A Thesis in General Surgery

COMPARISON BETWEEN RIPASA AND ALVARADO SCORING IN DIAGNOSING ACUTE APPENDICITIS.

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Requirements for the Degree of
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Kilpauk Medical College

The Tamilnadu Dr. M.G.R Medical University

Chennai

April 2016

DECLARATION BY THE CANDIDATE

I hereby declare that this dissertation titled "**COMPARISON BETWEEN RIPASA AND ALVARADO SCORING IN DIAGNOSING ACUTE APPENDICITIS**" is a bonafide and genuine research work carried out by me under the guidance of Dr. S.Balakrishnan, M.S., Professor, Department of General Surgery, Kilpauk Medical College, Chennai.

This dissertation is submitted to THE TAMIL NADU DR. M.G.R. MEDICAL UNIVERSITY, CHENNAI in partial fulfillment of the requirements for the degree of M.S. General Surgery examination to be held in April 2016.

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The Institutional Ethical Committee of Govt. Kilpauk Medical College, Chennai reviewed and discussed the application for approval "Comparison between RIPASA and Alvarado scoring in diagnosing acute appendicitis"- For Project Work-submitted by Dr.K.Lokeshwari, M.S. Post Graduate,Department of General Surgery, Govt Kilpauk Medical College, Chennai-10.

The Proposal is APPROVED.

The Institutional Ethical Committee expects to be informed about the progress of the study any Adverse Drug Reaction Occurring in the Course of the study any change in the protocol and patient information /informed consent and asks to be provided a copy of the final report.

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COMPARISON BETWEEN RIPASA AND ALVARADO SCORIN...

By 221311159. M.s. General Surgery Dr. Lokeshwari. K

"COMPARISON+BETWEEN+RIPASA+ AND+ALVARADO+SCORING+IN+ DIAGNOSING+ACUTE+ APPENDICITIS"++ ABSTRACT BACKGROUND AND OBJECTIVE

Acute appendicitis is one of the most common cause of **acute abdominal pain and** emergency appendicectomy **is the most common emergency surgery.** 10

The confirmed diagnosis of appendicitis is by histopathological examination which is not possible before appendicectomy. Also the rate of negative exploration remains high in the rate of 15- 30%. Scoring systems based on history , clinical examination and basic investigations are there in aiding

the diagnosis of acute appendicitis and decreasing **negative** 5

exploration. This study compares RIPASA and Alvarado scoring systems in diagnosing acute sppendicitis. METHODS A comparative study was done between November 2015 to June 2015. Patients diagnosed as acute appendicitis in department of General Surgery, Govt. Royapettah Hospital. 100 of them are to be selected on the basis of non probability (purposive) sampling method. After considering the inclusion and exclusion criteria 96 were enrolled into the study. A full history, clinical examination and both scoring systems were done on the patients. RESULTS Out of the 96 patients 46 patients (48%) were male and 50 patients (52%) were female. 65 patients underwent emergency appendectomy based on the clinical decision of a senior surgeon. The

sensitivity and specificity of the RIPASA scoring system was 98.0% **and** 80.43% **respectively. The** sensitivity and specificity **of** the Alvarado **scoring** 4

system was 80.43% and 86.95% respectively. The PPV of RIPASA and ALVARODO was 84% and 85% respectively. The NPP of RIPASA and ALVARADO was 97% and 71% respectively. The Diagnostic Accuracy was 89% for RIPASA and 77% for Alvarado. The Sensitivity, NPV, and Diagnostic accuracy of RIPASA scoring was significantly higher than the Alvarado scoring. (p<0.0001). CONCLUSION: The

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LIST OF ABBREVIATIONS

CRP	C-Reactive Protein.
USG	Ultrasonography.
MALT	Mucosa Associated Lymphoid Tissue.
RIF	Right IliacFossa.
RLQ	Right Lower Quadrant.
LR+	Positive Likelihood Ratio.
LR-	Negative Likelihood Ratio.
WBC	White Blood Cell
CT	Computed Tomography
IV	Intravenous.
KUB	Kidney, Ureter, Bladder.

ABSTRACT

BACKGROUND AND OBJECTIVE

Acute appendicitis is one of the most common cause of acute abdominal pain and emergency appendicectomy is the most common emergency surgery[1]. The confirmed diagnosis of appendicitis is by histopathological examination which is not possible before appendicectomy[2]. Also the rate of negative exploration remains high in the rate of 15-30%.

Scoring systems based on history , clinical examination and basic investigations are there in aiding the diagnosis of acute appendicitis and decreasing negative exploration[3]. This study compares RIPASA and Alvarado scoring systems in diagnosing acute appendicitis.

METHODS

A comparative study was done between November 2015 to June 2015. Patients diagnosed as acute appendicitis in department of General Surgery, Govt. Royapettah Hospital. 100 of them are to be selected on the basis of non probability (purposive) sampling method. After considering the inclusion and exclusion criteria 96 were enrolled into the study. A full history, clinical examination and both scoring systems were done on the patients.

RESULTS

Out of the 96 patients 46 patients (48%) were male and 50 patients (52%) were female.65 patients underwent emergency appendicectomy based on the clinical decision of a senior surgeon. The sensitivity and specificity of the RIPASA scoring system was 98.0% and 80.43% respectively. The sensitivity and specificity of the Alvarado scoring system was 80.43% and 86.95% respectively. The PPV of RIPASA and ALVARADO was 84% and 85% respectively. The NPP of RIPASA and ALVARADO was 97% and 71% respectively. The Diagnostic Accuracy was 89% for RIPASA and 77% for Alvarado. The Sensitivity, NPV, and Diagnostic accuracy of RIPASA scoring was significantly higher than the Alvarado scoring. ($p<0.0001$).

CONCLUSION

The RIPASA scoring appeared to be a better test for scoring the probability of Acute Appendicitis.

KEY-WORDS: Alvarado, RIPASA, Acute Appendicitis

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INTRODUCTION

“Diagnosis of appendicitis is usually easy” – thus wrote Sir Zachary Cope, but with the order: “but there are difficulties which need to be discussed”. The “difficulty” alluded to by Cope relates to our inability to reliably diagnose appendicitis on clinical grounds.[4]

Acute Appendicitis is a common cause of abdominal pain for which a prompt diagnosis is rewarded by a marked decrease in morbidity & mortality.[5]

The question "Does this patient have appendicitis?" is an important question for the following reasons:

- Appendicitis is one of the common causes of abdominal pain.
- Western literatures report that 6% of population have risk of suffering from appendicitis during their lifetime.[6]
- Although the overall mortality from appendicitis has dropped from about 26% to less than 1% with the advent of antibiotics and early surgical intervention, in elderly it is approximately 5 to 15%.
- The morbidity due to appendiceal perforation(rupture) and incidence of rupture ranges from 17% to 40%.The perforation rate is higher in elderly and children.[7]
- Failure to make an early diagnosis converts acute appendicitis to perforated appendicitis, a disease with potential complications including intra

abdominal abscesses, wound infection & death.[8]

- The negative laparotomy rate ranges from 15% to 35% and is associated with significant morbidity[7,9]. The negative laparotomy rate is significantly higher in young women (up to 45%) because of prevalence of pelvic inflammatory disease (PID) and other common obstetrical and gynecological disorders[7,9].

Thus, diagnosing acute appendicitis accurately is very important in order to decrease morbidity and mortality.

Routine history and physical examination remains the most effective and practical diagnostic modalities. The typical history is onset of generalized abdominal pain followed by anorexia and nausea. Typically, the patient presents with central abdominal pain shifting to the right lower quadrant. Vomiting may happen at this time, especially in children. Physical examination will reveal signs similar to any acute intra-abdominal process-local rebound tenderness, muscle guarding, rigidity, cutaneous hyperesthesia, and tenderness on rectal examination. Since, about a third of all patients with acute appendicitis present with atypical symptoms[7,10], the differential diagnosis is varied such as gastroenteritis, regional enteritis, ovarian & tubal disorders (in young women), Ureteric colic, peptic ulcer, diverticulitis, etc.

The routine laboratory examination of blood and urine is mandatory. Leucocytosis with a left shift is a useful but non specific finding and may be absent, particularly in a very old patient. C - reactive protein is a non specific indicator of acute inflammatory conditions. Estimation of CRP may help to

support surgeon's clinical diagnosis and to reduce negative appendicectomies.[11]

Plain radiographs have an overall accuracy of only 8%. There are many findings which have been taken as appendiceal inflammation including the presence of faecolith, dilated sentinel loop of ileum, ileal or caecal air fluid level on erect films, haziness in the right lower quadrant and blurring of right psoas outline. The ileal Air/fluid level has specificity of 95% but sensitivity of only 51%, where as sentinel loop has a sensitivity of 78% and specificity of only 62%.

Though the accuracy of barium enema examination is between 50% & 84% it has limitations[12]. The major being the risk of caecal perforation and

- The findings are often negative even when the appendix has perforated and an abscess has formed.
- Time consuming for the radiologist.
- Uncomfortable for the patient.
- Entails ionizing radiation.

Computed Tomography may occasionally pick up the inflamed and normal appendix but usually depends for diagnosis on the presence of fluid in the right lower quadrant or an abscess. Laparoscopy has been shown by some authors to be particularly in young women in reproductive age because gynecological conditions may mimic acute appendicitis. The rate of diagnostic error is twice as high in women of reproductive age as that in men.

High-resolution Ultrasonography (USG) with graded compression is potentially of enormous value in diagnosing acute appendicitis but has its own limitations[13]. There have been numerous publications on the use of these diagnostic tools. These studies demonstrate a sensitivity of 75% to 94%, a specificity of 86% to 100% and overall accuracy of 87% to 96%[13,14]. Several prospective studies have been conducted in which the results of USG were used as an aid in helping the surgeon to arrive at the decision to operate.

Even, with all these diagnostic modalities the rate of negative appendicectomy of 15-25% has been accepted. However, the complication rate of unnecessary operation is up to 13%, close to that of genuinely inflamed appendix. Removing a normal appendix carries a mortality of 0.65 for every 100 operations. Prolonged clinical observations in an attempt to minimize unnecessary operation may mean a delayed operation in 28% of cases and greater risk of perforation.

Alvarado A described the scoring system in 1986. M. Kalan, D. Tabot,WJ Culliffe and AJ Rier in 1994 later modified it by taking one laboratory finding off the scoring system. The Alvarado scoring system in patients with pre-operative clinical diagnosis of appendicitis has been useful in the early diagnosis of acute appendicitis as demonstrated by various studies and was helpful in reducing the incidence of negative appendectomies without increasing the morbidity and mortality.

Similarly, Chong et al in 2010 developed a new scoring system which had 15 parameters each with a score of 0.5,1,2. This was called as RIPASA, named after the hospital in Brunei at which it was developed.[15]

RIPASA= Raja Isteri Pengiran Ank Saleha Appendicitis Score.

The need for this new scoring was based on the fact that Alvarado and Modified Alvarado were developed in western countries and its use in Asian populations did not yield the same results.

AIMS OF THE STUDY

- TO COMPARE **RIPASA** AND **ALVARADO SCORING** IN DIAGNOSING ACUTE APPENDICITIS.

REVIEW OF LITERATURE

The word “appendicitis” refers to inflammation of appendix veriformis. The literal meaning of appendix is an appendage – anything that is attached to a larger or major part as a tail or limb. The Latin word vermiform means a worm like structure. The appendix vermiformis is a worm – shaped tube arising from the posterior-medial caecal wall, 2cm or less below the end of the terminal ileum. It is confined almost entirely to humans and the higher primates, and occasionally be absent in humans.

HISTORICAL NOTE:

Though the presence of the appendix has been known for centuries, the credit for its first description goes to the physician-anatomist, Berengario Da Capri, in the year 1521[16]. The appendix was clearly depicted in anatomic drawings by Leonardo da Vinci, made in 1492 but not published until the 18th century, and was well illustrated in the AndreasVesalius work, “De Humani Corporis Fabrica,” published in 1543.

EVOLUTION OF APPENDICITIS

The disease appendicitis has been known for centuries. Aretaeus in the second century A.D. described a case in which he drained an abscess of the right part of the abdomen near the liver. This might have been a description of an abscess arising from some other source.

Jean Fernel, the great French Physician, described a case of perforated appendicitis in his Universa Medicina, which was published in 1554. He gave an account of a seven- year old girl who had diarrhea for several days and her grandmother gave her a large quince. It stopped her diarrhea, but the girl began to have severe abdominal pain and eventually she died. At autopsy the “caecum intestinum was narrow and constricted; also quince was found adherent to the inside and stopping of the lumen”.

In 1711 Lorenz Heister, professor of surgery at Helmstadt discovered a case of appendicitis when he was called to dissect the body of a criminal who had been executed. In account he wrote later that as he was “about to demonstrate the situation of the great guts (he) found the vermiform process of the caecum preternaturally black, adhering closer to the peritoneum than usual.”[17]

William Ballonius, in his Consiliorum Medicinalium published in Geneva in 1734, gave the description of gangrenous appendicitis in the living patient, although he did not use this term.

Sir Zachary Cope in his book “A history of Acute Abdomen”, has reported this. John Parkinson and Wegelar of England & Oliver Prescott of New England reported perforation of appendix in 1812. However, J.B.Louyer-Villermay in 1824 emphasized the importance of the condition in his paper, “Observations of Use in the inflammatory Conditions of the Caecal Appendix”[18], presented before the Royal academy of Medicine in Paris. Walcott Richard’s diagnosis of perforation of appendix, which he described as “ulceration of the appendix veriformis” in 1838, was confirmed on autopsy.

During the nineteenth century, the caecum was considered the chief cause of trouble in the lower quadrant and the disease of the caecum and appendix was not differentiated. All the troubles of the right lower quadrant were termed under the term typhlitis, or inflammation of the caecum. Husson and Dance in 1827, Goldbeck in 1830 and Dupuytren in 1835 developed the concept of inflammation arising in the cellular tissue surrounding the caecum. It was Goldbeck who confined the term “perityphlitis”. Later J.F.H.Albers of Bonn described four varieties of typhlitis in 1837, influencing medical thought for 50 years.[17]

Frederick Merling in the study of the pathologic anatomy of the appendix published in 1838 reported that a foreign body has been found in the appendix and was thought to have caused gangrene. Since then much has been written about foreign bodies in the appendix and are blamed for perforations[17]. In 1965 R.E.Shaw reported that the stones found in the appendix are true calculi, not just faecoliths. He said that calculous appendicitis was more apt to gangrene and perforation[17].

Reginald Fitz[19] of Boston gave his classical paper on appendix before the Association of American Physicians in 1886. His paper was based on an analysis of 257 cases of perforating ulcer of appendix and of 209 cases clinically diagnosed as typhlitis and perityphlitic abcess. The disease was found to be most common in young adults, especially males. A faecal concretion or foreign body was present in three- fifths of cases. He went on to discuss the origin of the term typhlitis, perityphlitis and paratyphlitis abscess and concluded that in vast majority of cases the primary cause was inflammation of the appendix. He preferred the term "appendicitis" to all others. He wrote "in most cases of typhlitis, the caecum is intact whilst the appendix is ulcerated and perforated." Surgeons in the United States discarded the old term of typhlitis in the 1890's and after the 19th century the idea that the caecum was the cause of inflammations in the right lower quadrant was discarded and the appendix correctly considered to be the origin.

In 1899 Charles Mcburney of New York illustrated that "exact locality of the maximum tenderness, when one examines with the fingertips in adults, is one-half to two inches inside the right anterior spinous process of the ilium on the line drawn to the umbilicus. The accuracy of this sign (Mcburney's point) I have demonstrated in every case operated upon by me since I first made the observation"[17]. This point corresponds to the base of the appendix and therefore does not move with the tip.

EVOLUTION OF APPENDICECTOMY

According to R.G.Richardson in "The Surgeons Tale", the first appendicectomy was performed at St.Georges Hospital, London, in 1726 by Claudius Amyand[20]. The patient, a boy, had hernia and a faecal fistula. Richardson reported: "When he opened the scrotum he found the appendix in the unusual position and moreover, that the appendix was perforated by a pin. He removed the appendix and then dealt with the hernia and fistula"[21].

Hancock in London successfully drained an appendix abscess in a female patient aged 30 years that was in her eighth month of pregnancy in 1848. After incising the peritoneum, fluid was drained and he made no search for the appendix[17]. Willard Parker, an American surgeon, started draining appendiceal abscesses since 1867. He did not remove the appendix and his technique is still used but the appendix is removed later on.[17]

Lawson Tait, the great English surgeon, was the first to remove an acutely inflamed appendix[21]. He thought that his patient had a general peritonitis resulting from rupture of caecum or appendix. However, when he opened the abdomen he found "a large abscess which extended deeply down towards the brim of the pelvis lying bare was the vermiform appendix which was black and discolored and gangrenous". The patient made a perfect recovery following appendicectomy and drainage of abscess.[17]

Abraham Groves performed the first elective appendicectomy in Canada in 1883. His patient was a twelve- year old boy. The appendix was removed and the stump was cauterized with a heat probe heated over the flame of a lamp. The patient recovered. Early operation for appendicitis was widely promulgated by surgeons like John Deaver (1855-1931), Charles Mcburney (1845-1913) and Murphy of Chicago[22].

In 1894, Mcburney described his incision for appendicectomy. Though he was the first to describe this incision, L.L.McArthur, who had used the incision in more than 60 cases[17], had used it for a longer time. Later McBurney gave McArthur credit for using the incision first, but despite this, it is still known as the Mcburney's incision. Later others modified the incision like Rutherford Morison in 1896, A.E.Rockey in 1905, and G.G.Davis in 1906[18].

Noteworthy as these various dates are, it is doubtful whether any of them are as important in the history of the appendicectomy as 24th June 1902. The coronation of King Edward VII had been arranged to take place on 26th June 1902, but the king fell ill with abdominal pain and fever only a few days before, At a consultation of some of the most distinguished surgeons in the land, including Lord Lister, it was decided that the only chance to save his life lay in urgent operation. Frederick Treves, who had performed his first successful appendicectomy in 1887, opened the abdomen and drained an appendix abscess on 24th June 1902. The king made a good recovery and the operation was entirely successful. After the postponed coronation on 9th august 1902, Treves received a

knighthood and Lister was made a Privy Councillor and one of the 12 original members of the Order of Merit. When welcoming Lister to his Council, the king is supposed to have said, 'I know that is it had not been for you and your work, I would not have been here today'[17].

ANATOMY

Embryologically, the vermiform appendix is the part of the caecum, which forms the distal end. It develops from the caudal part of the midgut loop. The usual surface marking for the Appendicular base is the junction of the lateral and middle thirds of the line joining the right anterior superior iliac spine to the umbilicus (Mc Burney's point); but this is merely a useful surgical approximation, with considerable variation. The three taenia coli on the ascending colon and caecum converge on the base of the appendix, and merge into its longitudinal muscle. The anterior caecal taenia is usually distinct and can be traced to the appendix, which affords a guide to its location in clinical practice.[23]

Its length varies from 2cm to 20cm, with average length of 9cm. It may occupy one of the several positions, thus it may be retrocaecal, retrocolic, pelvic or descending over the pelvic brim, in close relation to the right uterine tube and ovary. Other positions are occasionally seen especially when there is a long appendix mesentery allowing greater mobility which include subcaecal, preilial and postilieal. It has a mesoappendix with which it is attached to the ileal mesentery.[24]

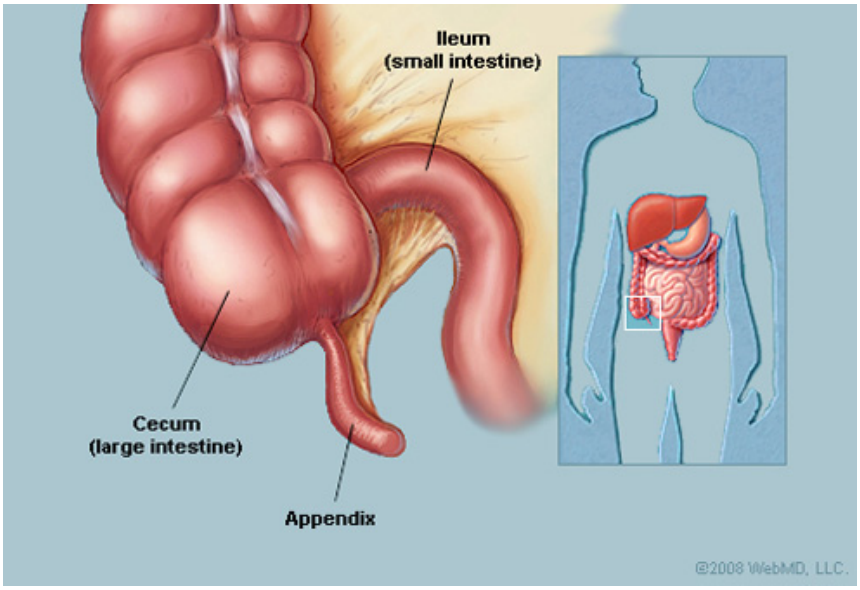


Figure 1. Anatomy of the appendix.[25]

The lumen of the appendix is small (admits a matchstick) and opens into the caecum by an orifice lying below and slightly posterior to the ileocaecal opening. The orifice is sometimes guarded by a semilunar mucosal fold forming a valve. The appendicular artery supplies it, which is the branch of the lower division of ileocolic artery which runs behind the terminal ileum and enters the mesoappendix a short distance from the appendicular base; here it gives off a recurrent branch which anastomoses at the base of the appendix with a branch of the posterior caecal artery. The main Appendicular artery approaches the tip of the organ, at first near to and then in the edge of the mesoappendix. The terminal part of the artery, however, lies on the wall of the appendix and may get thrombosed in acute appendicitis, resulting in distal gangrene or necrosis[26]. The appendix is drained via one or more appendicular veins into the posterior caecal or ileocolic

vein and thence into the superior mesenteric vein[27]. A variable number of slender lymphatic channels traverse the mesoappendix to empty into the ileocolic nodes. The appendix and overlying visceral peritoneum are innervated by sympathetic and parasympathetic nerves from the superior mesenteric plexus[18].

Histologically, it resembles the large intestine. The serosa is a complete investment, except along the mesenteric attachment. The muscular layer consists of longitudinal and circular muscles[28]. The submucosa is well developed, containing many lymphoid masses. The mucosa is covered by columnar epitheliocytes and attenuated antigen-transporting 'M' cells. The submucosal lymphoid follicles are organized like those of other examples of gut-associated lymphoid tissue and have been considered the part of the mucosa- associated lymphoid tissue (MALT)[16].

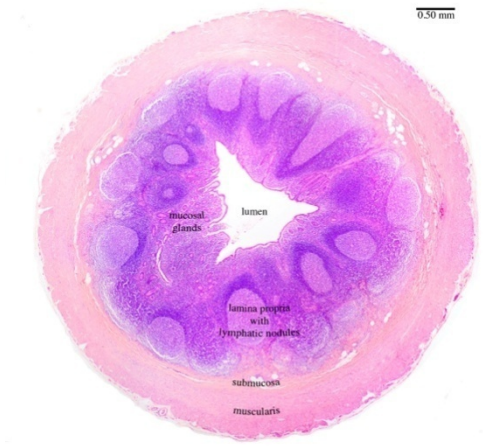


Figure 2. Histology of the appendix.

Though the physiologic role of the appendix is unproved and immunologic function is suggested by its content of lymphoid tissue. Nevertheless, it is a useful

organ for surgeons as it can be used for on table lavage of large bowel. It can also be used as a conduit for permanent continent urinary diversion[29].

The position of the appendix can be anywhere along the arc with the center at the base of the caecum[16]. It is the only organ in the body that has no constant anatomic position; in fact, its only constant feature is its mode of origin from the ceacum. The various positions of the appendix are: paracolic, retrocolic, preileal, postileal, promontoric, pelvis and subcaecal[30]. The appendix may be situated in the left lower quadrant of the abdomen in cases of transposition of viscera. The retrocaecal position is the most common. Wakeley (1933), in an analysis of 10,000 cases at post- mortem, gives the location of the appendix as follows: retrocaecal 65.28%, pelvis 31.01%, subcaecal 2.26%, preileal 1% and right paracolic and postileal 0.4%.[21]

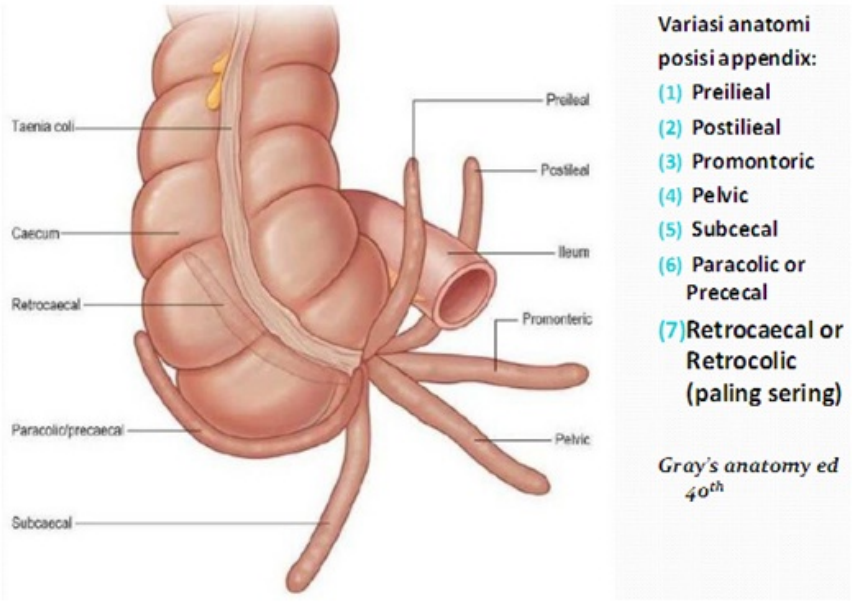


Figure 3. Positions of the Appendix

ACUTE APPENDICITIS

INCIDENCE

Acute Appendicitis is one of the most common causes of the acute surgical abdomen[21]. But since the disease is not notifiable, its exact incidence is not known. The incidence of appendicitis seems to have risen greatly in the first half of this century, particularly in Europe, America and Australia, with up to 16% of the population undergoing appendicectomy. In the past 30 years the incidence has fallen dramatically in these countries, such that the individual lifetime risk of appendicectomy is 8.6% and 6.7% among males and females respectively. The number of operations performed annually in England and Wales declined from 1,13,000 in 1966 to 48,000 in 1990, while in Sweden there has been an annual decrease of 17% in the numbers of appendicectomies performed between 1987 and 1996. Appendicitis has shown an association with western diet habits, it is undoubtedly much more common among meat eating white races and relatively rare in those races that habitually live on a bulk cellulose diet. It is also believed that there is a familial tendency in this disease that could be explained to be due to an inherited malformation of the organ. Anderson and colleagues compared 29 children between the ages of 5 and 15 years suffering from appendicitis with 29 controls. Twenty in the study group compared with four in the controls gave a history of appendicitis in parents and siblings[18]. However, family history of appendicitis has no diagnostic value.

PATHOLOGY

Acute appendicitis is thought to arise from infection superimposed on luminal obstruction[31]. The lumen of the appendix becomes obstructed by hyperplasia of submucus lymphoid follicles, fecolith, stricture, tumor, or any pathological condition. Once obstruction occurs, continous mucus secretion and inflammatory exudation increases intraluminal pressure, obstructing lymphatic drainage. Oedema and mucosal ulceration develops with bacterial translocation to the submucosa. Resolution may occur at this point either spontaneously or in response to antibiotic therapy. If this condition progresses, further distention of the appendix may cause venous obstruction and ischemia of the appendix wall. With ischemia, bacterial invasion occurs through the muscularis propria and sub mucosa, producing acute appendicitis. Finally ischemic necrosis of the appendix wall produces gangrenous appendicitis, with free bacterial contamination of the peritoneal cavity. Alternatively, the greater omentum and loops of small bowel become adherent to the inflamed appendix, walling of the spread of peritoneal contamination, resulting in a Appendicular mass or Appendicular abscess.[18]

The bacteriology of the normal appendix is similar to that of the normal colon. The appendiceal flora remains constant throughout life with the exception of Porphyromonas gingivalis, which is seen in adults[32]. The principal organisms seen in the normal appendix, in acute appendicitis, and in perforated appendicitis are Escherichia Coli and Bacteroides Fragilis. However, a wide variety of both facultative and anaerobic bacteria and mycobacteria may be present. Appendicitis

is a polymicrobial infection with some series reporting up to 14 different organisms cultured in patients with perforation[33]. According to a study by Pieper and colleagues of the bacteriology of 50 inflamed appendices, both aerobic and anaerobic bacteria were isolated in all patients. Anaerobic isolates were more than aerobic, 141 versus 96 isolates. E.Coli were the most common aerobic bacterium (45 out of 50). Other gram negative aerobes like klebsiella, and proteus and pseudomonas were isolated in ten patients.[18]Enterococci were found in 15 patients and streptococci in 21 patents. Among the anaerobes, the most common was Bacteroides fragilis. Next in frequency were gram positive cocci. Clostridium perfingeus was isolated from 9 patients.

There are two types of acute appendicitis, Catarrhal & Obstructive appendicitis[34]. Catarrhal appendicitis is initially a mucosal and submucosal inflammation. Externally; the appendix may be quite normal, or hyperemic in early stages. However the mucosa wall is thickened, edematous and reddened. Later it becomes studded with dark brown hemorrhagic infarcts, patches of green gangrene, or small ulcers. Eventually the appendix becomes swollen and turgid and the serosa becomes roughened coated with fibrinous exudates, in these cases the lumen of appendix is patent and these cases rarely progress to gangrene. However the lymphoid hyperplasia may lead to obstruction of the lumen and proceed to gangrene. Furthermore, if the episode of catarrhal appendicitis resolves, adhesion formation and kinking of the appendix may lead to a final episode of acute obstructive appendicitis.[18]

Obstructive appendicitis is the dangerous type, since the appendix becomes a closed loop of bowel containing feacal matter. When the appendix gets obstructed, the appendix becomes distended with mucus in which the bacteria proliferate. Because of increase in intraluminal pressure, there is pressure atrophy of the mucosa and the bacteria invade the deeper tissue plane. The inflammation of the wall of the appendix leads to thrombosis of the vessels, as the appendix has an end arterial blood supply, gangrene occurs inevitably followed by perforation of the necrotic appendix wall[35].

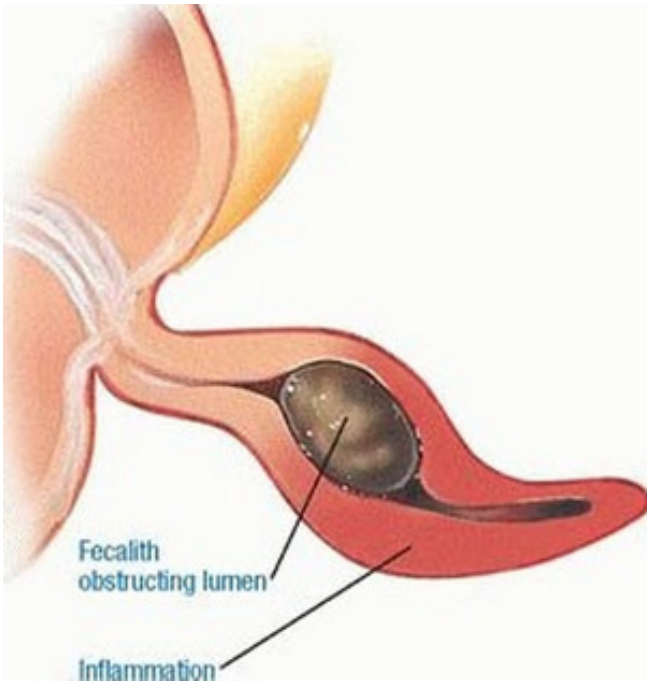


Figure 4. Fecolith of the Appendix causing Obstructive Appendicitis

Wilkie demonstrated the relationship between obstruction of the appendix and gangrenous appendicitis in 1914, which showed that acute appendicitis

followed ligation of the appendix in the rabbit[36]. Wangensteen and colleagues documented in 1937 and 1940 that combined obstruction and bacterial infection resulted in acute appendicitis.

In two third of all gangrenous appendicitis, feacolith is in the appendiceal lumen[37]. A true fecolith is ovoid, about 1 to 2 cms in length, and fecal coloured. The great majority of these fecoliths are radioopaque and, in 10% of cases, contain sufficient calcium to be demonstrated on plain x-ray film of the abdomen. Other foreign bodies like food, debris, worms, or even gallstones have been found to obstruct the appendix lumen[21]. One of the rare causes of obstructive appendicitis is the appendix becoming strangulated in hernial sac. Thomas et al (1982) reported seven such cases[38].

The most frequent site of perforation is along the antimesenteric border, usually near the tip, as the Appendicular artery is subserosal at this point and more prone to be involved in the inflammatory process and become thrombosed. After perforation a localized abscess may form in the right iliac fossa or the pelvis, or diffuse peritonitis may ensue. Whether the peritonitis remains localized or becomes generalized depends on many factors, including age of the patient, the virulence of the invading bacteria, the rate at which he inflammatory condition has progressed within the appendix and the position of the appendix[18]. It is usually stated that the poorer localization of the infection occurs in infants because the omentum of the child is filmy and less able to form a protective sheath around the inflamed appendix. A more likely explanation is that delays in

diagnosis are more prone to occur in infants. Similar delays occur in the management of elderly persons. Gangrenous appendix is more dangerous than the catarrhal type of appendicitis. An appendix situated in the retrocaecal position is more likely to form a local abscess than one in the preilieal or subcaecal position[39].

The consequences of a perforated appendix are potentially severe in women of childbearing age. The relative risk of infertility is increased three to five times in a female patient with a history of a ruptured appendix.[8]

The entity of chronic or grumbling appendicitis is controversial[18]. It has been well said that “the appendix does not grumble – it either screams or remains silent.” Both the clinical and experimental data support the belief that some patients have repeated attacks of appendicitis. In fact, it is not unusual for one or more such episodes to precede a full blown acute appendicits. In such cases, surgical specimens have shown chronic inflammatory infiltrates depending on whether the appendicectomy was performed during the attack or in between the bouts[40]. Thus the term chronic appendicitis has been used. But, it definitely does not mean prolonged abdominal pain lasting weeks or months.

CLINICAL MANIFESTATIONS

The diagnosis and management of acute abdominal pain remains one of the last bastions of clinical medicine. There is no other common situation where clinical features, accurate diagnosis, and immediate decision are of such

importance. The diagnosis of acute appendicitis is made primarily on the basis of the history and the physical findings, with additional assistance from laboratory and radiographic examinations. In appendicitis, there is highly characteristic sequence of signs and symptoms[41].

The classical features of acute appendicitis begin with poorly localized colicky abdominal pain. This is due to the midgut visceral discomfort in response to appendiceal inflammation and obstruction[42]. The pain is frequently initially noticed in the epigastric or periumbilical region, presumably due to the distention of the appendix. This central abdominal pain is followed by anorexia, nausea and vomiting. With progressive inflammation of the appendix, the parietal peritoneum in the right iliac fossa becomes irritated, producing more intense, constant and localized somatic pain that begins to predominate. During the first 6 hours, there is rarely any alteration in temperature or pulse rate, after some time, slight pyrexia with corresponding increase in pulse rate is usual. Though the patient frequently complains of constipation especially during early phase of visceral pain, many patients particularly children may present with diarrhea. If the temperature is considerably raised (i.e. >103°F) at the very beginning attack then appendicitis is less likely unless there is perforation. And perforation is extremely uncommon before 24-36 hours of onset of symptoms[43].

Physical findings are determined by the anatomic position of the inflamed appendix, as well as by whether the organ has already ruptured when the patient is first examined. The order of occurrence of the symptoms is of utmost

importance[43]. It was J.B.Murphy who recognized the importance of the sequence of symptoms.

The march of event is

- Pain, usually epigastric or umbilical
- Anorexia
- Nausea or vomiting
- Tenderness
- Fever
- Leukocytosis

The sequence of symptoms of pain abdomen followed by vomiting and then by fever is termed as “Murphy’s syndrome”. If vomiting occurs before pain abdomen then the diagnosis of acute appendicitis is questionable and a peaceful night is assured to the surgeon[44].

Murphy stated: “The symptoms occur almost without exception in the above order, and when the order varies I always question the diagnosis.” This dictum is usually true with occasional exceptions.

Tenderness in the right iliac fossa (RIF)

It is a very important sign. The early deep tenderness is almost always detected just below the joining of anterior superior iliac spine and the umbilicus.

Tenderness over the Mcburney's point is not so constant which corresponds to the base of the appendix, as the tenderness appears to be located actually in the appendix itself. In fact, the site of the tenderness varies somewhat according to the position of the appendix. Tenderness may be less in case of retrocaecal or post ileal appendix. With a retrocecal or a post ileal appendix, the anterior abdominal findings are less striking and tenderness maybe most marked in the flank. When the inflamed un-perforated appendix hangs over the brim of the pelvis or is lying wholly within the pelvis; the so called 'silent appendix', abdominal findings may be entirely absent, and the diagnosis may be missed unless the rectum is examined, pain is felt in the suprapubic area ,as well as locally within the rectum[21,44].

Peritoneal signs

A) Mc Burney's sign

Finger tip pressure is made over the Mc Burney's point (i.e, at the junction of lateral third with medial two thirds of the right spino-umbilical line), which if the sign is positive, registers the maximum abdominal tenderness[45].

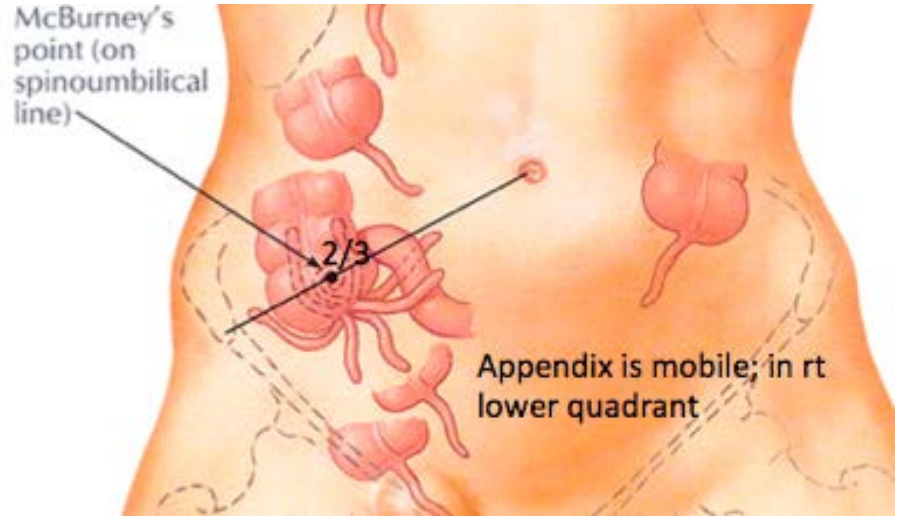


Figure 5. Mc Burney's point

B) Pointing test

When the patient is asked to point the site of pain this usually corresponds with the site of localized tenderness in McBurney's point.

C) Rovsings sign

Palpation of the left iliac fossa may produce pain in the right iliac fossa(crossed tenderness). This sign appears to be due to the shift of coils of ileum to the right impinging on an inflamed focus in the right iliac fossa[46].

D) Cough Test

When the patient coughs vigorously and holds his or her RLQ or Refuses to cough because of pain, RLQ peritonitis is confirmed[47].

E) Blumberg's sign or Rebound tenderness or Release sign

Pain on abrupt release of the palpating hand in the right iliac fossa suggests localized peritoneal irritation. However, since this exam causes severe pain to the patient, it should not be elicited frequently.

F) Cope's Psoas test

A retrocaecal appendix lies on the psoas major muscle. Inflammation of this causes irritation of psoas major muscle which is concerned with flexion of hip joint[48]. The patient is turned to the left and the right thigh is extended. This initiates pain.

G) Cope's obturator test

Internal rotation of hip in a patient with pelvic appendicitis Initiates pain as it lies over the obturator internus muscle[48].

H) Baldwing's sign

A hand is placed over the right flank and the patient is asked to raise the right lower limb with knee extended, in retrocaecal appendicitis this initiates pain and indicates the retrocecal position of the appendix.

Local hyperesthesia

In the Sherren's triangle (this is formed by lines joining the umbilicus, right anterior superior iliac spine and symphysis pubis) is regarded as a good guide in diagnosis of gangrenous appendicitis. This nearly always lies in the area of distribution of the nerves from tenth, eleventh and twelfth dorsal and first lumbar spinal segments. Hyperaesthesia signifies that the inflamed appendix is, as yet, unperforated; when perforation occurs it passes off.

Guarding

A state of voluntary contraction and rigidity- a state of involuntary contraction are uncommon findings in the early stage. Rigidity is usually present in case of diffuse peritonitis due to perforation.

However, the accuracy of these signs in diagnosing appendicitis is not clear. Wagner et al did the systematic review of literatures regarding evaluation of the accuracy of the clinical presentation of appendicitis. Three findings show a high positive likelihood ratio (LR+) and, when present are most useful for identifying patients at increased likelihood for appendicitis: right lower quadrant pain (LR+=8.0), rigidity (LR+=4.0) and the migration of pain to right lower quadrant (LR+=3.1). Unfortunately, no single component consistently provided a low negative likelihood ratio(LR-) that would rule out appendicitis. The absence of right lower quadrant pain and the presence of similar pain in the past demonstrate powerful negative LRs (0.2and 0.3,respectively).

In another prospective study[49], the diagnostic value of 21 elements of the history, clinical findings, body temperature and laboratory examinations were assessed and compared in 496 patients with suspected appendicitis. No single variable had sufficiently high discriminating or predicting power to be used as a true diagnostic test. But, the independent predictors of appendicitis were total leukocyte and differential counts, CRP concentrations, rebound tenderness, abdominal guarding and patient gender. This study showed that the element of disease history had low power in discriminating for appendicitis and advanced appendicitis. However, the elements of clinical findings had better discriminating power than history except the site of tenderness. A family history of appendicitis, previous experience of similar symptoms, anorexia, nausea, constipation, diarrhea or the progression of pain had no diagnostic value for appendicitis. Right sided rectal tenderness was found to be a predictor of negative exploration.

DIFFICULTY IN DIAGNOSIS

Clinical diagnosis is difficult in patients who present with diarrhea which mimic enteritis, especially if the appendix is in pelvic position with minimal abdominal signs. Also, in obese patients it is difficult to demonstrate the signs. Poor historians are our worst enemies. However, the greatest difficulties lie in young children, elderly and the pregnant.[21,22,43]

Appendicitis in children is rare before the age of 2 years because of the wider lumen in infants. The clinical picture of acute appendicitis in young

children is often atypical, presenting with a generalized abdominal pain. It is a good rule that if there is a localized tenderness and muscle guarding in the RIF, in a previously healthy child, then the chances are very strong indeed that the diagnosis is one of acute appendicitis[50].

Appendicitis in elderly is a more serious condition[51]. The clinical features of patients more than 60 years of age are similar to those of younger age groups in the pattern and duration of symptoms, the temperature changes, and the leukocyte responses. The poorer localization of the infection, thrombosis of the appendicular artery which occurs early, clinical signs not obvious due to muscular atropy and diminished blood supply as a result of generalized atherosclerosis are important factors in allowing rapid progression of the disease.

Appendicitis in pregnancy, the risk is similar to that of non pregnant woman of the same age[52]. Appendicitis occurs more frequently during the first two trimesters, and during this time period the symptoms of appendicitis are similar to those seen in non pregnant women[53]. During the third trimester, the cecum and appendix are displaced laterally. This results in localization of pain either more cephalad or laterally in the flank, leading to delay in diagnosis and an increased incidence of perforation and diffuse peritonitis as displacement of the omentum by the uterus impairs localization of the inflamed appendix. It is the peritonitis, and not the appendicectomy, that poses the risk to the mother and fetus alike, and therefore, early operation is the rule[54].

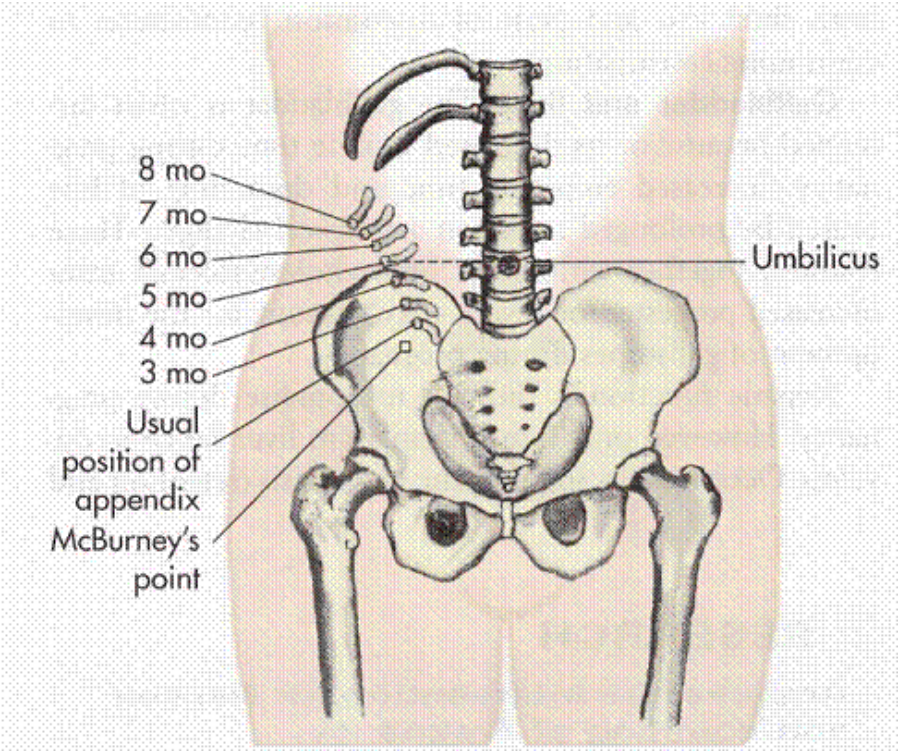


Figure 6. Position of Appendix during pregnancy

DIFFERENTIAL DIAGNOSIS

Nothing can be so easy or as difficult as the diagnosis of acute appendicitis. The clinical examination and the investigations are non-specific. Thus, the list of differential diagnosis is long. Most of the entities in the differential diagnosis of appendicitis also require operative therapy and are not made worse by an exploratory laparotomy, but it is necessary to eliminate pancreatitis, myocardial infarction, and basal pneumonia for which surgery would be a blunder. The disease in young children that are most frequently mistaken for acute appendicitis are gastroenteritis, mesenteric lymphadenitis, meckels's diverticulitis, pyelitis, small intestinal intussusception, enteric duplication, and basilar pneumonia[55]. In

teenagers and adults, the differential diagnosis is different in men and women. In young women, the differential diagnosis include ruptured ectopic pregnancy, mittelschmertz, endometriosis, uretric colic and salpingitis. Chronic constipation also needs a consideration. In young men, the potential list is smaller and includes the acute onset of regional enteritis, right sided renal or ureteric calculi, torsion of the testis, and acute epididymitis. In older patients, the differential diagnosis include diverticulitis, a perforated peptic ulcer, acute cholecystitis, acute pancreatitis, intestinal obstruction, perforated cecal carcinoma, mesenteric vascular occlusion, rupturing aortic aneurysm, and the disease entities already mentioned for young adults[56].

DIAGNOSTIC STUDIES

Acute appendicitis is essentially a clinical diagnosis. Routine history and physical examination remain the most practical diagnostic modalities. No laboratory or radiological test yet devised is diagnostic of this condition.

WHITE CELL COUNT

The polymorph leucocytosis is an important feature of acute appendicitis[57]. In three quarters of patients the white cell count is raised above 12,000/mm^3[7]. However, in others, the count may be slightly raised or normal, especially in children. Neutrophilia is also one of the features of appendicitis. In 1982,Pieper et al[58] noted that 66.7% had white cell count of 11,000/mm^3 or more and in only 5.5% it was raised above 20,000/mm^3. Andersson et al[49] reported that

the WBC and neutrophils count had higher power in discriminating for advanced appendicitis than for all appendicitis. Appendicitis was unlikely at lowest level of the WBC and neutrophils count and rate (LR0.16-0.28 at WBC count <8000/mm³, neutrophils count <7000/mm³, or rate<70%) and likely at the highest WBC Count. neutrophils count >13,000/mm³ and rate >85%. However, Coleman C et al reported that WBC is a poor predictor of the severity of the disease in the diagnosis of acute appendicitis[59].

URINE EXAMINATION

The presence of hematuria or pus cells in the urine does not rule out appendicitis. Irritation of ureter or urinary bladder by the inflamed appendix may cause microscopic hematuria or pyuria[21,22,44]. Graham(1965) quantitatively analyzed midstream urine specimens in 71 patients operated upon with the diagnosis of acute appendicitis. Of these, 62 had an acutely inflamed appendix removed and nine patients had normal appendix. In this whole group, nine female patients had microscopic pyuria and one also had hematuria. One male patient had microscopic hematuria[21].

C-REACTIVE PROTEIN

CRP is a non specific acute phase reactant, which appears in the sera of individuals in response to a variety of inflammatory conditions and tissue necrosis[57]. It is a non-specific indicator for acute appendicitis. There have been various studies regarding the importance of CRP in differentiating appendicitis

from other non inflammatory conditions of the abdomen. One of the such studies showed that CRP value is increased markedly only after appendiceal perforation or abscess formation[11]. However increase in leukocyte count was found to be an early marker of appendiceal inflammation. This study reported that the CRP concentration and temperature had high power in discriminating advanced appendicitis than all appendicitis. Also the CRP concentration >10mg/L was found to be one of the independent predictors of appendicitis[49].

RADIOGRAPHY

Plain films of abdomen in supine and erect position are of value in differential diagnosis of acute abdominal pain. However, they are non specific. Brookes and Killen[60] have described a number of radiological signs in patients with acute appendicitis:

- Fluid level localized to the caecum and to the terminal ileum
- Localized ileus, with gas in the caecum, ascending colon or terminal ileum.
- Increased soft tissue density in the right lower quadrant.
- Blurring of right flank stripe, the radiolucent line produced by fat between the peritoneum and transverse abdominals.
- A faecolith in the right iliac fossa

- Blurring of psoas shadow on the right side
- A gas filled appendix
- Free peritoneal gas
- Deformity of caecal gas shadow due to an adjacent inflammatory mass

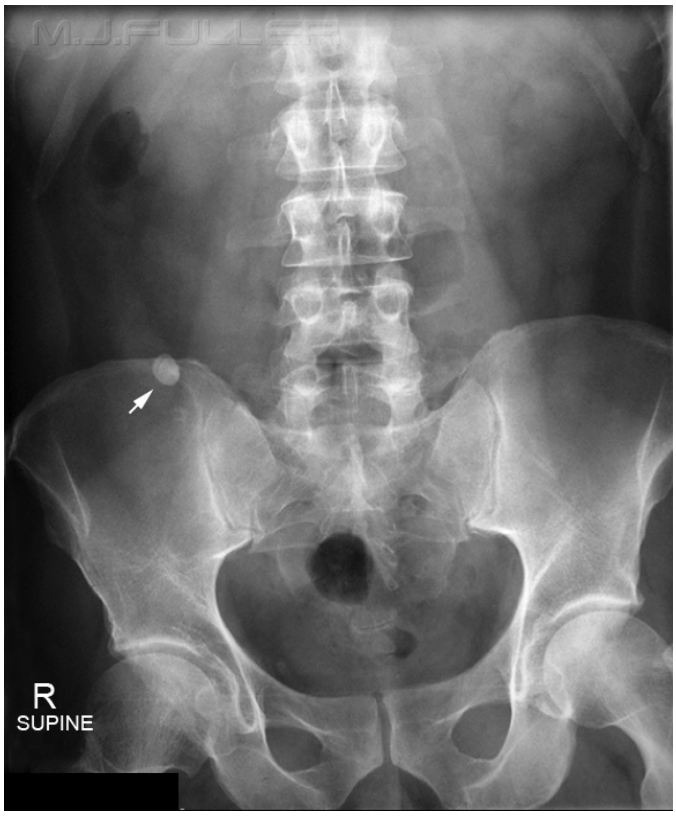


Figure 7. Fecolith of Appendix in X-ray abdomen erect

They reviewed the x-rays of 200 patients undergoing laparotomy for acute appendicitis without knowing the diagnosis. 80% of patients with acute appendicitis had one or more of these signs positive. However, 37% of patients who had normal appendix had similar x-ray findings. Thus, plain films of abdomen are neither sensitive of specific to alter the maxim “If the diagnosis of

appendicitis remains in doubt, take appendix out"[61].

ULTRASONOGRAPHY

In 1989, Julien B.C.M. Puylaert described the value of graded compression sonography in the evaluation of acute appendicitis. The accuracy afforded by sonography should keep negative laparotomy rates at approximately 10%, clearly an improvement over the rate achieved by instinct alone. Ultrasound proved most useful for those patients who have an indeterminate probability to the disease upon initial clinical examination[62]. The sonographic hallmark of appendicitis is direct visualization of the inflamed appendix. The typical appearance is that of a concentrically layered, almost incompressible, sausage like structure demonstrated as the site of maximum tenderness.

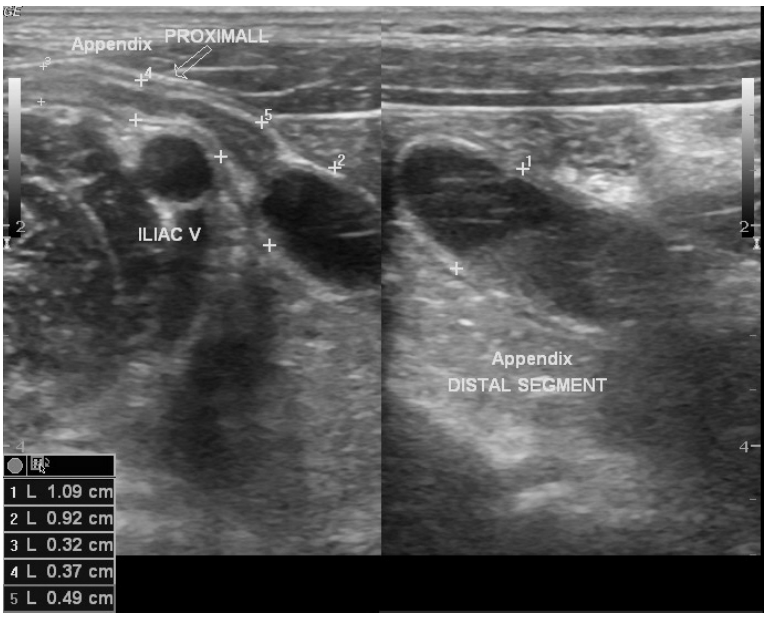


Figure 8. USG in Acute Appendicitis

The usual findings are:

- Visualization of noncompressible appendix as a blind-ending tubular aperistaltic Structure.
- Target appearance of >6mm in total diameter on cross section (81%) maximal mural wall thickness >2mm
- Diffuse hypoechogenecity (associated with higher incidence of perforation)
- Lumen maybe distended with anechoic/hyperechoic material.
- Loss of wall layers
- Visualization of appendicolith (6%)
- Localized periappendiceal fluid collection
- Prominent hyperechoic mesoappendix/pericaecal fat.

Colour Doppler findings are:

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

The most important reason for a false negative ultrasound examination is over looking the inflamed appendix[63]. In experienced hands the inflamed appendix can be visualized in 90% of patients with non-perforated appendicitis, 85% of those with an appendiceal mass and in 55% of those with free perforation

of the appendix.

Peritonism preventing graded compression probably accounts for the limited success in patients with appendiceal perforation. In addition air filled dilated bowel loops from adynamic ileus may hide the appendix from view.

COMPUTED TOMOGRAPHY

Abdominal CT has become the most important imaging study in the evaluation of patients with atypical presentations of appendicitis[64]. Studies have shown a decrease in negative laparotomy rate and appendiceal perforation rate when abdominal CT is used in selected patients with suspected appendicitis.

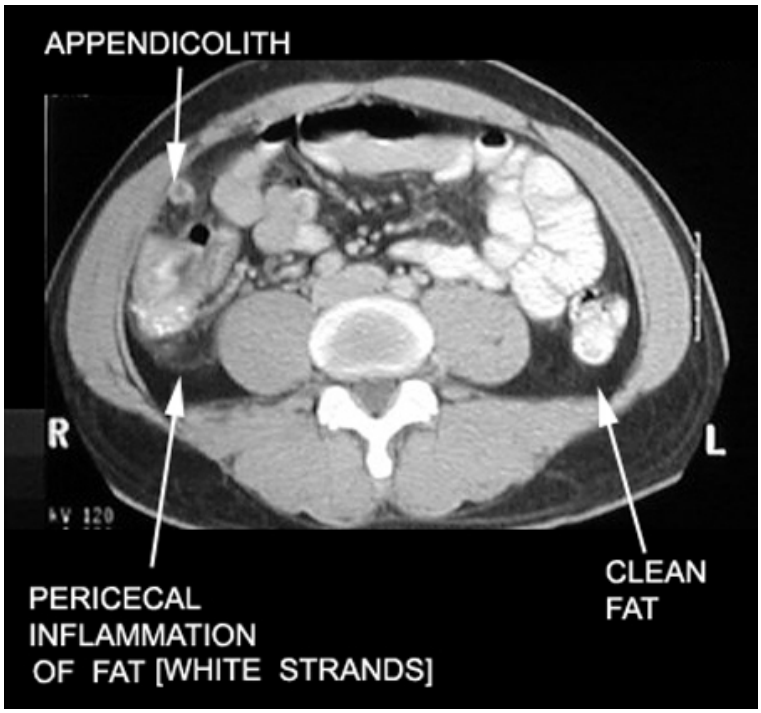


Figure 9. CT Showing inflammed appendix with faecolith

Advantages of CT scanning include its superior sensitivity and accuracy compared with those of other imaging techniques, ready availability, noninvasiveness, and potential to reveal alternative diagnoses[65].

Disadvantages include radiation exposure, potential for anaphylactic reaction if intravenous (IV) contrast agent is used, lengthy acquisition time if oral contrast is used, and patient discomfort if rectal contrast is used.

Initial studies evaluated sequential (nonhelical) CT in the diagnosis of appendicitis. In 1993, Malone evaluated nonenhanced, sequential CT in 211 patients and reported a sensitivity of 87% and a specificity of 97%. The addition of IV and oral contrast agent increases sensitivity to 96-98% but increases cost. Sequential CT with oral and IV contrast enhancement is highly accurate but time consuming and expensive; it is best used for equivocal presentations when helical CT is not available.

In 1997, Lane evaluated helical CT without contrast enhancement and found a sensitivity of 90% and specificity of 97%. More recent studies of noncontrast helical CT in adults with suspected appendicitis showed a sensitivity of 93-96% and a specificity of 92-99% (Lane, 1999; Ege, 2002; Yuksekkaya, 2004).

In a 2004 study of pediatric patients, Kaiser found that nonenhanced CT was 66% sensitive.Sensitivity increased to 90% with the use of IV contrast material.In 1997, Rao found that focused (lower abdominal and upper pelvic)

helical CT with 3% Gastrograffin instilled into the colon (without IV contrast agent) had a superior sensitivity of 98% and specificity of 98%. Focused helical scanning without IV contrast agent eliminates the risk of anaphylaxis and reduces the cost. Acquisition time is <15 minutes.

Radiation exposure is less than that of a standard obstruction series. Alternative diagnoses are revealed in up to 62% of patients and include diverticulitis, nephrolithiasis, adnexal pathology, RLQ tumor, small-bowel hernias, and ischemia.

The current literature suggests that limited helical CT with rectal contrast enhancement is a highly accurate, time-efficient, cost-effective way to evaluate adults with equivocal presentations for appendicitis. Two studies of focused helical CT in children suggest a sensitivity of 95-97%. Continued improvements in helical CT technology and image interpretation may allow nonenhanced helical CT to be the imaging test of choice in the future[66].

SCORING SYSTEM

In order to reduce the negative appendicectomy rates various scoring systems have been developed for supporting the diagnosis of acute appendicitis[67]. Initial evaluation studies have shown excellent results, indicating that scoring systems would be ideal as diagnostic aids because they have good performance and require no special equipment, being user friendly and comprehensible to the clinician. One such scoring system was Alvarado score[68]

that was based on sophisticated statistical analysis of symptoms, signs and laboratory data on 305 patients admitted to Nazareth Hospital in Philadelphia from 1975 to 1976. Studies have shown that Alvarado score has diagnostic accuracy of around 88%

Interpretation of the Alvarado score[69]

Characteristic	**Score**
M = migration of pain to the RLQ	1
A = anorexia	1
N = nausea and vomiting	1
T = tenderness in RLQ	2
R = rebound pain	1
E = elevated temperature	1
L = leukocytosis	2
S = shift of WBC to the left	1
Total	**10**

Similarly, Chong et al in 2010 developed a new scoring system which had 15 parameters each with a score of 0.5,1,2. This was called as RIPASA, named after the hospital in Brunei at which it was developed.[15]

RIPASA= Raja Isteri Pengiran Ank Saleha Appendicitis Score.

The need for this new scoring was based on the fact that Alvarado and Modified Alvarado were developed in western countries and its use in Asian populations did not yield the same results.

Interpretation of RIPASA Scoring[15]

	Score
Patient's Demographic	
Female	***0.5***
Male	***1.0***
Age < 39.9 yrs	***1.0***
Age > 40 yrs	***0.5***
Symptoms	
RIF pain	***0.5***
Pain migration to RIF	***0.5***
Anorexia	***1.0***
Nausea & Vomiting	***1.0***
Duration of symptoms < 48 hrs	***1.0***
Duration of symptoms > 48 hrs	***0.5***
Signs	
RIF tenderness	***1.0***
Guarding	***2.0***
Rebound tenderness	***1.0***
Rovsing's Sign	***2.0***
Fever >37°C, <39°C	***1.0***
Investigations	
Raised WCC	***1.0***
Negative urinalysis	***1.0***
Additional Scores	
Foreign NRIC	***1.0***
Total	

CLINICAL OUTCOME FOR APPENDICITIS[70]

- Resolution
- Gangrenous appendicitis

- Perforation leading to generalized peritonitis
- Appendicular mass or abscess formation
- Fibrosis

TREATMENT

SURGICAL THERAPY

Thousands of classic appendectomies (open procedure) have been performed in the last 2 centuries. Mortality and morbidity have gradually decreased, especially in the last few decades because of antibiotics, early diagnosis, and improvements in anesthesiologic and surgical techniques[71].

Since 1987, many surgeons have begun to treat appendicitis laparoscopically. This procedure has now been improved and standardized. The reported results of both laparoscopic and open-procedure appendectomies seem to be overlapping. In fact, the average rate of abdominal abscesses, negative appendectomies, and hospital stays are very similar according to a recent overview of 17 retrospective studies.

Laparoscopy has some advantages, including decreased postoperative pain, better aesthetic result, a shorter time to return to usual activities, and lower incidence of wound infections or dehiscence[72]. This procedure is cost effective but may require more operative time compared with open appendicectomy.

PREOPERATIVE DETAILS

Preparation of patients undergoing appendicectomy is similar for both open and laparoscopic procedures. Because they may mask the underlying disease, do not administer analgesics and antipyretics to patients with suspected appendicitis who have not been evaluated by the surgeon. Perform complete routine laboratory and radiologic studies before intervention. Venous access must be obtained in all patients diagnosed with appendicitis. Venous access allows administration of isotonic fluids and broad- spectrum intravenous antibiotics prior to the operation[73].

Prior to the start of the surgical procedure, the anesthesiologist performs endotracheal intubation to administer volatile anesthetics and to assist respiration.The abdomen is washed, antiseptically prepared, and then draped.

INTRAOPERATIVE DETAILS

OPEN APPENDICECTOMY

Prior to incision, the surgeon should carefully perform a physical examination of the abdomen to detect any mass and to determine the site of the incision.Open appendicectomy requires a transverse incision in the RLQ over the McBurney's point (i.e., two thirds of the way between the umbilicus and the right anterior superior iliac spine). The vertical incisions (i.e., the Battle pararectal) are rarely performed because of the tendency for dehiscence and herniation.

The abdominal wall fascia (i.e., Scarpa's and Camper's fascia) and the underlying muscular layers are sharply dissected or split in the direction of their fibers to gain access to the peritoneum. If necessary (e.g., because of concomitant pelvic pathologies), the incision may be extended medially, dissecting some fibers of the oblique muscle and retracting the lateral part of the rectus abdominis. The peritoneum is opened transversely and entered. Note the character of any peritoneal fluid to help confirm the diagnosis and then suction it from the field; if purulent, collect and culture the fluid.

Retractors are gently placed into the peritoneum. The cecum is identified and medially retracted. It is then exteriorized by a moist gauze sponge or Babcock's clamp, and the taenia coli are followed to their convergence. The convergence of teniae coli is detected at the base of the appendix, beneath the Bauhin valve (ie, the ileocecal valve), and the appendix is then viewed. If the appendix is hidden, it can be detected medially by retracting the cecum and laterally by extending the peritoneal incision.

After exteriorization of the appendix, the mesoappendix is held between clamps, divided, and ligated. Simple ligature of the appendiceal stump is done by crushing the appendix at its base with a hemostat, then moving the hemostat and replacing it on the appendix just distal to the crushed line. A ligature of monofilament suture is placed in the groove caused by the crushing clamp and is tied tightly. The appendix is transected just proximal to the hemostat and removed. The appendix may be inverted into the cecum with the use of a

pursestring suture or z-stitch. Although performed by several surgeons, the appendiceal stump inversion is not mandatory.

The cecum is placed back into the abdomen. When evidence of free perforation exists, peritoneal lavage with several liters of warm saline is recommended. After the lavage, the irrigation fluid must be completely aspirated to avoid the possibility of spreading infection to other areas of the peritoneal cavity. The use of a drain is not commonly required in patients with acute appendicitis, but obvious abscess with gross contamination requires drainage.

The wound closure begins by closing the peritoneum with a running suture. Then, the fibers of the muscular and fascial layers are reapproximated and closed with a continuous or interrupted absorbable suture. Lastly, the skin is closed with subcutaneous sutures or staples. In cases of perforated appendicitis, some surgeons leave the wound open, allowing for secondary closure or a delayed primary closure until the fourth or fifth day after operation. Other surgeons prefer immediate closure in these cases.

LAPAROSCOPIC APPENDICECTOMY[74-76]

The surgeon typically stands on the left of the patient, and the assistant stands on the right. The anesthesiologist and the anesthesia equipment are placed at the patient's head, and the video monitor and instrument table are placed at the feet.Although some variations are possible, 3 cannulae are placed during the procedure. Two of them have a fixed position (i.e., umbilical and suprapubic).

The third is placed in the right periumbilical region, and its position may vary greatly depending on the patient's anatomy. According to the preferences of the surgeon, a short umbilical incision is made to allow the placement of a Hasson cannula or Veress needle that is secured with 2 absorbable sutures. Pneumoperitoneum (10-14 mm Hg) is established and maintained by insufflating carbon dioxide. Through the access, a laparoscope is inserted to view the entire abdomen cavity.

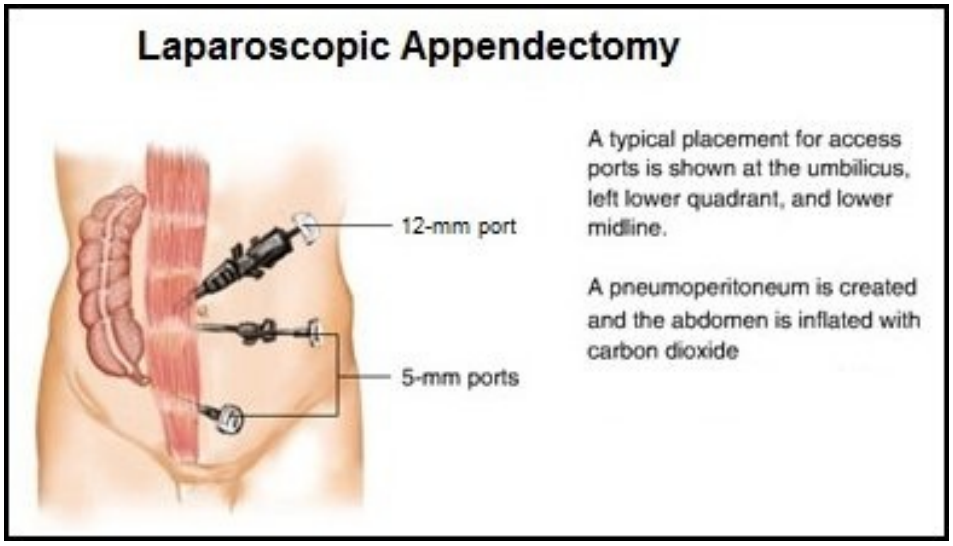


Figure 10. Port Placement in Laparoscopic Appendicectomy

A 12-mm trocar is inserted above the pubic symphysis to allow the introduction of instruments (eg. incisors, forceps, stapler). Another 5-mm trocar is placed in the right periumbilical region, usually between the right costal margin and the umbilicus, to allow the insertion of an atraumatic grasper to expose the appendix. The appendix is grasped and retracted upward to expose the mesoappendix. The mesoappendix is divided using a dissector inserted through the suprapubic trocar. Then, a linear Endostapler, Endoclip, or suture ligature is

passed through the suprapubic cannula to ligate the mesoappendix. The mesoappendix is transected using a scissor or electrocautery. To avoid perforation of the appendix and iatrogenic peritonitis, the tip of the appendix should not be grasped.

The appendix may now be transected with a linear Endostapler, or, alternately, he base of the appendix may be suture ligated in a similar manner to that in an open procedure. The appendix is now free and may be removed through the umbilical or the suprapubic cannula using a laparoscopic pouch to prevent wound contamination. Peritoneal irrigation is performed with antibiotic or saline solution. Completely aspirate the irrigant. The cannulae are then removed and the pneumoperitoneum is reduced.

The fascial layers at the cannula sites are closed with absorbable suture, while the cutaneous incisions are closed with interrupted subcuticular sutures or sterile adhesive strips.

POSTOPERATIVE DETAILS

Administer intravenous antibiotics postoperatively. The length of administration is based on the operative findings and the recovery of the patient. In complicated appendicitis, antibiotics may be required for many days or weeks[77]. Antiemetics and analgesics are administered to patients experiencing nausea and wound pain. The patient is encouraged to ambulate early. When appendicitis is not complicated, the diet may be advanced quickly postoperatively

and the patient is discharged from the hospital once a diet is tolerated. In patients with complicated appendicitis, a clear liquid diet may be started when bowel function returns. These patients may be discharged after complete restitution of infection.

FOLLOW-UP CARE

After hospital discharge, patients must have a light diet and limit their physical activity for a period[78].

MORTALITY

The mortality rate following appendicitis has dramatically decreased since Sir Reginald Fitz in 1889 described appendicitis. The statistics of England and Wales showed that in 1938, there were more than 3000 deaths per year from appendicitis. By 1980, it had fallen to only 179.

Grey Turner reported in 1955 than on reviewing 2500 personal appendicectomies, he found that the mortality rate of 0.68% in cases with diffuse peritonitis. The overall mortality of the series was 3.5%[21]. Pieper et al in 1982 reported only 2 deaths in their review of 1018 appendicectomies(0.2%)[58]. Mortality has decreased from 26% to less than 1% in the last hundred years.

MATERIALS AND METHODS

METHOD OF COLLECTION OF DATA

Patients who presented to the Emergency/General Surgery Department of Govt. Royapettah Hospital, Kilpauk Medical College for a period of 8 months from Nov. 2014 to July 2015 with RIF pain and who were suspected of acute appendicitis were considered for the study.

Inclusion criteria were patients of all age groups admitted with complaints of RIF pain and clinical suspicion of acute appendicitis.

Patients who had non RIF pain and who had been admitted with other complaints previously were excluded from the study. Similarly, patients with pain >5 days, suspected to have Appendicular lump/mass, features of peritonitis, previous history of urolithiasis or pelvic inflammatory were excluded from the study.

100 consecutive patients with clinical suspicion of Acute Appendicitis were enrolled into the study. After satisfying the inclusion and exclusion criteria 96 patients formed the study population.

Evaluation was done with regards to RIPASA and Alvarado scoring in all these patients.

Post operative specimen was sent for histopathological examination.

Both scoring systems were done in all the patients. Sensitivity, specificity, positive predictive value, negative predictive value were assessed and compared for both scoring systems.

Period of Study

Nov. 2014 – July 2015

Type of Study

Comparative study

Sample Size

100 Patients

Source of Data

Patients diagnosed as acute appendicitis in department of General Surgery, Govt. Royapettah Hospital. 100 of them are to be selected on the basis of non probability (purposive) sampling method.

Inclusion Criteria

Patients with RIF pain and suspicion of acute appendicitis.

Exclusion Criteria

- Patients admitted with other complaints and later developed RIF pain.
- Patients with pain >5 days.

- Suspected to have Appendicular lump/mass.
- Features of peritonitis.
- Previous history of urolithiasis or pelvic inflammatory disease.

After the initial evaluation of the patient in the casualty/out patient department of Govt. Royapettah Hospital by the Duty Assistant Professor of general surgery, patients with the diagnosis of acute appendicitis were admitted to the wards. The female patient had pelvic examination or gynecological consultation if felt necessary.

The detailed history, clinical examination, laboratory investigations were done which included routine Hematological investigations, Urine routine, X-Ray KUB and USG Abdomen and Pelvis in some equivocal cases.

Two specially designed proforma was filled in for each patient.

- These proforma had general information about the patient plus eight variables based on the Alvarado scoring system.
- Another proforma had similar patient details and the fourteen variables based on RIPASA scoring system.

The decision to operate on the patient (vs conservative line of management) was based solely on the clinical suspicion of an experienced Surgeon who was not part of/involved in the study.

Scoring was performed at every review until a decision was made from either appendicectomy or continued conservative line of management.

The diagnosis of acute appendicitis was confirmed by operative findings and histopathological assessment of the appendicectomy specimen with the ultimate criterion for the final diagnosis of acute appendicitis being the histological demonstration of polymorphonuclear leukocytes throughout the thickness of the appendix wall.

Those patients who were treated conservatively and subsequently discharged were reviewed in the surgical out patient within a week.

Cut-off Threshold

RIPASA

- The optimal cut-off value for the RIPASA score derived from ROC is 7.5
- 14 parameters were considered and each was scored accordingly as 0.5,1 or 2.
- A total value above 7.5 was considered to be a positive RIPASA with High probability of Acute Appendicitis.

ALVARADO SCORE

- The optimal cut-off value was taken as 7.

- 8 parameters were considered with a score of 0, 1 or 2.
- A score above 7 was considered to be a positive Alvarodo and a high probability of acute appendicitis.

Sensitivity, Specificity, Positive predictive value and Negative predictive value for both these scorings were calculated and analyzed comparatively with a chi-square test (SPSS Software).

RIPASA appendicitis (RIPASA) score

		Score
1.	**Patients :**	
	Female	0.5
	Male	1.0
	Age < 39.9 years	1.0
	Age > 40 years	0.5
2.	**Symptoms**	
	RIF Pain	0.5
	Pain Migration to RIF	0.5
	Anorexia	1.0
	Nausea & Vomiting	1.0
	Duration of Symptoms < 48 hrs.	1.0
	Duration of Symptoms > 48 hrs.	0.5
3.	**Signs**	
	RIF Tenderness	1.0
	Guarding	2.0
	Rebound Tenderness	1.0
	Rovsing Sign	2.0
	Fever > 37° C < 39° C	1.0
4.	**Investigation**	
	Raised WBC	1.0
	Negative Urine Analysis	1.0

Alvarado appendicitis scoring system

		Score
1.	**Symptoms**	
	Pain Migration to RIF	01
	Anorexia	01
	Nausea – Vomiting	01
2.	**Signs**	
	RIF tenderness	02
	Rebound Tenderness	01
	Fever	01
3.	**Investigation**	
	Raised WBC	02
	Shift of WBC to Left	01
	Total score	10

RIPAS APPENDICITIS (RIPASA) SCORE

PATIENT'S NAME:_____ AGE: _____

IC NO:_____ MRN NO:_____

Date of Assessment							
Time of Assessment							
	Score	**Score**	**Score**	**Score**	**Score**	**Score**	**Score**
Patient's Demographic							
Female	***0.5***						
Male	***1.0***						
Age < 39.9 yrs	***1.0***						
Age > 40 yrs	***0.5***						
Symptoms							
RIF pain	***0.5***						
Pain migration to RIF	***0.5***						
Anorexia	***1.0***						
Nausea & Vomiting	***1.0***						
Duration of symptoms < 48 hrs	***1.0***						
Duration of symptoms > 48 hrs	***0.5***						
Signs							
RIF tenderness	***1.0***						
Guarding	***2.0***						
Rebound tenderness	***1.0***						
Rovsing's Sign	***2.0***						
Fever >37°C, <39°C	***1.0***						
Investigations							
Raised WCC	***1.0***						
Negative urinalysis	***1.0***						

ALVARADO APPENDICITIS SCORING SYSTEM

PATIENT'S NAME:_____

IC NO:_____ MRN NO:_____

Date of Assessment							
Time of Assessment							
	Score	**Score**	**Score**	**Score**	**Score**	**Score**	**Score**
Symptoms							
Pain migration to RIF	***1***						
Anorexia	***1***						
Nausea & Vomiting	***1***						
Signs							
RIF tenderness	***2***						
Rebound tenderness	***1***						
Fever	***1***						
Investigations							
Raised WCC	***2***						
Shift of WCC to left	***1***						
Total Score							

Total score is achieved by adding all the score for each category together.

RESULTS

During the 8-month period from Nov 2014 to July 2015, a study of the use of RIPASA and Alvarado score was made on a consecutive series of 96 patients admitted to the Department of Surgery, Govt. Royapettah Hospital, Kilpauk Medical College, Chennai with clinical features suggestive of Acute Appendicitis. The results are as follows.

- Out of the 100 patients recruited, only 96 satisfied the inclusion and exclusion criteria.

- In the present study, the minimum age was 14 yrs and the maximum age was 74 yrs.

- The number of patients was highest in the age group of 20 to 30 years followed by 30 to 40 years. The least was in the age group of 70 to 80 years.

- Mean age was 30.58. Standard deviation: 12.3

- (Age range 14-74 yrs.).

- Median Age was 28 years.

- Out of the 96 patients, 46 were Male and 50 were Female. The Male to Female ratio was 1:1.08.

Most of the patients were in the younger age group. This shows that there is a predominance in younger age group and the incidence peaks between 20-40 yrs. and decreases as age progressed.

Table-1. Age Distribution

Age(years)	Total
<20	16
20-30	39
30-40	22
40-50	8
50-60	6
60-70	1
>70	1

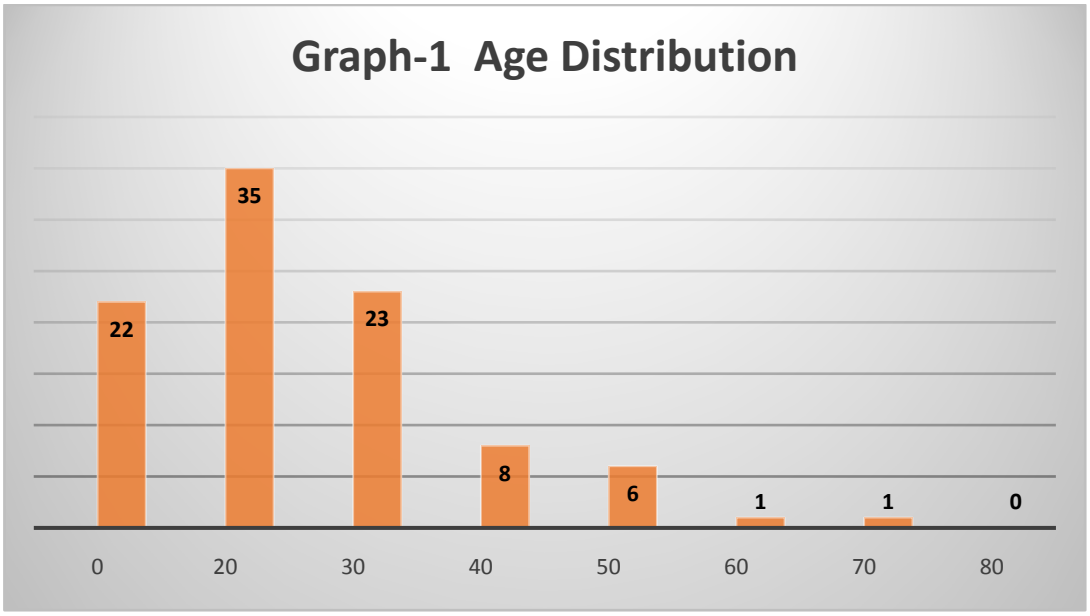
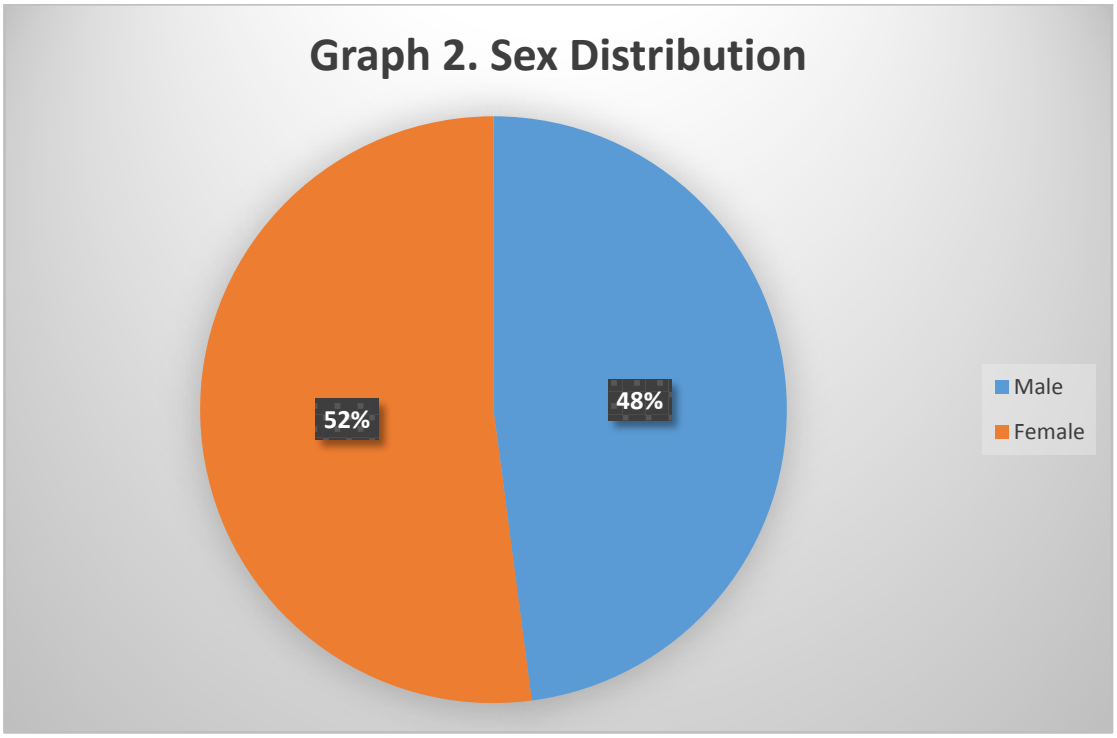


Table 2. Sex Distribution:

Male	Female
46	50



The operative details of the study group were as follows:

- 65 Patients underwent emergency appendicectomy. This was based on the surgeon's clinical judgment.
- Out of these, 50 cases were confirmed histologically as having Acute appendicitis or its complications.
- This included, 4 cases of gangrenous appendicitis and 4 cases of perforated appendicitis.
- 15 of the operated patients had a normal histology of the appendix.
- This indicated a negative appendicectomy rate of 23 % when based only on clinical decision.
- The mean hospital stay duration was 4.6 ± 2.0 days.
- 5 out of the 65 patients operated developed postoperative complications, mainly superficial wound infection.

All 65 patients were discharged alive.

Table 3. Patient's Demographics (n=96)

Demographic	**Value**
Gender	
1. Male	46
2. Female	50
Mean Age± SD	30.58± 12.3
Total Emergency Appendicectomy	65
1. Confirmed histology of Acute Appendicitis	50
2. Negative histology for Acute Appendicitis	15
Mean hospital stay± SD	4.6± 2.0
Perforated Appendicitis	3
Postoperative wound infection	5
Patients discharged alive	96

Table 4. Distribution of patients according to RIPASA

	Positive Histology	**Negative Histology**
RIPASA >7.5	49	9
RIPASA <7.5	1	37

According to RIPASA score, 58 patients were diagnosed to have appendicitis. Out of these 58, 49 patients had evidence of appendicitis histopathologically. Nine patients were falsely diagnosed to have appendicitis by RIPASA scoring system. Out of the 38 patients diagnosed by RIPASA as not having appendicitis only one was missed.

Table 5. Distribution of patients according to Alvarado Scoring

	Positive Histology	**Negative Histology**
Alvarado Score >7	34	6
Alvarado Score <7	16	40

According to Alvarado score, 40 patients were diagnosed to have appendicitis. Out of these 40 patients, 34 patients had evidence of appendicitis histopathologically. Six patients were falsely diagnosed to have appendicitis by Alvarado scoring system. Out of 56 patients diagnosed by Alvarado as not having appendicitis, 16 patients were missed by this scoring system.

Table 6-Test Characteristics for RIPASA scoring applied on the Study Population:

	Estimated Value	95% Confidence Interval	
		Lower Limit	Upper Limit
Prevalence	0.520833	0.416994	0.622987
Sensitivity	0.98	0.879892	0.998955
Specificity	0.804348	0.656222	0.901378
For any particular test result, the probability that it will be:			
Positive	0.604167	0.49894	0.70096
Negative	0.395833	0.29904	0.50106
For any particular positive test result, the probability that it is:			
True Positive (Positive Predictive Value)	0.844828	0.720749	0.92233
False Positive	0.155172	0.07767	0.279251
For any particular negative test result, the probability that it is:			
True Negative (Negative Predictive Value)	0.973684	0.84566	0.998625
False Negative	0.026316	0.001375	0.15434

Table 7-Test Characteristics for ALVARADO scoring

applied on the Study Population:

	Estimated Value	95% Confidence Interval	
		Lower Limit	Upper Limit
Prevalence	0.520833	0.416994	0.622987
Sensitivity	0.68	0.531689	0.800722
Specificity	0.869565	0.730471	0.94584
For any particular test result, the probability that it will be:			
Positive	0.416667	0.318279	0.521799
Negative	0.583333	0.478201	0.681721
For any particular positive test result, the probability that it is:			
True Positive (Positive Predictive Value)	0.85	0.694794	0.937509
False Positive	0.15	0.062491	0.305206
For any particular negative test result, the probability that it is:			
True Negative (Negative Predictive Value)	0.714286	0.57592	0.823145
False Negative	0.285714	0.176855	0.42408

Table 8. Comparison between the RIPASA and Alvarado scoring systems with respect to different variables.

Score in % (95% confidence interval)

Variable	RIPASA >7.5	Alvarado >7.0	p-value
Sensitivity	98.0 % (87.98-99.89)	68 % (53.16-80.0)	<0.0001
Specificity	80.43 % (65.62-90.13)	86.95 % (73.04-94.58)	
Positive Predictive Value	84.44 % (72.07-92.23)	85 % (60.47-93.75)	
Negative Predictive Value	97.36 % (84.56-99.86)	71.42 % (57.59-82.31)	<0.0001
Diagnostic Accuracy	89.58 %	77.08 %	<0.0001
Negative appendicectomy rate	15.51 %	15 %	

Details of RIPASA and ALVARADO Score applied on the study population:

SENSITIVITY/ True Positive:

- The RIPASA score accurately classified 49 (98%) patients confirmed with histology as Acute Appendicitis into the High probability group.
- This was higher when compared to the 34 (68%)patients classified correctly by the Alvarado Score.
- The difference in the sensitivities/ True positive rates was statistically significant.
- The RIPASA score had a higher sensitivity.

False Negative:

- 16 patients who were missed by the Alvarado score were classified wrongly as false negative by the Alvarado Score.
- There false negatives in the RIPASA group was 1.
- This was significantly higher than those wrongly classified by RIPASA score as false negative.
- There was a statistically significant difference in the false negative rates. The RIPASA scoring had a lower false negative rate.

True Negative:

- The RIPASA score correctly classified 37 patients without Acute Appendicitis into the true negative group.
- Similarly, the Alvarado score classified 40 patients into the true negative group.
- There was no statistically significant difference between the true negative groups of both the scores.

Comparison:

- At the optimal cut-off threshold score of 7.5 for the RIPASA score, the calculated sensitivity and specificity were 98% (95% confidence interval [CI] 87.98%– 99.89%) and 80.43% (95% CI 65.62%–90.13%), respectively compared with 68% (95% CI 53.16%– 80.0%) and 86.95% (95% CI 73.04%–94.58%), respectively for Alvarado score at an optimal cut-off threshold of 7.0
- The PPV and NPV for the RIPASA score were 84.44% and 97.36%, respectively compared with 85% and 71.42%, respectively for the Alvarado score.
- This shows that the negative predictive value was significantly higher for the RIPASA score compared to that of the Alvarado score ($p < 0.0001$).

Diagnostic Accuracy:

- The diagnostic accuracy was 89.58 % for the RIPASA score and 77.08% for the Alvarado score, which showed a difference of 12.5%.
- This difference was staistically significant and higher for the RIPASA scoring.

Negative Appendicectomy Rate:

- The predicted negative appendicectomy rate for RIPASA scoring was 15.51%
- The predicted negative appendicectomy rate for Alvarado scoring was 15 %.

This was not statistically significant.

Table 9. Final Diagnosis (Operative + Histopathology)

Findings	No. of Patients
Acute Appendicitis	42
Gangrenous Appendix	4
Perforated Appendix	4
Normal Histology	15
Total Operated Patients	65

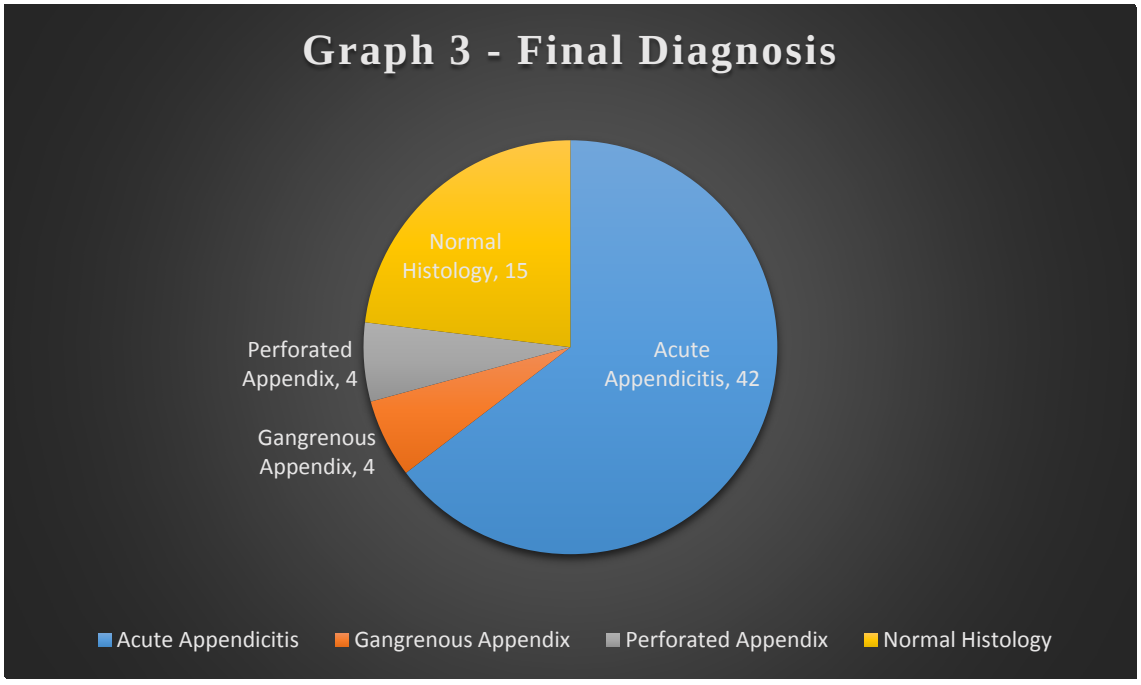
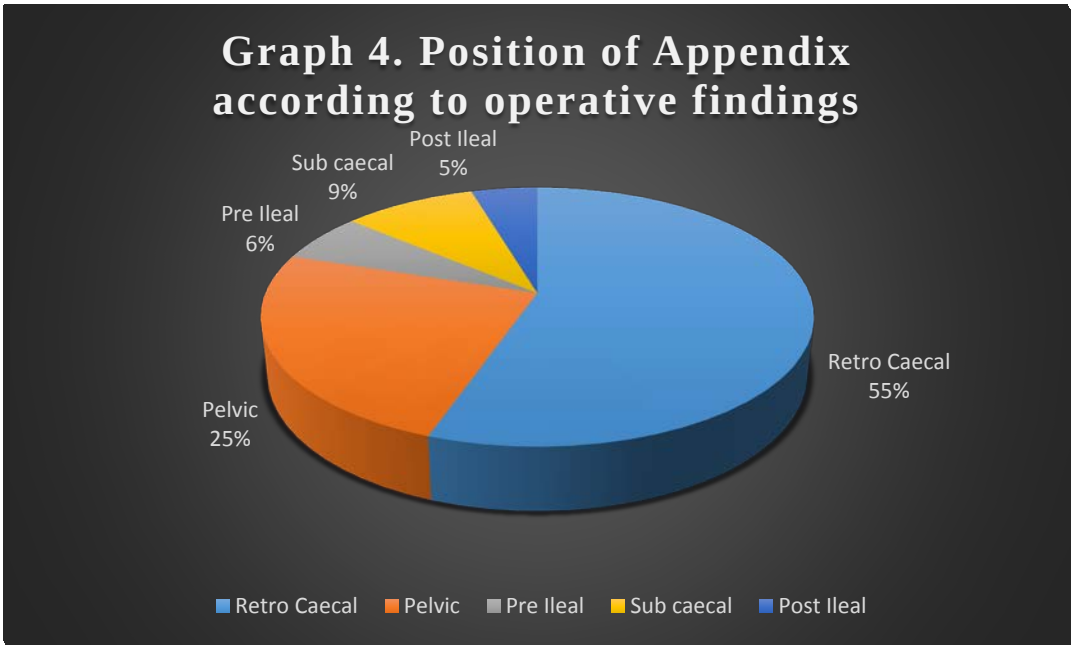


Table 10. Position of Appendix According to Operative Findings

Position Of Appendix	No. of Patients	Percentage
Retro Caecal	36	55
Pelvic	16	25
Pre Ileal	4	6
Sub caecal	6	9
Post Ileal	3	5



DISCUSSION

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

The diagnostic accuracy of clinical assessment of acute appendicitis varies from 50%-80%. The series from US Naval Hospital, San Diego, California, revealed an accuracy of 87%. The clinical diagnosis is especially difficult in the very young, the elderly and in the women of reproductive age group.

Appendicitis still poses a diagnostic challenge and many methods have been investigated to try to reduce the removal of a normal appendix without increasing the perforation rate. Radiological methods such as ultrasonography and computed tomography, as well as laparoscopy are all methods that have been investigated previously. Many diagnostic scores have been advocated but most are complex and difficult to implement in a clinical situation.

The Alvarado score, first described in 1986, is a simple scoring system. Good clinical acumen remains the mainstay of correct diagnosis of appendicitis. It is a scoring system that can be instituted easily in the outpatient setting and a cheap and quick tool to apply in the emergency room.

The Alvarado criterion for the diagnosis of acute appendicitis which was later modified to accommodate additional parameters along with original Alvarado scoring system. Since then the modified Alvarado has been the most widely used clinical scoring for acute appendicitis.

Recent studies have indicated that the accuracy of diagnosing Acute Appendicitis in Asian populations using the Alvarado Scoring gave much poorer results when compared to western literature.

This led to the development of a newer scoring system in 2010 by Chong et al, that included 14 fixed parameters. Data showed significantly increased the accuracy of diagnosing Acute Appendicitis in the Asian populations.

Our study compared the widely used Alvarado Scoring with the newer RIPASA scoring in our population group.

When the RIPASA score was applied, 98.0% of patients who actually had acute appendicitis were correctly diagnosed and placed in the high-probability group (RIPASA score > 7.5) and managed appropriately, compared to only 68% when using the Alvarado score on the same population sample. Thus, the

Alvarado score failed to diagnose 28.5% of patients (n = 16) with acute appendicitis and wrongly classified them in the low-probability group (Alvarado score < 7.0). The difference in diagnostic accuracy of 12.5% between the RIPASA score and Alvarado score was statistically significant (Fig. 3, $p < 0.0001$), indicating that the RIPASA score is a much better diagnostic tool for the diagnosis of acute appendicitis in our patient population. Similarly, for patients who were classified in the low-probability group, i.e. true negative group with RIPASA score < 7.5 and Alvarado score < 7.0, the RIPASA score again outperformed the Alvarado score by correctly diagnosing 97.3% of patients who did not have acute appendicitis, compared with the Alvarado score, which only managed to correctly diagnose 71.42%.

The RIPASA score is a useful, rapid diagnostic tool for acute appendicitis, especially in the settings of the emergency, as it requires only the patient's demographics(age, gender), a good clinical history (RIF pain, migration to RIF, anorexia, nausea and vomiting), clinical examination (RIF tenderness, localized guarding, rebound tenderness, Rovsing's sign and fever) and two simple investigations (raised white cell count and negative urinalysis performed at triage, which is defined as an absence of red and white blood cells, bacteria and nitrates).

Thus, in the emergency setting, a quick decision can be made upon seeing patients with RIF pain. Those with a RIPASA score > 7.5 need admission and further management admission, while patients with a RIPASA score < 7.0 can either be observed. With its high sensitivity (98%) and NPV (97.3%), the RIPASA score can also help to reduce unnecessary and expensive radiological investigations such as routine CT imaging.

CONCLUSION

- In conclusion, the RIPASA score is currently a much better diagnostic scoring system for acute appendicitis compared to the Alvarado score.

- RIPASA had significantly higher sensitivity, NPV and diagnostic accuracy, in our study group.

- The 14 fixed parameters can be easily and rapidly obtained in any population setting by taking a complete history, and conducting a clinical examination and two simple investigations.

- In remote settings or emergency, a quick decision can be made with regards to referral to an operating surgeon or observation.

The use of RIPASA scoring would help in decreasing the unwarranted patient admissions and also expensive radiological investigations.

SUMMARY

One hundred patients with suspision of Acute Appendicitis were enrolled. 96 of them stisfied the inclusion and exclusion criteria and were included in the study.

- In this study, 46 patients (48%) were male and 50 patients (52%) were female.

- In this study, maximum patients were from age group 20 – 30 years who accounted for 36.4 % followed by 30 – 40 years age group (23%) and least number of patients in the 70 – 80 years age group (1%).

- 65 patients underwent emergency appendicectomy based on the clinical decision of a senior surgeon.

- The histopathology showed Acute Appendicitis in 42 patients (64.6%). Gangrenous and Perforated appendix in 4 each (6.1%). Normal histology was found in 15 patients (23%).

- The 2 scoring systems were applied on these patient populations with the histologic confirmation as the Gold standard.

- The sensitivity and specificity of the RIPASA scoring system was 98.0% and 80.43% respectively.

- The sensitivity and specificity of the Alvarado scoring system was 80.43% and 86.95% respectively.
- The PPV of RIPASA and ALVARODO was 84% and 85% respectively.
- The NPP of RIPASA and ALVARADO was 97% and 71% respectively.
- The Diagnostic Accuracy was 89% for RIPASA and 77% for Alvarado.
- The Sensitivity, NPV, and Diagnostic accuracy of RIPASA scoring was significantly higher than the Alvarado scoring. ($p<0.0001$)
- There appeared to be no statistically significant difference in the specificity, and PPV.

The RIPASA scoring Appeared to be a better test for scoring the probability of Acute Appendicitis.

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ANNEXURE

PROFORMA

Name

I.P. no:

Phone No:

Age / sex:

Date of admission:

Date of discharge:

Occupation:

Chief complaints:

H/o RIF pain

H/o migrating pain

H/o fever

H/o nausea

H/o vomiting:

H/o anorexia:

H/o burning micturition:

Previous history of medical and surgical illness:

H/o drug intake:

H/o smoking and alocohol intake:

Diet history:

GENERAL EXAMINATION

Nutritional status:

Hydration:

Temperature:

Pulse rate:

Blood pressure:

Cardiovascular system:

Respiratory system:

Examination of abdomen:

- RIF tenderness:
- Rebound tenderness:
- Guarding:
- Rovsing’s sign:

Digital rectal examination:

LABORATORY INVESTIGATIONS

Complete blood count

Renal function test

Urine routine analysis

Histopathology report

CONSENT FORM

சுய ஒப்புதல் படிவம்

ஆய்வு செய்யப்படும் தலைப்பு :

COMPARISON BETWEEN RIPASA AND ALVARADO SCORING IN ACUTE APPENDICITIS

ஆராய்ச்சி நிலையம் : பொது அறுவை சிகிச்சைத் துறை
கீழ்பாக்கம் மருத்துவக் கல்லூரி
சென்னை – 600 010.

பங்கு பெறுபவரின் பெயர் : வயது :

பங்கு பெறுபவரின் எண். :

பங்கு பெறுபவரது இதனை (✓) குறிக்கவும்

மேலே குறிப்பிட்டுள்ள மருத்துவ ஆய்வின் விவரங்கள் எனக்கு விளக்கப்பட்டது என்னுடைய சந்தேகங்களை கேட்கவும், அதற்கான தகுந்த விளக்கங்களைப் பெறவும் வாய்ப்புளிக்கப்பட்டது. ☐

நான் இவ்வாய்வின் தன்னிச்சையாகத்தான் பங்கேற்கிறேன். எந்தக் காரணத்தினாலோ எந்தக் கட்டத்திலும் எந்த சட்ட சிக்கலுக்கும் உட்படாமல் நான் இவ்வாய்வில் இருந்து விலகிக் கொள்ளலாம் என்று அறிந்து கொண்டேன். ☐

இந்த ஆய்வு சம்மந்தமாகவோ, இதைச் சார்ந்த மேலும் ஆய்வு மேற்கொள்ளும்போது இந்த ஆய்வில் பங்குபெறும் மருத்துவர் என்னுடைய மருத்துவ அறிக்கைகளைப் பார்ப்பதற்கு என் அனுமதி தேவையில்லை என அறிந்து கொள்கிறேன். நான் ஆய்வில் இருந்து விலகிக் கொண்டாலும் இது பொருந்தும் என அறிகிறேன். ☐

இந்த ஆய்வின் மூலம் கிடைக்கும் தகவல்களையும், பரிசோதனை முடிவுகளையும் மற்றும் சிகிச்சை தொடர்பான முடிவுகளையும் மருத்துவர் மேற்கொள்ளும் ஆய்வில் பயன்படுத்திக் கொள்ளவும் அதைப் பிரசுரிக்கவும் என் முழு மனதுடன் சம்மதிக்கிறேன். ☐

இந்த ஆய்வில் பங்கு கொள்ள ஒப்புக்கொள்கிறேன். எனக்குக் கூறப்பட்ட அறிவுரைகளின்படி நடந்து கொள்வதுடன், இந்த ஆய்வை மேற்கொள்ளும் மருத்துவ அணிக்கு உண்மையுடன் இருப்பேன் என்றும் உறுதியளிக்கிறேன். என் உடல் நலம் பாதிக்கப்பட்டாலோ அல்லது எதிர்பாராத நோய்க்குறி தென்பட்டாலோ உடனே அதை மருத்துவ அணியிடம் தெரிவிப்பேன் என உறுதி அளிக்கிறேன். ☐

பங்கேற்பவரின் கையொப்பம் .....இடம் ..... தேதி
கட்டைவிரல் ரேகை

பங்கேற்பவரின் பெயர் மற்றும் விலாசம் .....

ஆய்வாளரின் கையொப்பம் ..... இடம் ..... தேதி

ஆய்வாளரின் பெயர் .....

MASTER CHART

S. No.	IP No.	Age	Sex	Dur/Hrs	Manag.	Histopath	App. Pos.	RIPASA Group	Alvarado Group	*PARAMETERS*	Migrating Pain	Anorexia	Nausea/Vom	RIF Tend.	Rebound	Fever	Inc. WBC	Left Shift	RIF Pain	Guarding	Rovsing's	Neg. U/A	RIPASA Score	Alvarado Score
1	24329	40	F	8	Em. App	Ac. App.	RC	>7.5	>7.0		1	1	0	1	1	1	1	1	1	0	0	1	9	9
2	21174	74	M	6	Conservative	N/A	N/A	<7.5	<7.0		1	0	0	1	0	1	1	0	1	0	0	0	6.5	6
3	20984	60	F	12	Em. App	Ac. App.	Pelvic	>7.5	>7.0		1	1	1	1	1	1	1	0	1	0	0	1	10	9
4	24219	15	F	24	Em. App	Ac. App.	RC	>7.5	>7.0		1	0	1	1	1	1	1	0	1	0	0	1	9.5	8
5	21106	27	M	72	Conservative	N/A	N/A	<7.5	<7.0		1	1	0	1	0	0	0	0	1	0	0	0	5.5	4
6	17276	22	F	96	Em. App	Normal	Pre Ileal	<7.5	<7.0		1	0	0	1	0	1	1	0	1	0	0	0	6	6
7	19014	46	F	72	Conservative	N/A	N/A	<7.5	<7.0		0	1	0	1	0	1	1	0	1	0	0	0	6	6
8	19642	27	F	36	Em. App	Ac. App.	RC	>7.5	<7.0		1	0	1	1	1	0	0	0	1	1	0	1	9.5	5
9	21105	32	M	36	Em. App	Ac. App.	RC	>7.5	>7.0		1	1	0	1	1	1	1	1	1	1	0	1	12	9
10	17981	29	F	96	Conservative	N/A	N/A	<7.5	<7.0		0	0	1	1	0	1	1	0	1	0	0	0	6.5	6
11	19408	23	M	60	Em. App	Normal	RC	<7.5	<7.0		1	0	0	1	0	1	0	0	1	0	0	1	6.5	4
12	17517	39	M	46	Em. App	Normal	RC	>7.5	>7.0		1	1	0	1	1	1	1	0	1	1	0	1	12	8
13	24556	29	F	36	Em. App	Ac. App.	RC	>7.5	>7.0		0	0	1	1	1	1	1	1	1	1	1	1	13	8
14	17686	19	M	40	Em. App	Ac. App.	Pelvic	>7.5	<7.0		0	0	1	1	0	1	1	0	1	0	0	1	8.5	6
15	18789	18	M	12	Em. App	Ac. App.	RC	>7.5	>7.0		1	1	0	1	1	1	1	0	1	1	0	1	12	8
16	21766	41	M	24	Em. App	Ac. App.	RC	>7.5	>7.0		1	0	1	1	1	1	1	0	1	1	0	1	11.5	8
17	23317	34	F	50	Conservative	N/A	N/A	<7.5	<7.0		0	1	0	1	1	0	0	0	1	0	0	1	6.5	4
18	19479	25	F	24	Em. App	Ac. App.	Pre Ileal	>7.5	>7.0		1	0	1	1	1	1	1	1	1	1	0	1	11.5	9
19	18490	39	M	36	Conservative	N/A	N/A	<7.5	<7.0		0	1	0	1	0	1	0	0	1	0	0	0	6.5	4
20	18238	17	F	12	Em. App	Normal	RC	>7.5	>7.0		1	1	0	1	1	1	1	0	1	0	0	1	9.5	8
21	22792	23	F	72	Conservative	N/A	N/A	<7.5	<7.0		0	1	0	1	0	1	0	0	1	0	0	0	5.5	4
22	17967	21	F	72	Conservative	N/A	N/A	<7.5	<7.0		0	1	1	1	1	0	0	0	1	0	0	0	6.5	5
23	17427	21	F	60	Conservative	N/A	N/A	<7.5	<7.0		0	0	1	1	0	1	0	0	1	0	0	0	5.5	4
24	18739	31	F	36	Em. App	Ac. App.	SubCaecal	>7.5	>7.0		1	1	0	1	1	1	1	1	1	1	1	0	12.5	9
25	17988	20	F	46	Conservative	N/A	N/A	<7.5	<7.0		0	1	0	1	0	1	0	0	1	0	0	1	7	4
26	19182	40	M	36	Em. App	Normal	Postlleal	>7.5	<7.0		0	0	1	1	1	0	1	0	1	0	0	1	8	6
27	19948	21	M	24	Em. App	Ac. App.	Pelvic	>7.5	<7.0		0	1	0	1	1	1	0	0	1	1	0	1	10.5	5
28	22249	20	F	30	Em. App	Ac. App.	RC	>7.5	<7.0		0	0	0	1	1	1	1	0	1	0	0	1	8	6
29	23527	23	M	24	Em. App	Ac. App.	RC	>7.5	<7.0		0	0	1	1	0	1	0	1	1	1	0	1	9.5	5
30	22929	38	M	100	Conservative	N/A	N/A	<7.5	<7.0		0	0	1	1	0	1	1	0	1	0	0	0	7	6
31	19241	32	F	32	Em. App	Ac. App.	RC	>7.5	>7.0		0	1	0	1	1	1	1	1	1	0	0	1	9	8
32	18335	21	F	24	Em. App	Ac. App.	SubCaecal	>7.5	>7.0		1	1	0	1	1	1	1	1	1	1	0	1	11.5	9
33	24777	25	M	12	Em. App	Normal	RC	>7.5	>7.0		0	1	1	1	1	1	1	0	1	0	0	1	10.5	8
34	19481	39	F	56	Conservative	N/A	N/A	<7.5	<7.0		0	0	1	1	0	0	1	0	1	0	0	0	5.5	5
35	26684	52	M	72	Em. App	Normal	RC	<7.5	<7.0		0	0	1	0	0	1	1	0	1	0	0	0	5.5	4

S. No.	IP No.	Age	Sex	Dur/Hrs	Manag.	Histopath	App. Pos.	RIPASA Group	Alvarado Group	*PARAMETERS*	Migrating Pain	Anorexia	Nausea/Vom	RIF Tend.	Rebound	Fever	Inc. WBC	Left Shift	RIF Pain	Guarding	Rovsing's	Neg. U/A	RIPASA Score	Alvarado Score
36	26788	34	F	18	Em. App	Ac. App.	SubCaecal	>7.5	>7.0		0	0	1	1	1	1	1	1	1	1	0	1	11	8
37	17921	27	M	56	Em. App	Ac. App.	RC	<7.5	<7.0		0	0	1	1	0	1	1	0	1	0	0	0	7	6
38	21011	41	M	24	Em. App	Ac. App.	RC	>7.5	>7.0		1	0	1	1	1	0	1	1	1	1	0	1	10.5	8
39	21571	18	F	36	Em. App	Ac. App.	Pelvic	>7.5	>7.0		1	0	0	1	1	1	1	1	1	1	0	1	10.5	8
40	22267	20	M	72	Conservative	N/A	N/A	<7.5	<7.0		0	0	1	0	0	1	1	0	1	0	0	0	6	4
41	21306	14	F	36	Em. App	Normal	PostIleal	>7.5	>7.0		1	1	0	1	1	1	1	0	1	0	0	1	9.5	8
42	18868	15	F	90	Conservative	N/A	N/A	<7.5	<7.0		0	1	0	1	0	1	0	0	1	0	0	1	6.5	4
43	18763	40	F	46	Em. App	Ac. App.	Pelvic	>7.5	>7.0		1	0	1	1	1	1	1	1	1	1	0	1	11	9
44	16515	28	F	72	Em. App	Normal	PostIleal	<7.5	<7.0		0	0	1	1	0	0	1	0	1	0	0	0	5.5	5
45	17848	22	M	84	Conservative	N/A	N/A	<7.5	<7.0		0	0	1	1	0	0	1	1	1	0	0	0	6	6
46	25027	29	M	90	Em. App	Ac. App.	RC	>7.5	>7.0		1	1	0	1	1	1	1	1	1	1	1	1	13.5	9
47	19999	30	F	24	Em. App	Ac. App.	RC	>7.5	<7.0		0	0	1	1	0	1	1	0	1	0	0	1	8	6
48	25840	56	M	36	Em. App	Ac. App.	Pelvic	>7.5	>7.0		1	1	1	1	0	1	1	1	1	0	0	1	9.5	9
49	25319	27	M	24	Em. App	Normal	Pelvic	>7.5	<7.0		0	0	1	1	0	1	1	0	1	1	0	1	10.5	6
50	15837	31	M	90	Conservative	N/A	N/A	<7.5	<7.0		0	0	0	1	0	1	1	0	1	0	0	0	6	5
51	17284	27	M	36	Em. App	Ac. App.	RC	>7.5	>7.0		0	1	1	1	1	1	1	1	1	0	0	1	10.5	9
52	16376	52	F	24	Em. App	Ac. App.	RC	>7.5	<7.0		0	0	0	1	1	0	1	1	1	1	0	1	8.5	6
53	22466	40	F	12	Em. App	Ac. App.	RC	>7.5	>7.0		0	1	1	1	1	0	1	1	1	1	0	1	10.5	8
54	19631	35	F	24	Em. App	Normal	RC	>7.5	>7.0		1	0	1	1	1	1	1	1	1	0	0	1	9.5	9
55	22667	49	F	36	Em. App	Ac. App.	RC	>7.5	>7.0		1	1	0	1	1	1	1	1	1	1	0	1	11	9
56	16208	50	F	12	Conservative	N/A	N/A	<7.5	<7.0		0	0	0	1	0	1	0	0	1	0	0	1	5.5	3
57	18252	15	M	90	Conservative	N/A	N/A	<7.5	<7.0		0	0	1	1	0	1	0	0	1	0	0	0	6	4
58	21100	53	F	36	Em. App	Ac. App.	SubCaecal	>7.5	>7.0		1	0	0	1	1	1	1	1	1	1	0	1	10	8
59	19449	25	F	12	Em. App	Normal	RC	>7.5	>7.0		1	0	1	1	1	1	1	1	1	0	0	1	9.5	9
60	20831	36	M	24	Em. App	Ac. App.	Pelvic	>7.5	>7.0		0	0	1	1	1	1	1	1	1	0	0	1	9.5	8
61	22823	30	F	18	Em. App	Ac. App.	RC	>7.5	<7.0		0	0	0	1	1	0	1	1	1	1	0	1	9	6
62	26667	42	M	24	Em. App	Ac. App.	RC	>7.5	<7.0		0	0	1	1	1	0	1	0	1	0	0	1	8	6
63	21137	32	F	18	Em. App	Ac. App.	RC	>7.5	>7.0		0	0	1	1	1	1	1	1	1	1	1	1	13	8
64	20096	32	M	24	Em. App	Normal	Pelvic	>7.5	<7.0		0	0	0	1	0	0	1	0	1	1	0	1	8.5	4
65	24436	14	F	72	Conservative	N/A	N/A	<7.5	<7.0		0	0	1	1	0	0	0	0	1	0	0	0	4.5	3
66	17665	15	M	36	Conservative	N/A	N/A	<7.5	<7.0		0	0	1	1	0	0	0	0	1	0	0	1	6.5	3
67	23992	50	F	40	Conservative	N/A	N/A	<7.5	<7.0		0	1	0	1	0	1	0	0	1	0	0	0	5.5	4
68	26094	20	M	60	Em. App	Ac. App.	Pelvic	>7.5	>7.0		1	0	1	1	1	1	1	1	1	1	0	1	11.5	9
69	24629	17	F	24	Em. App	Ac. App.	RC	>7.5	>7.0		1	1	0	1	1	1	1	0	1	0	0	1	9.5	8
70	23306	37	M	36	Em. App	Ac. App.	RC	>7.5	>7.0		0	1	1	1	1	1	1	1	1	1	0	1	12.5	9

S. No.	IP No.	Age	Sex	Dur/Hrs	Manag.	Histopath	App. Pos.	RIPASA Group	Alvarado Group	PARAMETERS												RIPASA Score	Alvarado Score
										Migrating Pain	Anorexia	Nausea/Vom	RIF Tend.	Rebound	Fever	Inc. WBC	Left Shift	RIF Pain	Guarding	Rovsing's	Neg. U/A		
71	16478	28	M	12	Em. App	Normal	Pelvic	<7.5	<7.0	0	0	0	1	0	0	1	0	1	0	0	0	5.5	4
72	25030	15	F	60	Conservative	N/A	N/A	<7.5	<7.0	0	0	1	1	0	1	1	0	1	0	0	0	6.5	6
73	19340	37	M	90	Conservative	N/A	N/A	<7.5	<7.0	0	0	1	1	0	0	1	0	1	0	0	0	6	5
74	17513	59	F	42	Em. App	Ac. App.	RC	>7.5	>7.0	0	0	1	1	1	1	1	1	1	1	0	1	10.5	8
75	21316	20	F	60	Conservative	N/A	N/A	<7.5	<7.0	0	0	1	1	0	1	0	0	1	0	0	1	6.5	4
76	17377	18	F	24	Em. App	Normal	Pre ileal	<7.5	<7.0	0	0	1	1	1	0	0	0	1	0	0	1	7	4
77	24762	28	M	36	Em. App	Ac. App.	RC	>7.5	>7.0	0	1	1	1	1	1	1	0	1	1	0	1	12.5	8
78	25975	24	M	24	Em. App	Ac. App.	RC	>7.5	<7.0	0	0	1	1	0	1	0	0	1	1	0	1	9.5	4
79	23835	30	M	12	Em. App	Ac. App.	Pelvic	>7.5	<7.0	1	0	0	1	0	0	0	0	1	1	0	1	8	3
80	23007	21	M	60	Conservative	N/A	N/A	<7.5	<7.0	0	1	1	1	0	1	0	0	1	0	0	0	7	5
81	22473	26	M	24	Em. App	Ac. App.	Pelvic	>7.5	<7.0	0	0	1	1	0	0	1	0	1	1	0	1	9.5	5
82	25171	26	M	12	Em. App	Ac. App.	Pelvic	>7.5	<7.0	0	1	0	1	0	1	0	0	1	1	0	1	9.5	4
83	19851	47	F	8	Em. App	Ac. App.	Pre ileal	>7.5	>7.0	1	0	1	1	1	0	1	1	1	1	0	1	10	8
84	18496	20	M	18	Em. App	Ac. App.	RC	>7.5	>7.0	1	0	0	1	1	1	1	1	1	1	0	1	11	8
85	21045	20	F	24	Em. App	Ac. App.	SubCaecal	>7.5	>7.0	0	1	0	1	1	1	1	0	1	1	0	1	11	7
86	26767	36	F	56	Em. App	Ac. App.	SubCaecal	>7.5	>7.0	0	0	1	1	1	1	1	1	1	1	0	1	10.5	8
87	19170	27	M	24	Conservative	N/A	N/A	<7.5	<7.0	0	0	1	1	0	1	0	0	1	0	0	0	6.5	4
88	18957	24	F	36	Conservative	N/A	N/A	<7.5	<7.0	0	0	1	0	0	0	1	1	1	1	0	0	7	4
89	21121	38	F	40	Em. App	Ac. App.	Pelvic	>7.5	>7.0	1	0	1	1	1	0	1	1	1	0	0	1	8.5	8
90	24324	15	M	72	Conservative	N/A	N/A	<7.5	<7.0	0	1	0	1	0	1	0	0	1	0	0	1	7	4
91	26170	25	M	90	Conservative	N/A	N/A	<7.5	<7.0	0	1	0	1	0	1	0	0	1	0	0	0	6	4
92	24399	20	F	60	Conservative	N/A	N/A	<7.5	<7.0	0	0	1	1	0	0	1	0	1	0	0	1	6.5	5
93	22731	62	M	8	Em. App	Ac. App.	Pelvic	>7.5	<7.0	0	0	1	1	1	0	0	0	1	1	0	1	9	4
94	26403	21	F	24	Em. App	Ac. App.	RC	>7.5	<7.0	0	1	1	1	0	1	0	0	1	1	0	1	10	5
95	17089	28	M	72	Conservative	N/A	N/A	<7.5	<7.0	0	1	0	1	0	0	1	0	1	0	0	0	6	5
96	19442	35	M	24	Em. App	Ac. App.	RC	>7.5	>7.0	1	0	1	1	0	1	1	1	1	0	0	1	9	8

KEY TO MASTER CHART

ABBREVIATIONS USED:

Mang. – Management of the Patient

Em. App – Emergency Appendicectomy

Ac. App – Acute Appendicitis

App. Pos. – Position of the Appendix

RC – Retrocaecal

- For each “Parameter” the CODE 1 indicates its presence and CODE 0 represents its absence. Note that this doesn’t represent the actual RIPASA or Alvarado score of these individual parameters. Score is calculated as described earlier in the study, based on the scoring system and presence or absence of the parameter.
- The parameters of Age, Sex and Duration (hrs) of symptoms are scored in the RIPASA system based on its criteria.

The Final RIPASA and ALVARADO Scores are calculated and represented in the last 2 columns of the data chart.