

SETTING: Coimbatore Medical College Hospital

PATIENTS: Retrospective study and Comparative study was conducted among 50 patients admitted in surgical unit IV with clinical diagnosis of acute appendicitis between November 2009 and November 2011. The final diagnosis and decision to operate were made by a senior surgeon. Preoperative, complete blood count, Blood sugar, Blood urea, Serum Creatinine, Bleeding time, Clotting time, Plain x ray chest, Plain x ray abdomen erect , ECG and Urine analysis were performed.

3.1.1. Retrospective study Description

Blood sample were collected for WBC count and serum CRP before surgery. The decision to operate was made for patients with Central pain moving towards RIF, symptoms < 20 hours, Rebound tenderness in the Mc Burneys point for appendicitis Study One - Patients taken for surgery has been divided into 2 groups .The one with pathologically proven appendicitis and the other with normal histopathology of appendix. The clinical features along with Ultra sonogram are correlated with the mean value of white blood cells and C- reactive protein to give high specificity and sensitivity in diagnosis.

3.1.2.Comparative study Description

Study Two – comprised the group of patients who under gone appendectomies without delay including patients with generalized sepsis and the other group comprised of patients who had undergone appendectomies after an overnight delay.

There reason for delaying were, the time of admission (after 10pm) to hospital and the lack of Ultra sonogram abdomen. This is been supervised by senior surgeon .Both the groups were kept in Nil per oral .Intravenous Crystalloids and antibiotics were administered at the time of diagnosis. The rate of complications were recorded and compared between early surgeries and an over night delayed sugeries.

3.1.3. Criteria for the Diagnosis of Acute Appendicitis

1. History of localized or shifting right iliac fossa pain, nausea, vomiting, and anorexia.
2. Clinical findings of fever, tenderness in right iliac fossa (Mc Burneys point), guarding/rigidity, and rebound tenderness in right iliac fossa.
3. Patients with right iliac fossa pain having urinary complaints, gynecological problem. Loose stools, and mass in the right iliac fossa were excluded from the study.

3.2. White Blood Cells Measurement

3.2.1.Detemination of WBC levels in this study,

It is a quantitative measurement done by autoanalyser.

Patient was explained about the purpose of the test and the need for a blood sample to be drawn. No fasting is required before the test. A 7-mL blood sample is drawn in a collection tube containing heparin or EDTA. The tourniquet must not be in place longer than 60 seconds. Gloves are worn throughout the procedure. Apply pressure at venipuncture site. Apply dressing, periodically assessing for continued bleeding.

The blood sample collected is sent for quantitative analysis of White blood cells by autoanalyser.

3.2.2. Quantitative CRP Measurement

Laboratory Methods of Measuring CRP

Latex agglutination assay

It is a qualitative method with a detection limit of approximately 10 mg/L. upper limit of normal value. Latex agglutination assay is subject to false negative reactions due to prozone phenomenon. The antibody binding sites of the latex particles are bound to an excess of CRP so that no cross linking (agglutination) can occur. Consequently the qualitative test should be performed on several dilutions. If it is performed in several dilutions, the latex agglutination test can be converted into a semi-quantitative test. By this method, positive distinctions can be made between the levels of CRP. The distinction between bacterial (high value) and viral (normal or low) infections can be done by semi quantitative method. A nephelometer can quantify latex enhanced reactions for protein determination.

Immunoassay

Highly specific antibodies to CRP permit the development of rapid. Specific and sensitive assays. The available new methods are laser nephelometry, radio immunoassay, and enzyme linked immunoassay. With the new instruments assays can be performed in 10 to 20 minutes of turnaround time.

Ultra sensitive or high sensitivity (HS) CRP Assay

An ultra sensitive immunoturbedimetric assay has been developed for CRP. The new assay measures the increased turbidity resulting from antibody – antigen

complexes formed when a sample and antibody reagent are mixed. The ready – to – use reagents can be placed directly on a chemical analyzer, which will yield precise result can be placed directly on a chemical analyzer, which will yield precise result in few minutes. The assay has a sensitivity of 0.1 mg/L.

3.2.3. Measuring CRP Using Nephelometer

Physical Fundamentals

Nephelometer permits fully automatic, rapid quantitative measurement of precipitation and latex enhanced reactions for protein determinations. Proteins present in the sample react with specific antiserum or latex reagent to form insoluble complexes. When the light passes through this suspension, a portion of light is scattered forward by the complexes and focused on to a photodiode by an optical lens system. An infrared high performance light emitting diode is used as the light source (wave length 840 nm). In a nephelometric protein determination, the Mie scattering is primarily involved in which the particle diameter is larger than the wavelength.

Immunochemical Fundamentals

Quantification of plasma proteins is based on the specific reaction of the protein to be determined with highly specific antisera. Precipitation is antigen-antibody complexes which show up in solution as turbidity, scattering incident light and thus generating signals. The relationship between the quantity of the antigen and the measuring signal at constant antibody concentration is shown by a Heidelberger Kendal Curve. If there is an excess of antibodies, there is a approximately Proportional radio between the quantities. With the quantities of the antigen and antibodies being equal in the measuring curette, an equivalent range prevails. With an

excess of antigens, the antigen excess range prevails. In this process, the measuring signal diminishes again and may in theory cause equivocal results.

3.2.4 Factors Affecting the Level of CRP

Hemolytic, lipemic, and turbid sample may give incorrect results. False positive results are reported in oral contraceptive users and in women with intra - uterine contraceptive device. Steroids, immune suppression drugs, and Non steroidal Anti Inflammatory Drugs (NSAIDS) may induce false negativity.

3.2.5. Determination of Serum CRP Levels in this Study

Blood was drawn from a vein, usually from the inside of the elbow or the back of the hand. The puncture site was cleaned with antiseptic, and an elastic band or blood pressure cuff was placed around the upper arm to apply pressure and restrict blood flow through the vein. This causes veins below the band to swell with blood. A needle was inserted into the vain, and the blood was collected in an air – tight vial or a syringe. During the procedure, the band was removed to restore circulation. Once the blood had been collected, the needle was removed, and the puncture site was covered to stop any bleeding. No preparation was necessary for the test. Obtaining a blood sample from some people may be more difficult than from others. Collected blood sample were sent to a laboratory to measure serum CRP levels.

Serum CRP levels quantified by nephelometry, using DADE BEHRING BN 100 nephelometer and the method complies with IFCC/BCR/CAP reference preparation. Normal value of serum CRP measured by this method using the current system is less than 8 mg/L. The system can measure CRP levels for a wide range, i.e.0.175 to 1100 mg/L.

Reagent used in this study contained polystyrene particles coated with mice monoclonal antibodies; and the reagent contained gentamycin and amphotericin as preservatives. The reagent was ready to use as procured and was stable at temperatures between 2 and 8^0C. Suitable assay specimen was serum as well as heparin and EDTA – plasma sample, either fresh or frozen. The serum was coagulated and devoid of fibrin. Lipemic and turbid sample were clarified by centrifugation before use. The reagent and sample were kept at room temperature before using on nephelometer.

The reagent was agglutinated when mixed with sample containing CRP. The concentration of suspended polystyrene particles was optimal for agglutination. The measurement was done by immune-nephelometry. The intensity of the scattered light in the nephelometer depends on the CRP content of the sample; and therefore the CRP concentration can be determined using dilutions of a standard of a know concentration. Necessary serial dilutions of the standard were made automatically by the system with diluents. Controls were included in the reference curve development and measurement of CRP.

Samples were automatically diluted to either 1:400 or 1:20 dilution, with N diluents. Some samples with very levels of CRP yielded signals out of the range of the reference curve. Those samples were diluted using 1:2000 dilution. Results were automatically calculated by the instrument, using the reference curve, and reported as mg/L.

3.2.6. Ultrasonography

Ultrasonogram is a noninvasive method of diagnostic testing in which ultrasound. Ultrasonogram was done for all fifty patients. For 25 patients who came during the day hours USG was per formed immediately . For 25 patients who came in the night time after 10 pm the USG was done with a overnight delay .

Waves are sent into the body with a small transducer pressed against the skin. The Transducer then receives any returning sound waves, which are deflected back as they bounce off various structures. The transducer converts the returning sound waves into electric signals that are then transformed by a computer into a visual display on a monitor.

The normal appendix is not frequently visible on ultrasound scan. If seen, it is most likely that the appendix is inflamed. Ultra sound scan may demonstrate free fluid around a swollen appendix. An outer thickness of greater than 7mm on scan is also highly suggestive of inflammation of the appendix. Graded Compression Ultrasound greatly improves the sensitivity of ultrasound scan in the diagnosis of appendicitis in all age groups and sex.Graded Compression Ultrasound has been demonstrated to have a sensitivity of 100% and specificity of 96 % and accuracy of 98% in the diagnosis of appendicitis during pregnancy (Lim *et al*, 1992).

4. RESULTS AND DISCUSSION

4.1. Case Study Details

Patients for the study were selected from those admitted to the surgical unit: lV of Coimbatore Medical College Hospital from November 2009 to November 2011. A total number of 50 patients admitted in Fourth surgical unit with clinical diagnosis of acute appendicitis were included in the study. The selection was random; and the sample population consisted of both sexes and of different age group. There were 29 male patients and 21 female patients, age ranging from 13 to 60 years. The average age of the patients was 30.1±11.55 (mean±standard deviation).

The symptoms of appendicitis in patients were observed and recorded. Time interval between onset of pain and hospital admission varied from 10 hours to 5 days. The final diagnosis of appendectomy and decision to operate were made by a senior surgeon. All 50 patients underwent emergency open appendectomy. Out of 50 cases, 34 cases were operated by grid iron incision and 16 cases by Lanez incision. The removed appendices from all 50 patients were sent for histo pathological examination. The result was then used to categorize the operations as positive (acute appendicitis) or negative exploration (normal appendix). In the retrospective study the white blood count (WBC), CRP level, Pulse rate < 90/min ,Tempetature< 37.5 c , Ultrasound Adomen and histopathology findings were compared to assess the diagnosis of acute appendicitis. In comparative study post operative complications were studied for early and overnight delayed surgeries.

4.2. Analysis of Observations

4.2.1. Symptoms

Several symptoms were observed during the analysis of patients. All the patients had right iliac fossa pain. Most patients experienced nausea and vomiting. Fever and anorexia were also observed in several cases. The distribution of different symptoms among the patients is presented as follows:

1. Nausea and Vomiting: 48 cases (95%)
2. Classical shifting right iliac fossa pain: 48 cases (95%)
3. Fever: 40 cases (80%)
4. Anorexia: 34 cases (68%)
5. Nonshifting right iliac forssa pain: 23 cases (46%)
6. Recurrent cases: 9(18%)
7. Constipation: 8 cases (16%)

4.2.2. Signs

Detailed clinical examination was performed. All patients had right iliac tenderness and most of the patients had elevated body temperature. Details of physical findings are presented as below :

1. Right iliac fossa tenderness:50 cases (100%)
2. Elevated temperature: 40 cases (80%)
3. Rebound tenderness: 31 cases (62%)
4. Guarding/Rigidity: 11 cases (22%)
5. Rovsing’s sign: 8 cases (16%)

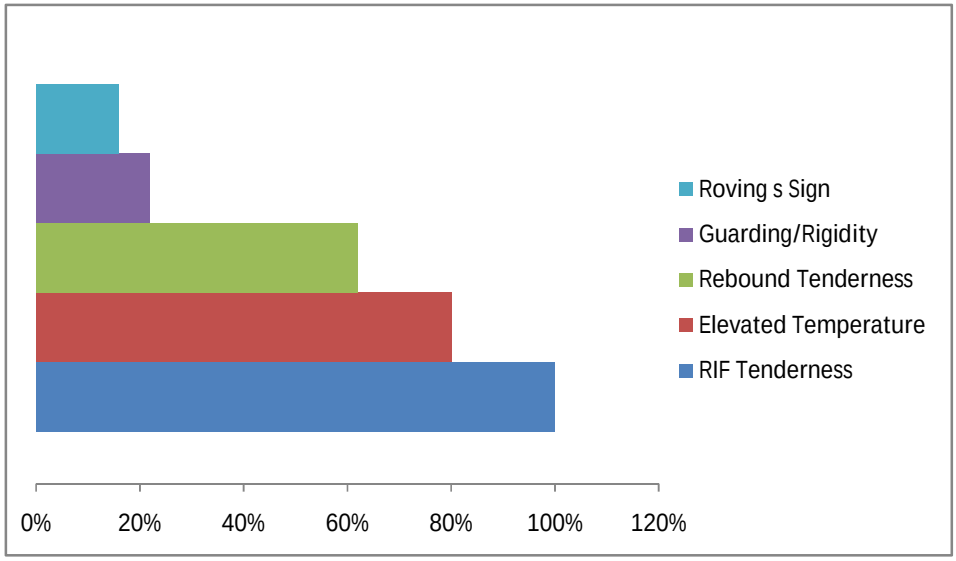


Fig .11 A Clinical signs

4.2.3. Histopathology

Appendix specimens from all 50 patients were collected and submitted to histopathological examination for final diagnosis . Figure 12 a and Figure 12 b; Figure 13 shows the wall of the appendix with the lumen at the top and peritoneal surface at the bottom. Mucosa has been destroyed and few remnants of the gland are seen. Wall is infiltrated with polymorphs, which is heavy in submucosa. There is exudate of fibrin and polymorphs on the peritoneal surface [bottom]; Figure 4 shows appendix, which is inflamed near its tip with fibrinous exudates on the peritoneal surface. Mucosa is heavily infiltrated with polymorphs. There is ulceration at the base of the gland [arrow]. Small amount of pus present in the lumen of the affected gland).Among the 29 males operated four patients were found to have normal appendix. Among the 21 female operated for appendicitis, five were found to have normal appendix. The total number of negative appendectomies performed was 9 (18 %) out of 50 cases.

Histology of Normal appendix

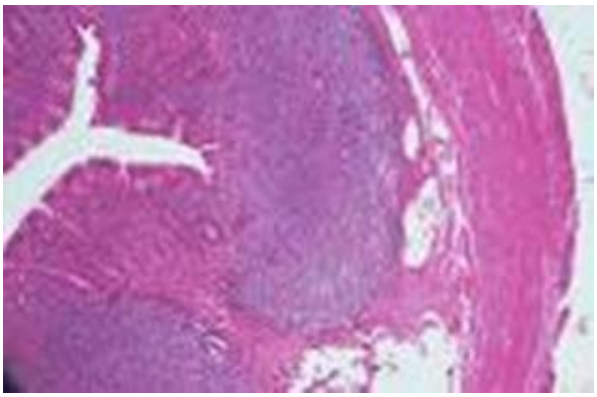


Fig.12a

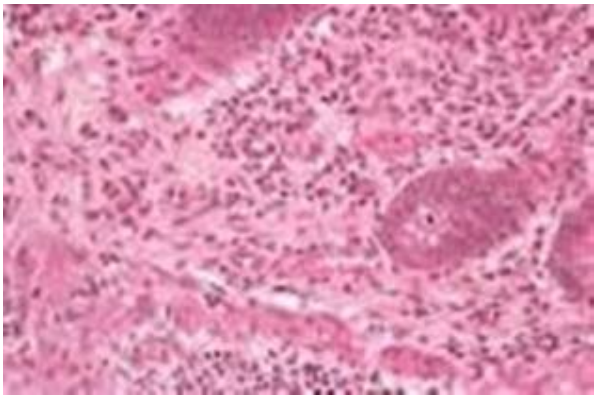


Fig12 b

Histology of Inflamed Appendix

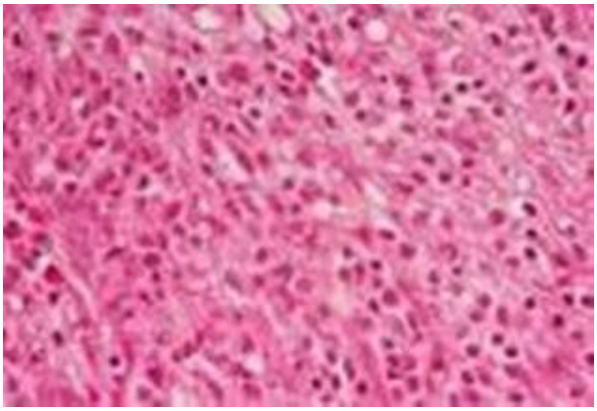


Fig .13

4.2.4. Investigations

Urine analysis was done to rule out hematuria and pyuria. No one had abnormal urine analysis. Complete Blood Count, Blood Sugar and Urea, X-ray of chest and abdomen and ECG were also normal.

4.2.5. White Blood Cell (WBC) Counts and Level of C - reactive protein (CRP)

Blood sample were collected from all 50 patients before surgery. Samples were sent to laboratory for WBC count and serum CRP measurement. Serum CRP was measured by Nephelometry method. The results of serum CRP and WBC were than correlated with diagnosis of appendicitis. Raw data for WBC count, CRP levels, and final diagnosis is presented in table 5 and 6.

4.2.6 White blood cell

White blood cell (WBC) counts in 50 patients varied from 7000 to 14,600 cells/mm^3. In acute appendicitis, the WBC varied between 10200 to 14,600 cells/mm^3. In all the positive cases, neutrophils constitute above 70%.

4.2.7 C-Reactive Protein

The levels of serum CRP in 50 cases varied from 0.1 to 160 mg/L(Table 7 and 8). The patients with final diagnosis of acute appendicitis had CRP levels between 9.1 and 160 mg/L. In seven cases, the CRP levels of were measured above 100 mg/L.Six out of those seven patients had appendicular perforations and one had gangrenous appendix. In negative exploration cases, the CRP levels varied between 0.1 and 11.9 mg/L (Table 8). In general, the serum CRP concentration in healthy persons is less

than 8mg/L. The CRP rise is due to appendicitis. With acute appendicitis, the value of CRP may vary in every eight hours.

Normal Values

CRP: 0–1.0 mg/dL or <10 mg/L (SI units)

4.2.8 Ultrasonogram

Ultrasonogram Abdomen was done for 52 patients. Out of which 41 cases showed Positive pathology in Appendix . For 25 cases Ultra sonogram was done 12 hrs delay due to non availability in the Night. In these 2 out of 25 came as normal appendix.

All the patients presented with clinical features of , duration of symptoms < 20 hours, Central pain moving to right iliac fossa and rebound tenderness at Mc Burmeys point are kept as constant.

TABLE 6. Positive Diagnosis of Appendicitis

S. No	Name	Age / Sex	IPno	Pulse/ Min	Temperature In ºC	WBC In mm^3	Serum CRP mg/L	Ultrasonogram Abdomen	Histopathology Report	Final Diagnosis.
01	Gomathi	33/F	20133	90	37.6	10200	41	Acute Appendicitis	Acute Appendicitis	Acute Appendicitis
02	Karthik	13/M	22935	110	38.6	14000	160	Gangrenous appendix	Gangrenous appendix	Gangrenous appendix
03	Uma	20/F	22910	112	39	13000	110	Appendicular Perforation	Appendicular Perforation	Appendicular Perforation
04	Pandi	15/M	24345	108	38.6	13600	120	Appendicular Perforation	Appendicular Perforation	Appendicular Perforation
05	Savitha	19/F	24253	100	37.8	10200	40	Acute Appendicitis	Acute Appendicitis	Acute Appendicitis
06	Suresh	25/M	26149	98	37.6	10000	28	Acute Appendicitis	Acute Appendicitis	Acute Appendicitis
07	Krishna	37/M	26127	94	37.6	10200	64	Acute Appendicitis	Acute Appendicitis	Acute Appendicitis
08	Murugesan	60/M	29216	98	38	10200	24	Acute Appendicitis	Acute Appendicitis	Acute Appendicitis
09	Mubarak	33/M	30903	94	38.2	10600	36	Acute Appendicitis	Acute Appendicitis	Acute Appendicitis
10	Vjayan	16/M	30847	98	38	10000	53	Acute Appendicitis	Acute Appendicitis	Acute Appendicitis
11	Suresh	27/M	37852	120	39	13200	134	Appendicular Perforation	Appendicular Perforation	Appendicular Perforation
12	Surya	27/F	39297	118	38.8	12000	132.6	Appendicular	Appendicular	Appendicular

								Perforation	Perforation	Perforation
13	Muthu	28/M	40661	94	37.8	10400	58.8	Acute Appendicitis	Acute Appendicitis	Acute Appendicitis
14	John	22/M	40802	96	37.6	10600	42	Acute Appendicitis	Acute Appendicitis	Acute Appendicitis
15	Rajeswari	44/F	43639	98	38	10680	36	Acute Appendicitis	Acute Appendicitis	Acute Appendicitis
16	Jaya	28/F	44025	92	37.6	11200	32	Normal Findings./ Probe tenderness +	Acute Appendicitis	Acute Appendicitis
17	Senthil	27/M	43271	92	38	11900	33	Acute Appendicitis	Acute Appendicitis	Acute Appendicitis
18	Jalende	35/M	52617	98	38.2	12000	38	Acute Appendicitis	Acute Appendicitis	Acute Appendicitis
19	Mani	19/M	68805	100	38.2	11600	32	Acute Appendicitis	Acute Appendicitis	Acute Appendicitis
20	Karuppusamy	35/M	19562	90	38	11000	30	Acute Appendicitis	Acute Appendicitis	Acute Appendicitis
21	Deepa	16/M	21032	92	37.9	12200	42	Acute Appendicitis	Acute Appendicitis	Acute Appendicitis
22	Veni	29/F	21093	90	37.8	11100	30	Acute Appendicitis	Acute Appendicitis	Acute Appendicitis
23	Zabura	25/F	25338	94	38	10200	06	Normal Findings / Probe tenderness+	Acute Appendicitis	Acute Appendicitis
24	Vasanthi	29/F	29924	96	37.8	10400	38	Acute Appendicitis	Acute Appendicitis	Acute Appendicitis
25	Vasanth	14/M	32845	96	38	10800	30	Acute Appendicitis	Acute Appendicitis	Acute Appendicitis
26	Tamil	14/M	36953	98	38	11000	22	Acute Appendicitis	Acute Appendicitis	Acute Appendicitis
27	Sathya	30/M	38410	94	37.8	11000	52	Acute Appendicitis	Acute Appendicitis	Acute Appendicitis
28	Dilzaa	20/F	39907	104	38.2	12200	38	Acute Appendicitis	Acute Appendicitis	Acute Appendicitis
29	Kathir	30/M	40025	106	38.4	10400	20	Acute Appendicitis	Acute Appendicitis	Acute Appendicitis

30	Srini	24/M	41278	120	39.2	13000	123	Gangrenous appendix	Gangrenous appendix	Gangrenous appendix
31	Samy	33/M	42762	104	38	11600	28	Acute Appendicitis	Acute Appendicitis	Acute Appendicitis
32	Dhanam	29/F	15572	100	38.2	10400	18	Acute Appendicitis	Acute Appendicitis	Acute Appendicitis
33	Santhosh	15/M	15453	92	38.4	10800	18	Acute Appendicitis	Acute Appendicitis	Acute Appendicitis
34	Shanmuma	15/M	15518	126	39.4	12200	82	Appendicular Perforation	Appendicular Perforation	Appendicular Perforation
35	Kanchana	29/F	33472	92	37.6	13000	70	Acute Appendicitis	Acute Appendicitis	Acute Appendicitis
36	Vanchikodi	15/F	35013	98	38.2	12000	46	Acute Appendicitis	Acute Appendicitis	Acute Appendicitis
37	Muthumari	21/F	35104	92	37.6	10600	22	Acute Appendicitis	Acute Appendicitis	Acute Appendicitis
38	Kalaivani	29/F	40742	94	37.8	11100	30	Acute Appendicitis	Acute Appendicitis	Acute Appendicitis
39	Chitra	34/F	60541	128	39	12400	112	Appendicular Abscess.	Appendicular Abscess.	Appendicular Abscess.
40	Lekshman	13/M	62929	122	38.8	13000	84	Appendicular Perforation	Appendicular Perforation	Appendicular Perforation
41	Naveen	14/M	62918	98	38.2	11600	60	Acute Appendicitis	Acute Appendicitis	Acute Appendicitis

TABLE. 7 . Negative diagnosis of appendicitis.

S. No	Name	Age / Sex	IPno	Pulse/ Min	Temperature In ^{o}C	WBC In mm^3	Serum CRP mg/L	Ultrasonogram Abdomen	Histopathology Report	Final Diagnosis.
1	Parvathi	27/F	62030	88	**37.6**	8000	0.1	Normal Findings / Probe tenderness +	Normal Appendix	Non specific Abdominal pain
2	Raghu	21/M	53580	86	**37.6**	10400	**0.2**	Normal Findings / Probe tenderness +	Normal Appendix	Non specific Abdominal pain
03	Parthiban	23/M	53554	90	**37.6**	8000	**0.2**	Normal Findings / Probe tenderness +	Normal Appendix	Non specific Abdominal pain
04	Manoharan	44/M	53558	84	**37.5**	7000	**0.9**	/ Normal Findings Probe tenderness +	Normal Appendix	Non specific Abdominal pain
05	**Revathi**	**26/F**	**62031**	**88**	**37.6**	**11000**	**11.9**	Acute Appendicitis	Normal Appendix	Terminal Ileitis
06	Usha	27/F	54716	90	**37.8**	8800	**0.5**	Acute Appendicitis	Normal Appendix	Non specific Abdominal pain
07	Padma	24/F	55434	90	**37.6**	8600	**0.2**	Normal Findings / Probe tenderness +	Normal Appendix	Non specific Abdominal pain
08	Arokiasamy	18/M	55637	84	**37.6**	11200	**0.1**	Normal Findings / Probe tenderness +	Normal Appendix	Non specific Abdominal pain
09	Kalaiselvi	30/F	55404	90	**37.6**	8000	**0.1**	Normal Findings / Probe tenderness +	Normal Appendix	Non specific Abdominal pain

4.3. Statistical Analysis

4.3.1. Test of Significance by Un paired student t-test [59]

The results were analyzed by one-way analysis of variance (ANOVA) for multiple comparisons. The differences between the two groups were determined by paired student t-test using a spreadsheet package; excel (Microsoft office XP). The two types of t-test were used to test the means of two different types of population, here namely positive and negative exploration cases. The t-test assumed that the variances of both populations are unequal. It is known as heteroscedatic t-test. . The P value of <0.005 was considered significant for all the tests. The results of the t-tests using excel are presented below.

4.3.2 Un Paired student t-test for CRP levels to positive and negative exploration of Acute Appendicitis [59].

P value and statistical significance:

The two-tailed P value equals 0.0002

By conventional criteria, this difference is considered to be extremely statistically significant.

Confidence interval:

The mean of Group One minus Group Two equals 52.456, 95% confidence interval of this difference: From 26.761 to 78.151.

Intermediate values used in calculations:

t = 4.1047

df = 48

standard error of difference = 12.780

Group	Group One	Group Two
Mean	54.034	1.578
SD	37.991	3.880
SEM	5.933	1.293
N	41	9

The mean CRP level in patients with positive exploration was 54.034 ± 37.99 mg/L

In negative explorations cases, the mean CRP level was 1.58±3.88mg/L

Only one patients in the latter group had high CRP levels, i.e., 11.9 mg/L

This patient was a 26 year old female found to have non specific abdomen pain.

4.3.3. Un Paired student t-test for WBC count in positive and negative exploration of acute appendicitis [59].

P value and statistical significance:

The two-tailed P value is less than 0.0001 By conventional criteria, this difference is considered to be extremely statistically significant.

Confidence interval:

The mean of Group One minus Group Two equals 2399.51 95% confidence interval of this difference: From 1530.66 to 3268.36

Intermediate values used in calculations:

t = 5.5528

df = 48

standard error of difference = 432.126

Data:

Group	Group One	Group Two
Mean	11399.51	9000.00
SD	1097.14	1500.00
SEM	171.34	500.00
N	41	9

In positive exploration the mean WBC level was 11399.51 ± 1097.14 mm^3

In negative explorations cases, the mean WBC level was 9000 ± 1500 mm^3

4.3.4. Un Paired student t-test for Pulse Rate in positive and negative exploration of acute appendicitis [59].

P value and statistical significance:

The two-tailed P value equals 0.0006. By conventional criteria, this difference is considered to be extremely statistically significant.

Confidence interval:

The mean of Group One minus Group Two equals 13.10 95% confidence interval of this difference: From 5.98 to 20.22

Intermediate values used in calculations:

t = 3.6987

df = 48

standard error of difference = 3.542

Data:

Group	Group One	Group Two
Mean	100.88	87.78
SD	10.48	2.54
SEM	1.64	0.85
N	41	9

In positive exploration the mean Pulse rate/min was 100.8 ± 10.48

In negative explorations cases, the mean Pulse rate/min was 87.78 ± 2.54

4.3.5 Un Paired student t-test for Temperature in positive and negative exploration of acute appendicitis [59].

P value and statistical significance:

The two-tailed P value equals 0.0015. By conventional criteria, this difference is considered to be very statistically significant.

Confidence interval:

The mean of Group One minus Group Two equals 0.547, 95% confidence interval of this difference: From 0.220 to 0.875

Intermediate values used in calculations:

t = 3.3626

df = 48

standard error of difference = 0.163

Data :

Group	Group One	Group Two
Mean	38.159	37.611
SD	0.483	0.078
SEM	0.075	0.026
N	41	9

In positive exploration the mean Temperature was 38.159 ± 0.483 ^{o} c

In negative explorations cases, the mean Temperature was 37.6 ± 0.78 ^{o} c

Table 8. Correlations between histopathology of appendix with serum C-reactive protein (CRP) levels, white blood cell (WBC), Pulse Rate and Temperature[59].

	Histopathology of Appendix		
	Positive (n=41)	**Negative (n=09)**	**P**
WBC Count, cells/mm^3	11399.51±1097.14	9000 ± 1500	<0.0001
CRP Levels, mg/L	54.034 ± 37.99	1.58±3.88	<0.0001
Pulse Rate /min	100.8 ± 10.48	87.78 ± 2.54	=0.0006
Temperature ^{o} c	38.159 ± 0.483	37.6 ± 0.78	=0.0015

Note: Values are represented as mean ± standard deviation.

4.3.6. Specificity, Sensitivity, and predictive analysis of serum CRP[59]

Specificity, sensitivity and predictive analysis (Park, 2000) for serum CRP levels were performed. Patient with high levels of serum CRP who also had acute appendicitis were considered as "true positive" (TP) cases; normal levels of serum CRP who also had normal appendix were referred as "true negative" (TN) cases; high levels of serum CRP who had normal appendix were termed as "false positive" (FP) cases; and normal levels of serum CRP but who had acute appendicitis were called "false negative" (FN) cases. There were 40 true positive (TP) cases, 08 true negative (TN) cases, 1 false positive (FP) case, and 1 false negative (FN) case. Serum CRP measurement was highly sensitive (97.5%) in patients with acute appendicitis and at the same time was highly specific (88.11) in patients who did not have appendicitis (Table 6).

Table 9. Sensitivity, Specificity, and Predictive values of serum CRP measurement in the diagnosis of acute appendicitis[59].

CRP	Histopathology		Total
	Positive	Negative	
High	40 (TP)	1(FP)	41
Normal	1(FN)	08(TN)	09
Total	41	09	50

Note: TP=true positive; TM=true Negative; FP=false Positive; FN=false Negative

Sensitivity (truly positive acute appendicitis cases) : TP/TP+FN=40/40+1[59]=97.5%

Sensitivity (truly positive appendicitis cases) : TN/TN+FP=08/08+1[59]=88.88%

Predictive value of positive test: TP/TP+FP=40/40+1[59]=97.5%

Predictive Value of negative test: TN/TN+FN=08/08+1[59]=88.88%

Percentage of false negatives : FN/FN+TP=1/1+40[59]=2.5%

Percentage of false Positives : FP/FP+TN=1/1+08[59]=11.2%

Serum CRP measurement was highly sensitive (97.5%) in patients with acute appendicitis and at the same time was highly specific(88.88%)in patient who did not have appendicitis(table 09).

4.3.7. A Specificity, Sensitivity, and predictive analysis of Ultrasonogram[59]

Specificity, sensitivity and predictive analysis (Park, 2000) for Ultrasonogram Abdomen performed. Patient with Positive pathology who also had acute appendicitis were considered as “true positive” (TP) cases:Patient with normal Ultrasound Abdomen also had normal appendix were referred as “true negative” (TN) cases; Patient with Positive pathology who had normal appendix were termed as “false positive” (FP) cases; Patients with Probe tenderness but who had acute appendicitis were called “false negative” (FN) cases. There were 38 true positive (TP) cases, 08 true negative (TN) cases, 02 false positive (FP) case, and 02 false negative (FN) case. Serum CRP measurement was highly sensitive (95%) in patients with acute appendicitis and at the same time was highly specific (80%) in patients who did not have appendicitis.

Table 10. Sensitivity, specificity, and predictive values of Ultrasonogram Abdomen in the diagnosis of acute appendicitis.[59]

Ultrasonogram Abdomen	Histopathology		Total
	Positive	Negative	
Positive Pathology	39 (TP)	02(FP)	41
Probe tenderness	02(FN)	08(TN)	09
Total	41	09	50
Ultrasonogram ------- P Value [59] < .0001			

Note: TP=true positive; TM=true Negative; FP=false Positive; FN=false Negative

Sensitivity (truly positive acute appendicitis cases) : TP/TP+FN [59]=39/39+2=95.12%

Sensitivity (truly positive appendicitis cases) : TN/TN+FP[59]=08/08+2=80%

Predictive value of positive test: TP/TP+FP=39/39+2[59]=95.12%

Predictive Value of negative test: TN/TN+FN=08/08+2[59]=80%

Percentage of false negatives : FN/FN+TP=2/2+39[59]=4.8%

Percentage of false Positives : FP/FP+TN=2/2+08[59]=20%

Ultrasound Abdomen was highly sensitive (95.12%) in patients with acute appendicitis and at the same time was highly specific(80%)in patient who did not have appendicitis(table 11).

4.3.8.Value of Diagnostic Accuracy on Over night delay

Diagnostic accuracy was of value in predicting the patients suffering from appendicitis .The positive predictive value is 95 .12% in Ultrasonogram .Two female patients found to have right sided overian cyst .One had large twisted cyst for which emergency laprotomy and Right Salphingo Oopherectemy was done by our duty OBG .Other was managed conservatively. So the over night delay in surgery due to Ultrasonogram will reduce the negative appendectomy[67] (more in females) and will not increase the post operative complications[29,67] compared to the early appendectomy as shown in the table 11.

Table .11. Complications of Appendectomies,

S No	Complications	Early Appendectomies	Late Appendectomies
01	Wound Infection	1 (8%)	1(4%)
02	Urinary tract Infection	1 (4%)	1 (4%)
03	Micturition Difficulty	2 (8%)	1(4%)
04	Head ache	2(8%)	1(8%)
05	Bowel Disturbances	2(8%)	2(8%)
06	Abdomenal Pain	1(4%)	1(4%)
07	Wound Pain	1(4%)	2(8%)

Rest of the patients for whom Appendectomies done (Early and Delayed) where not encountered with any other post operative complications.

4.4. DISCUSSION

The Proportion of normal, Inflamed and Perforated appendices encountered in this study was discussed by many authors [31,32]. This study involves clinical, biochemical and radiological correlation in arriving the diagnostic accuracy of Acute Appendicitis.

4. 4.1 Erikson et al., conducted a co hurt study, which included 227 patients with suspected acute appendicitis. Of the 227 appendicectomies. 170 had acute appendicitis. They measured serum CRP and WBC count every 4 hour. Sixty six patients were tested on two or more occasions every 4 hours. Among the 66 patients, 46 had acute appendicitis and all the 46 patients had raising levels of CRP on repetitive examination. The negative appendicectomy rate among 66 was 30% theoretically it would have fallen to 19% if appendicectomy was not done for patient with normal CRP. They concluded that if continuous CRP measurement was normal, acute appendicitis may be unlikely (Ereickson et al, 1994).

A multivariate analysis of Ooterlhuis etal. (1993) showed that the CRP measurement could improve the diagnosis accuracy of acute appendicitis. They studied 209 patients. Whit cell count and Serum CRP levels were correlated with age, sex, duration of abdominal pain, anorexia, nausea, Vomiting body temperature, , ESR. and histology of appendix. Out of 209 patients. 125 patients underwent appendicectomy and 101 were confirmed with appendicitis by histopathological examination (Oosterhuis. et al., 1993).

Gurleyik et al(19950 studied the diagnostic accuracy of serum CRP IN acute appendicitis and compared the test results with surgeon's clinical diagnosis.The researchers studied 108 clinical patients. Depending on the clinical diagnosis patients underwent appendicectomy. Serum CRP measured in all cases before operation; and the results were not taken into account for the decision of surgery. There was 18negative appendicectomies out of 108 (16.6% negative exploration) in the study, the sensitivity, specificity and accuracy of CRP measurement as a diagnostic tool for acute appendicitis was 93.5%, 80%and 91% respectively. They recommend CRPMeasurement as routine laboratory test in suspected acute appendicitis (Gurleyik et al., 1995).

Paajanen et al. (1997) retrospectively reviewed 600 patients who underwent surgery for suspected acute appendicitis. Patients were categorized by age group; up to five years, six to 19 years, 20 to 39 years, 40 to 59 years, 60 to 79 years, and older than 80 years. Laboratory test results and pathologic reports were examined. Abnormal values for white blood cell counts in adults were defined as greater than 10,000/mm^3 and as greater than 15,000/mm^3 in children from one to 15 years of age. The upper limit for the referens inderval for the C-reactive protein was 10 mg/L (paajanen et al., 1997).

In the young children, over one half of the appendectomies were negative. In older children and adults, this rate varied from 15 to 33%. Auxiliary temperature had no diagnostic value in differentiating appendicitis from a normal appendix. The leucocyte count was higher in patients with appendicitis than in those with a normal appendix in all groups except for the youngest age group (from birth to five years of age). The serum C-reactive protein concentration was elevated significantly only in

the patient with a perforated appendix. C-reactive protein appeared to have slightly better sensitivity in most age groups, but the leucocyte count had better specificity. Diagnosis accuracy remained between 50 and 78% for both the tests (paajanen et al., 1997).

The authors conclude that the leucocyte response is as good as or better than the C-reactive protein response in diagnosing uncomplicated appendicitis in all age groups except in infants. The C-reactive protein level did predict acute perforated Appendicitis in all age groups, although the leucocyte response was weaker in infants than in older patients. Leucocyte and C-reactive protein responses appear to be well conserved in older adults with appendicitis. Combining measurements of the leucocyte count and the C-reactive protein response may bring sensitivity to nearly 100%, but specificity declines to about 50%. Therefore, a negative C-reactive protein and leucocyte response may be more informative than appositive response (paajanen et al., 1997).

Asfar et al. (2000) studies 78 patients with a clinical diagnosis of acute appendicitis. They correlated the clinical diagnosis with serum CRP level. Based on clinical diagnosis and WBC count, they did appendicectomy in all 78 patients. Out of 78 patients, 63 were histologically confirmed to have appendicitis; and 15 patients had normal appendix. Asfar et al.(2000) reported a sensitivity of 93.6% and specificity of 86.6% specificity for CRP measurement in diagnosis of acute appendicitis. They concluded that normal preoperative serum CRP in suspected acute appendicitis rules out the possibility appendicitis (Asfar et al., 2000).

A more recent study (Ng and Lai, 2002) concluded that an elevated C-reactive protein level in combination with an elevated WBC count and neutrophilia were highly sensitive (97 to 100%) in diagnosing acute appendicitis. Therefore, if all three of these findings are absent, the chance of appendicitis. Therefore, if all three these findings The ultrasound-derived diagnosis of appendicitis had a sensitivity of 85.5%, a specificity of 84.4%, a positive predictive value of 88.3%, a negative predictive value of 80.1%, and an overall accuracy of 85.0%. The surgeon's clinical impression at the time of admission had a sensitivity of 62.9%, a specificity of 82.2%, a positive predictive value of 82.9%, a negative predictive value of 61.7%, and an overall accuracy of 71.2%. The overall accuracy of ultrasonography in the diagnosis of appendicitis was statistically superior to that of the surgeon's clinical impression ($P<.0001$). However, 24% of the patients with normal ultrasound findings were ultimately found to have appendicitis at operation, emphasizing the point that ultrasonography cannot be relied on to the exclusion of the surgeon's careful and repeated evaluation. (Arch Surg. 1993;128:1039-1046) .

Ultrasonography showed the highest diagnostic accuracy (92.9%; 95% confidence interval CI, 84.5%-98.0%, Bayes' theorem), followed by serum IL-6 concentration (77.6%; 67.1-86.1%, receiver-operating characteristic ROC curve analysis), clinical signs (69.5%; 59.5-79.0%, Bayes' theorem), white blood cell count (68.4%; 57.2-78.3%, ROC curve analysis), and serum C-reactive protein concentration (63.7%; 52.174.3%, ROC curve analysis). Ultrasonography achieved also the highest specificity (95.2%) and positive (93.8%) and negative (93.3%) predictive values, whereas clinical signs showed the highest sensitivity (93.9%). Ultrasonography was a more accurate diagnostic method (Croatian Medical Journal (2007).

In this study, the negative appendectomy rate was 18% [61] which is within the prevailing rate of 15 to 30%. In all patient with histological proven appendicitis the preoperative WBC count , serum CRP ,Pulse and Temperature were significantly high (p value <0.005) compared to those patients with normal appendix .This is correlated with Ultrasonogram Abdomen in arriving the diagnostic accuracy.

Preoperative serum CRP was normal in all negative exploration except one case (Table 7). Terminal ileitis was noted in that case which resulted in CRP elevation. These negative appendicectomies would have been avoided if preoperative WBC count and serum CRP levels were monitored and considered as diagnostic tools before surgery.

The sensitivity and specificity of CRP in the present study was 97.5% and 88.88% respectively. The positive and negative predictive values were 97.5% and 88.88% respectively. These results were similar to the results reported in previous studies (Asfar et al. 2000; Gurleyik et al. 1995).

4.4.2. Comparison between Alvarado Score and CRP Level.

Chan et al (2001) studied the accuracy of Alvarado scoring system in predicting acute appendicitis in patients with right iliac fossa pain. It was a retrospective study that included 148 patients and negative exploration was 21%. They derived a positive and negative predictive value for Alvarado's score of 7 or more as 77% and 97.6%, respectively. In the present study, the positive and negative predictive values for serum CRP were 97.5% and 88.8%, respectively.

Al-Hashemy and saleem (2004 studied 110 patients with diagnosed acute appendicitis using modified Alvarado score. All the 110 patients underwent appendicectomy; 30 were found to have normal appendix on histopathology. These researchers showed that the sensitivity and specificity for modified Alvarado score was 53.8% and 80%, respectively. In the present study the sensitivity and specificity for CRP measurement was 95.5%, and 88.8%, respectively.

4.4.3. Ultra sonogram

Douglas et al.(2000) conducted a randomized controlled trial of graded compression Ultra sonogram in the diagnosis of acute appendicitis incorporating Alvarado Score. Among 160 patients included in the study, 129 underwent ultra sonogram. Ultra sonogram was omitted for patient with extreme Alvarado scores. They showed that the sensitivity of ultra sonogram was 94.7% and specificity was 88.9% in diagnosing acute appendicitis.

In the patient study the sensitivity and specificity of USG Abdomen was 95% and 80% respectively. With reference to this study White blood cells and serum CRP measurement along with clinical features like Central pain moving to right iliac fossa,symptoms < 20 hrs,presence of rebound tenderness ,pulse > 90 beats/min and temperature > 37.5 c with Usltrasonogram Abdomen has a better sensitivity, specificity, and predictive accuracy in the diagnosis of acute appendicitis.

Several authors have attempted to improve diagnostic accuracy by means of symptoms ,physical findings score [25,33] . The results indicate that determining simple clinical accuracy[33] like Centrl pain radiating to RIF ,rebound tenderness at Mc Burneys point, increase in pulse > 90 beats / min and temperature > 37.6 ^{o} c , with

pre operative evaluation of WBC , CRP and Ultrasonogram gives over all positive predictive value > 90% and prevents negative appendectomy. This results suggests that if surgeon is clinically certain and if WBC and CRP are increased in Male then he is justified in performing appendectomy .In female Ultrasonogram is must before diagnosing . The investigations that have been advocated for diagnosis of appendicitis are WBC , CRP and Ultrasonogram [2 3.].

Is Surgical Delay Important ?

In this study and results suggests that an overnight delay in surgery caused by delay in doing ultrasonogram is necessary in arriving the diagnostic accuracy especially in Females . This over night delay will not increase the post operative complications[29,67].

5. CONCLUSION

Several resent studies recommend measurement of white blood cells [45] and serum C-reactive protein[35,38] as a laboratory evaluation for acute appendicitis with ,pulse > 90 beats/min[53,56] and temperature > 37.5 c[53,56] with Usltrasonogram [44,48] Abdomen in arriving the diagnostic accuracy.

An elevated White blood cells[45] (greater than 10000 cells cumm)and C-reactive protein levels[50] (greater than 8mg/L) and Ultrasonogram Abdomen [44] can be used as a diagnostic tests.

In this clinical study conducted with 50 patients, the negative appendicectomy rate was 18%. This is within the prevailing rate of 15 to 30%. In this study, the mean WBC level in patients with positive exploration was 11404.35+- 1437.32 and in negative exploration was 9000-+1309.58. The CRP level in patients with positive exploration was 54.03±43.64 mg/L. In negative exploration cases, the mean CRP level was 1.58±4.18 mg/L. In all patients with histologically proven appendicitis, the preoperative WBC and serum CRP was significantly high (p value <0.005) compared to those patients with normal appendix.

In the present study,White blood cells (P Value <.0001) , Serum CRP measurement (P Value <.0001) along with Ultrasonogram abdomen (P Value <.0005) was highly sensitive in patients with acute appendicitis; and at the same time was highly specific in patients who did not have appendicitis.

The results of this study implies that negative appendectomies can be avoided if preoperative White blood cells[45], serum CRP[50] and Ultrasonagram[44] are considered as diagnostic tests before surgery for the patients who are clinically diagnosed as Acute Appendicitis.

It is Concluded that Elevated WBC count, serum CRP, High resolution Ultrasonogram , and Surgeon's clinical diagnosis, are all to be correlated before making a decision to operate in acute appendicitis. An overnight delay in surgery caused by delay in doing ultrasonogram is necessary in arriving the diagnostic accuracy in Females.

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PROFORMA

Name :

Age / Sex :

Occupation :

Address :

Chief Complaints

1. Duration of Pain
2. Location of Pain
3. H/O Fever
4. H/O Vomiting
5. H/O Burning Micturation
6. H/O White Discharge
7. H/O Menorrhagia
8. H/O Diarrhoea
9. H/O Constipation.

PAST HISTORY

1. Diet
2. Sleep
3. Bowel / Bladder
4. Addiction

MENSTRUAL HISTORY

1. Age of Menarche / Menopause
2. Menstrual Cycle
3. L M P

MARTIAL HISTORY

Age of Marriage

OBSTETRIC HISTORY

Number and Nature of Deliveries.

FAMILY HISTORY

Size of the Family.

GENERAL EXAMINATIONS

1. Obese / Not Obese
2. Nutritional Status : Poor / Average / Good.
3. Pallor
4. Icterus
5. Cyanosis / Clubbing
6. General – Lymphadenopathy
7. B/L Pedel Edema
8. PR
9. BP

SYSTEMATIC EXAMINATION

Per Abdomen

Inspection

1. Shape
2. Movements
3. Distension

PALPATION

1. Tenderness – Generalised / Localised
2. McBurney point tenderness
3. Direct Rebound tenderness,
4. Referred or Indirect Rebound tenderness
5. Rovsing sign
6. Muscular resistance
7. Psoas sign
8. Obturator Sign

PERCUSSION

Dull / Resonent

ASCULTATION

Bowel Sounds

Per Rectal

Per Vaginal

RESPIRATORY SYSTEM

Inspection

Percussion

Auscultation

CARDIOVASCULAR SYSTEM

Inspection

Percussion

Auscultation

CENTRAL NERVOUS SYSTEM

Higher functions

Cranial Nervous

INVESTIGATIONS

Blood

1. Complete Blood Count
2. Sugar
3. Urea
4. E S R
5. Blood Grouping and Typing

BLOOD SERUM

1. Creatinine
2. Electrolytes

URINE ROUTINE

1. Ultra sonogram Abdomen and Pelvis
2. Chest X-Ray PA View Plain.
3. E C G

HISTO PATHOLOGICAL EXAMINATION

Specimen – Appendix

MANAGEMENT

Pre Operative Treatment

1. Nil Per Oral
2. Intra Venous Fluids
3. Antibiotics One Dose
4. Inj Metronidazole one dose
5. Anti Spasmodic
6. Anti Pyretic
7. Anti Inflammatory

OPERATIVE PROCEDURE

Type of Surgery

Anaesthesia GA / RA

POST OPERATIVE PERIOD

1. Treating Complications if any
2. Suture Removal

COMPLICATION EARLY AND LATE

1. Deep vein thrombosis
2. Pulmonary embolism
3. Wound Infection

4. Urinary tract infection
5. Micturition difficult
6. Persistent vomiting
7. Intra – abdominal abscess
8. Bowel obstruction
9. Wound disruption
10. Pancreatitis
11. Prolapsed piles
12. Bowel disturbance
13. Abdominal Pain
14. Wound Pain
15. Appetite loss
16. Weight loss
17. Pain not cured

Follow up.

MASTER CHART

Sr. No.	NAME	AGE / SEX	IP NO	OCCUPATION	SYMPTOMS	DURATION	RIF TENDER	TEMP ° c	Pulse / Min	WBC mm 3	CRP	USzG	SURGERY	UTI	Retension of Urine	Head ache	Bowel dis	Abdomen Pain	Wound Pain	Wound Infection	H Path	Diagnosis
1	Gomathi	33/F	20133	Labourer	RIF Pain	< 20hrs	Present	37.6ºc	90	10200	41	Ac appendicitis	Delay								Ac App	Ac App
2	Karthik	13/M	22935	Student	RIF Pain	< 20hrs	Present	38.6ºc	110	14000	160	Ganrenous	No Delay	Present		Present		Present	Present		Ac App	Ac App
3	Uma	20/F	22910	Student	RIF Pain	< 20hrs	Present	39ºc	112	13000	110	App Perforation	No Delay		Present		Present				Ac App	Ac App
4	Pandi	15/M	24345	Student	RIF Pain	< 20hrs	Present	38.6ºc	108	13600	120	App Perforation	No Delay								Ac App	Ac App
5	Savitha	19/F	24345	Student	RIF Pain	< 20hrs	Present	37.8ºc	100	10200	40	Ac appendicitis	No Delay								Ac App	Ac App
6	Suresh	25/M	26149	Labourer	RIF Pain	< 20hrs	Present	37.6ºc	98	10000	28	Ac appendicitis	Delay								Ac App	Ac App
7	Krishna	37/M	26127	Labourer	RIF Pain	< 20hrs	Present	37.6ºc	94	10200	64	Ac appendicitis	No Delay								Ac App	Ac App
8	Murugesan	60/M	29216	Farmer	RIF Pain	< 20hrs	Present	38ºc	98	10200	24	Ac appendicitis	No Delay								Ac App	Ac App
9	Mubarak	33/M	30903	Labourer	RIF Pain	< 20hrs	Present	38.2ºc	94	10600	36	Ac appendicitis	No Delay								Ac App	Ac App
10	Vijayan	16/M	30847	Student	RIF Pain	< 20hrs	Present	38ºc	98	10000	53	Ac appendicitis	Delay								Ac App	Ac App
11	Suresh	27/M	37852	Labourer	RIF Pain	< 20hrs	Present	39ºc	120	13200	134	App Perforation	No Delay			Present					Ac App	Ac App
12	Surya	27/F	39297	H Wife	RIF Pain	< 20hrs	Present	38.8ºc	118	12000	132.6	App Perforation	No Delay								Ac App	Ac App
13	Muthusamy	28/M	40661	Labourer	RIF Pain	< 20hrs	Present	37.6ºc	94	10400	58.8	Ac appendicitis	No Delay								Ac App	Ac App
14	John	22/M	40802	Labourer	RIF Pain	< 20hrs	Present	38ºc	96	10600	42	Ac appendicitis	No Delay								Ac App	Ac App
15	Rajeswari	44/F	43639	Labourer	RIF Pain	< 20hrs	Present	37.6ºc	98	10680	36	Ac appendicitis	Delay		Present		Present		Present	Present	Ac App	Ac App
16	Jaya	28/F	44025	H Wife	RIF Pain	< 20hrs	Present	38ºc	92	11200	32	WNL	Delay								Ac App	Ac App
17	Senthil	27/M	43271	Others	RIF Pain	< 20hrs	Present	38ºc	92	11900	33	Ac appendicitis	No Delay								Ac App	Ac App
18	Jalender	35/M	52617	Teacher	RIF Pain	< 20hrs	Present	38.2ºc	98	12000	38	Ac appendicitis	No Delay								Ac App	Ac App
19	Mani	19/M	68805	Student	RIF Pain	< 20hrs	Present	38.2ºc	100	11600	32	Ac appendicitis	No Delay								Ac App	Ac App
20	Karuppusamy	35/M	19562	Labourer	RIF Pain	< 20hrs	Present	38ºc	90	11000	30	Ac appendicitis	No Delay								Ac App	Ac App
21	Deepa	16/F	21032	Student	RIF Pain	< 20hrs	Present	37.9ºc	92	12200	42	Ac appendicitis	Delay								Ac App	Ac App
22	Veni	29/F	21093	H Wife	RIF Pain	< 20hrs	Present	37.8ºc	90	11100	30	Ac appendicitis	Delay								Ac App	Ac App
23	Zabura	25/F	25338	H Wife	RIF Pain	< 20hrs	Present	38ºc	94	10200	6	WNL	Delay								Ac App	Ac App
24	Vasanthi	29/F	29924	H Wife	RIF Pain	< 20hrs	Present	37.8ºc	96	10400	38	Ac appendicitis	Delay								Ac App	Ac App
25	Vasanth	14/M	32845	Student	RIF Pain	< 20hrs	Present	38ºc	96	10800	30	Ac appendicitis	No Delay		Present						Ac App	Ac App

26	Tamil	14/M	36953	Student	RIF Pain	< 20hrs	Present	38ºc	98	11000	22	Ac appendicitis	No Delay							Ac App	Ac App
27	Sathya	30/M	38410	Labourer	RIF Pain	< 20hrs	Present	37.8ºc	94	11000	52	Ac appendicitis	Delay							Ac App	Ac App
28	Dilzaa	20/F	39907	Labourer	RIF Pain	< 20hrs	Present	38.2ºc	104	12200	38	Ac appendicitis	Delay							Ac App	Ac App
29	Kathir	30/F	40025	Student	RIF Pain	< 20hrs	Present	38.4ºc	106	10400	20	Ac appendicitis	Delay							Ac App	Ac App
30	Srinivasan	24/M	41278	Labourer	RIF Pain	< 20hrs	Present	39.2ºc	120	13000	123	Ganrenous	No Delay							Ac App	Ac App
31	Samy	33/M	42762	Labourer	RIF Pain	< 20hrs	Present	38ºc	104	11600	28	Ac appendicitis	No Delay							Ac App	Ac App
32	Dhanam	29/F	15572	H Wife	RIF Pain	< 20hrs	Present	38.2ºc	100	10400	18	Ac appendicitis	Delay	Present				Present		Ac App	Ac App
33	Santhosh	15/M	15453	Student	Pain	< 20hrs	Present	38.4ºc	92	10800	18	Ac appendicitis	No Delay							Ac App	Ac App
34	Shanmugam	15/M	15518	Student	RIF Pain	< 20hrs	Present	39.4ºc	126	12200	82	App Perforation	No Delay							Ac App	Ac App
35	Kanchana	29/F	33472	H Wife	RIF Pain	< 20hrs	Present	37.6ºc	92	13000	70	Ac appendicitis	Delay							Ac App	Ac App
36	Vanchikodi	15/F	35013	Student	RIF Pain	< 20hrs	Present	38.2ºc	98	12000	46	Ac appendicitis	No Delay							Ac App	Ac App
37	Muthumari	21/F	35104	H Wife	RIF Pain	< 20hrs	Present	37.6ºc	92	10600	22	Ac appendicitis	No Delay							Ac App	Ac App
38	Kalaivani	29/F	40742	Labourer	RIF Pain	< 20hrs	Present	37.8ºc	94	11100	30	Ac appendicitis	Delay							Ac App	Ac App
39	Chitra	34/F	60541	H Wife	RIF Pain	< 20hrs	Present	39ºc	128	12400	112	App Abscess	No Delay			Present	Present			Ac App	Ac App
40	Lekshmanan	13/M	62929	Student	RIF Pain	< 20hrs	Present	38.8ºc	122	13000	84	App Perforation	No Delay							Ac App	Ac App
41	Naveen	14/M	62918	Student	RIF Pain	< 20hrs	Present	38.2ºc	98	11600	60	Ac appendicitis	Delay							Normal	NSAP
42	Parvathi	27/F	62030	H Wife	RIF Pain	< 20hrs	Present	37.6ºc	88	8000	0.1	WNL	Delay							Normal	NSAP
43	Raghu	21/M	53580	Labourer	RIF Pain	< 20hrs	Present	37.6ºc	86	10400	0.2	WNL	Delay							Normal	NSAP
44	Parthiban	23/M	53554	Labourer	RIF Pain	< 20hrs	Present	37.6ºc	90	8000	0.2	WNL	Delay							Normal	NSAP
45	Manoharan	44/M	53558	Labourer	RIF Pain	< 20hrs	Present	37.5ºc	84	7000	0.9	WNL	Delay							Normal	NSAP
46	Revathi	26/M	62031	H Wife	RIF Pain	< 20hrs	Present	37.6ºc	88	11000	11.9	WNL	Delay							Normal	NSAP
47	Usha	27/M	54716	Labourer	RIF Pain	< 20hrs	Present	37.8ºc	90	8800	0.5	Ac appendicitis	Delay							Normal	NSAP
48	Padma	24/F	55434	Student	RIF Pain	< 20hrs	Present	37.6ºc	90	8600	0.2	Ac appendicitis	Delay			Present	Present		Present	Normal	NSAP
49	Arokiasamy	18/M	55637	Student	RIF Pain	< 20hrs	Present	37.6ºc	84	11200	0.1	WNL	Delay							Normal	NSAP
50	Kalaiselvi	30/F	55404	H Wife	RIF Pain	< 20hrs	Present	37.6ºc	90	8000	0.1	WNL	Delay							Normal	NSAP