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A Study On Comparison Of Alvarado With Ripasa Score In Diagnosis Of Acute Appendicitis And Correlation Of Both The Scoring Systems With Intraoperative And Histopathological Findings

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I. INTRODUCTION

Acute Appendicitis is a common cause of acute abdominal pain for which an early diagnosis is rewarded by a decrease in morbidity & mortality. So we have to first confirm whether the patient has appendicitis or not. Acute appendicitis is defined as an acute inflammation of appendix. (A vestigial organ present in the human body.)

Acute appendicitis can be divided based on pathology into 2 types. They are obstructive appendicitis or non-obstructive appendicitis (also known as catarrhal appendicitis.)

- Appendicitis is the most common cause of acute abdominal pain.
- Western literature says that 6% of population have risk of suffering from appendicitis during their lifetime.
- Although the mortality arising from appendicitis dropped from about 26% to less than 1% with the advent of antibiotics and early surgery, in elderly it is approximately 5 to 15%.
- The morbidity due to appendicular perforation and its incidence ranges from 17% to 40%.The perforation rate is much higher in elderly and children.
- Failure to make an early and prompt diagnosis converts acute appendicitis to perforated appendicitis, a grave disease with life threatening complications including intra-abdominal abscesses, wound infection & even leading to death
- The negative laparotomy rate is 15% to 35% and leads to significant morbidity. The negative laparotomy rate is higher in young women (up to 45%) because of the prevalence of pelvicinflammatory disease (PID) and other causes of obstetrical and gynaecological disorders.

Thus, diagnosis of acute appendicitis is needed to be precise in order to decrease morbidity and mortality.

Routine history and physical examination are the most effective and practical diagnostic modalities. The history typically is onset of generalized abdominal pain followed by anorexia and nausea. Typically, the patient presents with abdominal pain over the umbilical region which shifts to the right lower quadrant. Vomiting may happen during this time, particularly in children. Physical examination reveals signs similar to any acute intra-abdominal process - local rebound tenderness, guarding, rigidity, cutaneous hyperesthesia and tenderness on per rectal examination. But about one third of all patients with acute appendicitis present with atypical symptoms. Hence, the differential diagnosis is varied such as gastroenteritis, regional enteritis, pelvic disorders (in young women), Ureteric colic, peptic ulcer disease, diverticulitis, etc.

The routine lab examination of blood and urine is essential. Leucocytosis with a left shift is a useful but non reliable, 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.

Plain x-rays have an accuracy of only 8%. The findings in favour of appendicular inflammation include the presence of faecolith, dilated sentinel loop of ileum, ileal or caecal air fluid level on erect films, haziness in right lower quadrant and blurring of the right psoas shadow. The ileal Air/fluid level has specificity rate of 95% but sensitivity is only 51%, whereas sentinel loop has sensitivity of 78% and its specificity is only 62%.

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Though barium enema examination has an accuracy between 50% & 84% it has limitations.

- The major being the risk of caecal perforation.
- The findings are often negative even for appendicular perforation and even when an abscess has been formed.
- Time consuming for the radiologist.
- Causes discomfort to the patient.
- Needs ionizing radiation.

Computed Tomography may pick up, inflamed and normal appendix but usually depends on the presence of fluid in the right lower quadrant or an abscess for the diagnosis. Laparoscopy helps particularly in young women in reproductive age because gynaecological conditions may mimic acute appendicitis. The diagnostic error is twice as high as in women of reproductive age as that in men. High-resolution Ultrasonography with graded compression is of enormous value in diagnosing acute appendicitis but has its own limitations. These studies show the sensitivity as 75% to 94%, a specificity of 86% to 100% and overall accuracy of 87% to 96%. Several studies were conducted in which the results of USG were used to help the surgeon to arrive at the decision to operate or not.

Even, with all these diagnostic modalities negative appendicectomy rate of 15-25% has been accepted. However, the complication rate of unnecessary operation is 13%, as high as that of genuinely inflamed appendix. Removal of a normal appendix carries a mortality of 0.65 for every 100 operations. On the other hand, prolonged clinical observations as an attempt to minimize unnecessary operation may mean a delayed operation in 28% of cases and lead to 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 helps in the early diagnosis of acute appendicitis as demonstrated by various studies is helpful in reducing the incidence of negative appendectomies without causing rise in morbidity and mortality.

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

RIPASA= Raja Isteri Pengiran Ank Saleha Appendicitis Score.

The use of this new scoring is based on the fact that Alvarado and Modified Alvarado were based on western countries and using these in Asian populations did not yield the same results.

II. AIM AND OBJECTIVE

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

III. REVIEW OF LITERATURE

The word "appendicitis" refers to inflammation of appendix. Literally appendix means an appendage – anything that is attached to a larger or major part as a tail or a 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 mostly to humans and the higher primates but sometimes absent in humans.

HISTORICAL NOTE:

Though appendix has been known for centuries, the credit for its first description is given to the physician-anatomist, Berengario Da Capri, in the year 1521. The appendix was 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 many hundred years. Aretaeus in the second century A.D. described a case in which he drained an abscess from the right part of the abdomen near the liver. This might have been due to an abscess arising from some other source. Jean Fernel, the great French Physician, described a case of perforated appendicitis in his Universa Medicina. He gave an account of a seven- year old girl with 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 died. Autopsy findings showed the "caecum was narrow and constricted; also quince was found adherent to the inside and obstructing the lumen".

In 1711, Lorenz Heister, professor of surgery at Helmstadt discovered a case of appendicitis when he dissected the body of a criminal who had been executed. In account he wrote that "he was about to demonstrate the situation of the great guts when he found the vermiform process of the caecum preternaturally

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black, adhering closer to the peritoneum than usual."

William Ballonius, in his Consiliorum Medicinalium published in Geneva in 1734, gave the description of gangrenous appendicitis in the living patient.

Reginald Fitz of Boston gave his 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 them were clinically diagnosed as typhilitis and perityphilitic abscess. The disease was found to be most common in young adults, especially males. A faecal concretion or foreign body was present in sixty percent of the cases. He went on to discuss the origin of the term typhlitis, perityphlitis and paratyphlitis abscess and concluded that in 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 but 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 causative factor.

In 1899 Charles Mcburney of New York illustrated that "exact location 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 area (Mcburney's point) I have demonstrated in every case operated upon by me since I first made the observation". This point corresponds to the base of the appendix and therefore does not move with the tipSir 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 appendicular perforation in 1812. However, J.B.Louyer-Villermay in 1824 highlighted the significance of the condition in his paper, "Observations of Use in the inflammatory Conditions of the Caecal Appendix", presented before the Royal academy of Medicine in Paris. Walcott Richard's diagnosis of Appendicular perforation which he described as "ulceration of the appendix vermiformis" in 1838, was confirmed on post mortem 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 named 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.

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

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. The patient was a boy, had hernia and a faecal fistula. Richardson reported: "When he opened the scrotum he found the appendix in that unusual position and moreover, that the appendix was perforated by a pin. He removed the appendix and then dealt with the hernia and fistula". Hancock in London drained an appendicular abscess in a female patient aged 30 years during her eighth month of pregnancy in 1848. After incising the peritoneum, fluid was drained and he did not search for the appendix. Willard Parker, an American surgeon, started draining appendicular abscesses since 1867. He did not remove the appendix and his technique is used but the appendix is removed later on.

Lawson Tait, the great English surgeon, was the first to remove an acutely inflamed appendix. He thought that his patient had a generalised peritonitis resulting from rupture of the caecum or the appendix. However, when he opened the abdomen he found "a large abscess which extended deeply down to 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.

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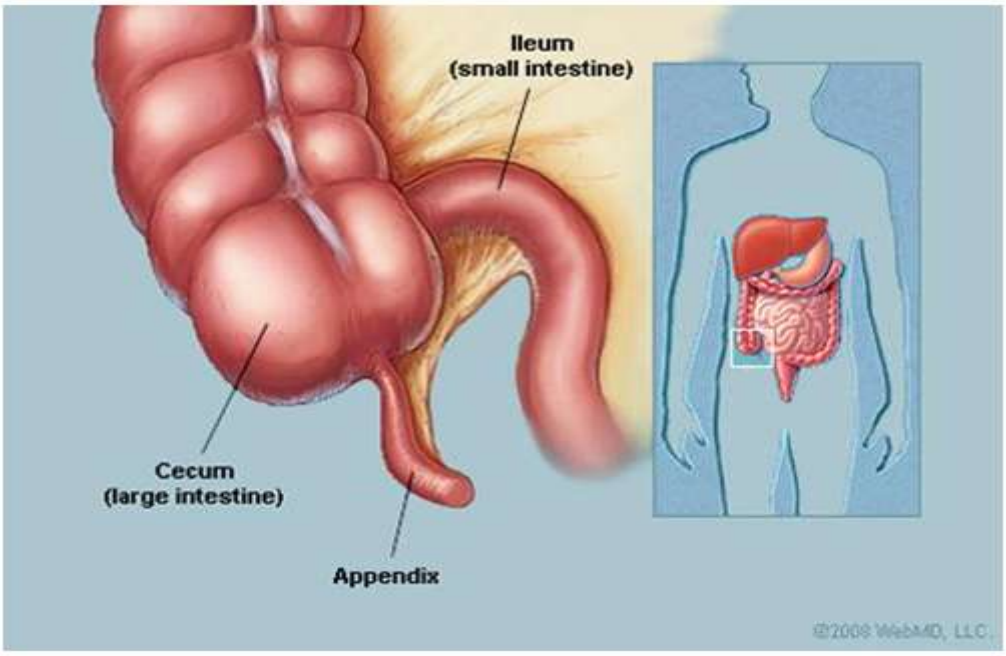
Abraham Groves was the first to perform elective appendicectomy in Canada in 1883. His patient was a twelve- year old boy. The appendix was removed and the stump was cauterized with a heat probe heated over the flame of a lamp. The patient recovered. In 1894, Mcburney described his incision for appendicectomy. Though he was the first to describe this incision, L.L.McArthur, who had used the incision in more than 60 cases, had used it for a longer time. Later McBurney gave McArthur credit for using the incision, but inspite of 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. Noteworthy as these various dates are, it is doubtful as to 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 severe abdominal pain and fever only a few days before, consultation with some of the most distinguished surgeons in the land, including Lord Lister, it was decided that the only chance to save his life lay is urgent operation. Frederick Treves, who 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 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.

ANATOMY

Embryologically, the vermiform appendix is a part of caecum, which forms the distal end. It arises from the caudal part of the midgut. The surface marking for the Appendicular base is junction of the lateral and middle one third of the line joining the right anterior superior iliac spine to the umbilicus (Mc Burney's point); but this is only a useful surgical approximation, with variation. The three taenia coli on the ascending colon and caecum converge on appendicular base, and merge into its longitudinal muscle. The anterior caecal taenia is usually distinct and can be traced to the appendix, which serves as a guide to its location. The length of Appendix varies from 2cm to 20cm, with average length of about 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 seen especially when there is long appendix mesentery allowing greater mobility which include subcaecal, preileal and postileal. It has a mesoappendix with which it is attached to the ileal mesentery.



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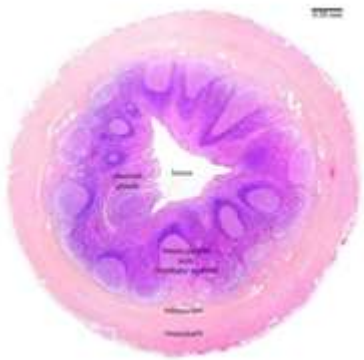
The appendicular lumen is small (admits a matchstick) and opens into the caecum by an orifice lying below and slightly posterior to the ileocaecal junction. The orifice is guarded by a semilunar mucosal valve. The appendicular artery supplies it, which is the branch of ileocolic artery which runs behind the terminal ileum and enters the mesoappendix a short distance from the appendicular base; here it gives off a recurrent branch which anastomose with a branch of the posterior caecal artery at the base of the appendix. The main Appendicular artery approaches the tip of the organ, at first near and then in mesoappendix edge. 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. The appendix is drained by one or more appendicular veins into posterior caecal or ileocolic vein and from there into the superior mesenteric vein. A 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.

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



Histology of the appendix.

Though the function of appendix is uncertain but its immunologic function is suggested by its content of lymphoid tissue. But, it is a useful organ for surgeons as it can be used for on table lavage of large bowel. Appendix also serves as a conduit for permanent continent urinary diversion.

The position of the appendix can vary anywhere with the center at the base of the caecum. It is the only organ in the body with no constant anatomic position; in fact, it's only constant feature is its origin from the ceacum. The various positions of the appendix are: paracolic, retrocolic, preileal, postileal, promontoric, pelvis and subcaecal. The appendix may be in the left lower quadrant of the abdomen in case of transposition of the abdominal viscera. The most common position is Retrocaecal. Wakeley 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%.

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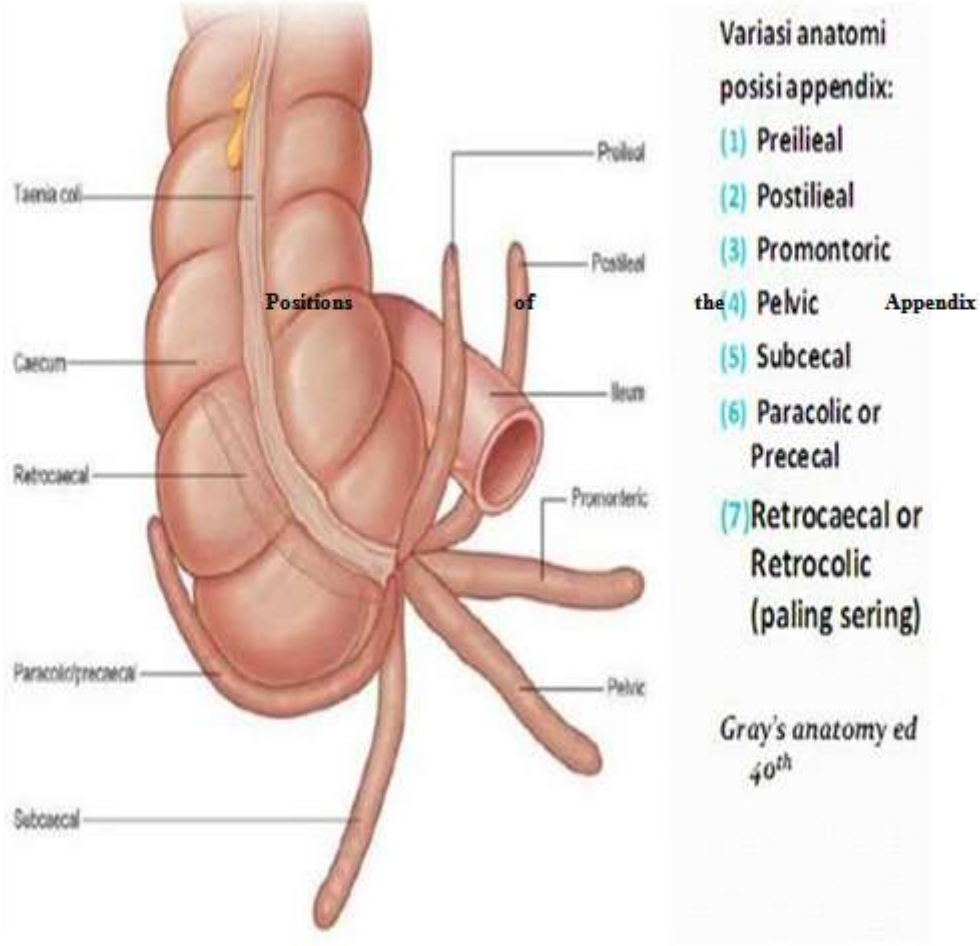

Positions of the Appendix

ACUTE APPENDICITIS

INCIDENCE

Acute Appendicitis is one of the most common cause of the acute abdomen. Since it is a non-notifiable disease, its exact incidence is not known. The incidence of appendicitis have risen greatly in the first half of this century, particularly in Europe, America and Australia, with 16% of the population undergoing surgery. During the past 30 years its 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 surgeries 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 appendicectomies performed between 1987 and 1996. There has been an association between Appendicitis and western diet habits. Appendicitis is much more common among meat eating white races and rare in races that habitually live on a bulk cellulose diet. Due to an inherited malformation of the organ, there has been a familial tendency. Anderson and colleagues compared 29 children between the age group 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. However, family history of appendicitis is of no diagnostic value.

PATHOLOGY

Acute appendicitis is believed to arise from infection superimposed on luminal obstruction. The Appendicular lumen becomes obstructed by hyperplasia of submucous lymphoid follicles, faecolith, stricture, tumor etc. Once the lumen is obstructed, continuous mucus secretion and inflammatory exudation increases intraluminal pressure, causing lymphatic obstruction. Oedema and mucosal ulceration results in bacterial translocation to the submucosa. Resolution at this

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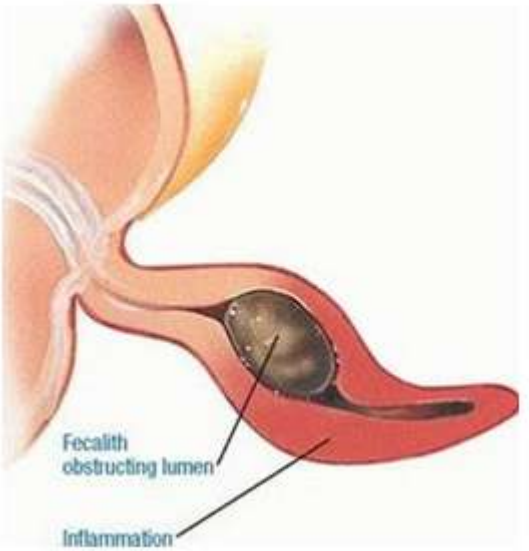
point may either be spontaneous or in response to antibiotic therapy. If this condition progresses, further distention of the appendix may lead to venous obstruction and ischemia of the appendix wall. With ischemia, bacterial invasion occurs through the muscularis propria and sub mucosa, results in acute appendicitis. Finally ischemic necrosis of the appendix produces gangrenous appendicitis, with bacterial contamination of the peritoneal cavity. Alternatively, the greater omentum and loops of small bowel become adherent to the inflamed appendix, preventing the spread of peritoneal contamination, resulting in appendicular mass or appendicular abscess.

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

Appendicitis is a polymicrobial infection with up to 14 different organisms cultured in patients with perforation. According to a study by Pieper and colleagues 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 was the most common aerobic bacterium (45 out of 50). Other gram negative aerobes like klebsiella, and proteus and pseudomonas were isolated in ten patients. Enterococci were found in 15 patients and streptococci in 21 patients. Among the anaerobes, the most common was Bacteroides fragilis. Next in the order was gram positive cocci. Clostridium perfringens.

There are two types of acute appendicitis, which are Catarrhal & Obstructive appendicitis. Catarrhal appendicitis is at first a mucosal and submucosal inflammation. The appendix may be quite normal or hyperemic at first. However later the mucosa wall is thickened, edematous and reddened. Then it becomes studded with dark brown haemorrhagic infarcts, patches of gangrene, or small ulcers. Eventually the appendix becomes swollen and turgid and the serosa becomes roughened and coated with fibrinous exudates. Till now the lumen of appendix is patent and these cases rarely progress to gangrene. Furthermore, the lymphoid hyperplasia may lead to obstruction of the lumen and proceed to gangrene. Furthermore, on resolution of catarrhal appendicitis, adhesion formation and kinking of the appendix may lead to a final episode of acute obstructive appendicitis.

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



Faecolith of the Appendix causing Obstructive Appendicitis

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Wilkie demonstrated the relationship between appendicular obstruction and gangrenous appendicitis in 1914, which showed that acute appendicitis followed ligation of the appendix in the rabbit. Wangensteen and colleagues documented that combined obstruction and bacterial infection resulted in acute appendicitis. In two third of all gangrenous appendicitis, faecolith is present in the lumen of Appendix. A true faecolith is ovoid, of 1 to 2 cm length, and faecal coloured. Majority of these faecoliths are radio-opaque and some, contain sufficient calcium to be demonstrated on plain x-ray film of the abdomen. Other foreign bodies like food, debris, worms, or even gallstones can also obstruct the appendix lumen. One of the rare causes of obstructive appendicitis is the appendix becoming strangulated in hernial sac.

The most frequent site of perforation is at the anti-mesenteric border, usually near the tip, as the Appendicular artery is subserosal at this point and more prone to be involved by inflammation and become thrombosed. After perforation an abscess may localise 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 the inflammatory condition has progressed within the appendix and the position of the appendix. It is usually stated that the localization of the infection in infants is poor 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 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.

The complications of a perforated appendix are more 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.

The entity of chronic appendicitis is controversial. It has been well said that "the appendix does not grumble – it either screams or remains silent." Clinical and experimental data support the belief that some patients have repeated attacks of appendicitis. In fact, it is usual for one or more such episodes to precede a full blown acute appendicitis. 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. Thus the term chronic appendicitis has been used. But, it definitely does not mean prolonged abdominal pain lasting weeks or months.

CLINICAL MANIFESTATIONS

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 on the basis of the history and the physical findings, with additional assistance from laboratory and radiographic examinations. In appendicitis, there is a characteristic sequence of signs and symptoms.

The clinical features of acute appendicitis begin with poorly localized central colicky abdominal pain. This is due to the midgut visceral discomfort in response to appendiceal inflammation and obstruction. The pain is frequently initially noticed in the epigastric or periumbilical region, presumably due to Appendix distension. This central abdominal pain is followed by anorexia, nausea and vomiting. With progressive inflammation of the appendix, the irritation of parietal peritoneum in the right iliac fossa, produces more intense, constant and localized somatic pain that begins to predominate. During the first 6 hours, there is usually no alteration in temperature or pulse rate, after some time, slight fever with corresponding tachycardia is usual. Though the patient frequently complains of constipation especially during early phase of visceral pain, many patients particularly children may present with diarrhoea. 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.

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.

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

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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 doubtful.

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)

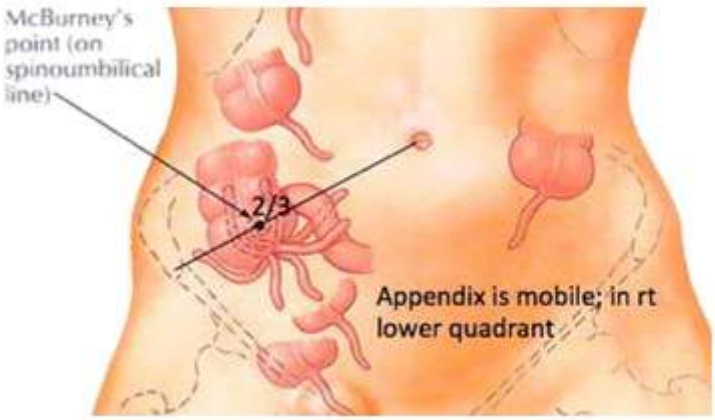
It is a very important sign. The early deep tenderness is almost always detected at murphy's point (the junction of lateral one third and medial two third of spino-umbilical line).

Tenderness over the Mcburney's point may vary which corresponds to appendicular base, as the tenderness appears to be located actually in the appendix itself. In fact, the tender point varies according to the position of the appendix. Retrocaecal or post ileal appendicitis may be less tender. 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 absent, and the diagnosis can be made only on rectal examination. Pain is felt in the suprapubic area, as well as locally within the rectum.

Peritoneal signs

A) Mc Burney's sign

Fingertip 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) .It is usually maximum abdominal tenderness.



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.

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.

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. 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.

H) Baldwing's sign

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A hand is placed over the right flank and the patient is asked to raise theRight lower limb with knee extended, in retrocaecal appendicitis this initiates pain and indicates the retrocaecal 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, these Diagnostic signs are not reliable. 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, 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 sufficient 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. Hence, the element of disease history had low power in discriminating for appendicitis from 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, diarrhoea or the progression of pain had no diagnostic value for appendicitis. Right sided rectal tenderness was found to be a predictor of negative exploration.atypical, presenting with a generalized abdominal pain. Mostly 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 acute appendicitis.

Appendicitis occurring in elderly is more serious. The clinical features of patients more than 60 years of age are same as that 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 atrophy and diminished blood supply as a result of generalized atherosclerosis are important factors in allowing rapid progression of the disease.

Risk of Appendicitis in pregnancy is same as that of non-pregnant woman of the same age. Appendicitis occurs frequently in the first two trimesters, and during this time period the symptoms of appendicitis are same as seen in non - pregnant women. During the third trimester, the caecum 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 due to 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 foetus alike, and hence, early operation is warranted.

DIFFICULTY IN DIAGNOSIS

Diagnosing Patients with diarrhoea which mimic enteritis, especially if the appendix is in pelvicposition with minimal abdominal signs may be difficult. Also, in obese, demonstration of the signs may be difficult. However, diagnosing appendicitis in young children, elderly and the pregnantis difficult.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 of

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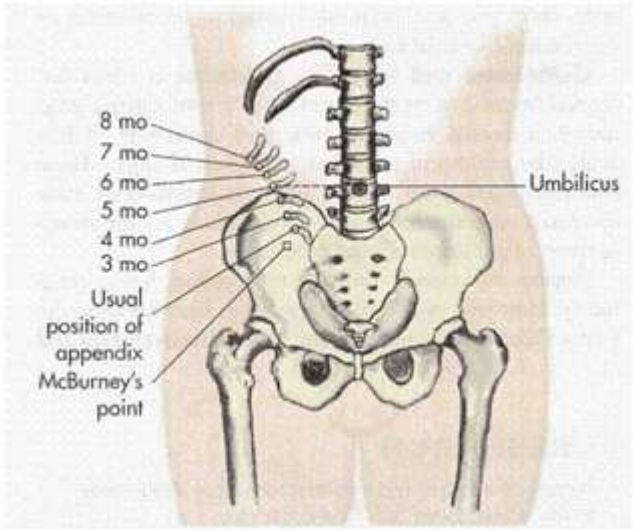

Position of Appendix during pregnancy

DIFFERENTIAL DIAGNOSIS

The diagnosis of acute appendicitis may be easy or difficult. The examination and the investigations are non-specific. Thus the differential diagnosis are many. Most of the entities in the differential diagnosis of appendicitis 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 Differential Diagnosis in Young Children for acute appendicitis are gastroenteritis, mesenteric lymphadenitis, Meckels's diverticulitis, Pyelitis, small intestinal intussusception, enteric duplication, and basilar pneumoniaIn, teenagers and adults, the differential diagnosis is different in men and women. In young women, the differential diagnosis include ruptured ectopic pregnancy, mittelschmertz, endometriosis, ureteric colic and salphingitis. 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 caecal carcinoma, mesenteric vascular occlusion, rupturing aortic aneurysm, and the disease entities already mentioned for young adults.

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. In three quarters of patients the white cell counts is raised above 12,000/mm³. However, in others, the count may be slightly raised or normal, especially in children. Neutrophilia is one of the features of appendicitis. In 1982, Pieper et al noted that 66.7% had white cell count of 11,000/mm³ or more and in only 5.5% it was raised above 20,000/mm³. Andersson et al reported that the WBC and neutrophils count had higher power in discriminating for advanced appendicitis than for all appendicitis. Appendicitis was unlikely when the WBC and neutrophils counts are low. (LR 0.16-0.28 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.

URINE EXAMINATION

The haematuria or pus cells in the urine does not exclude appendicitis.

Ureter or urinary bladder irritation by the inflamed appendix may cause microscopic hematuria or pyuria. Graham (1965) quantitatively analysed 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.

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C-REACTIVE PROTEIN

CRP is a nonspecific acute phase reactant, which appears in the sera of individuals in response to a variety of inflammatory conditions and tissue necrosis. It is a non-specific indicator for acute appendicitis. There have been various studies regarding the importance of CRP in differentiating appendicitis from othernon-inflammatory conditions of the abdomen. One of such studies showed that CRP value is increased markedly only after appendiceal perforation or abscess formation. However leukocytosis 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.

RADIOGRAPHY

Plain films of abdomen in supine and erect position helps in differential diagnosis of acute abdominal pain. However, they are non-specific. Brookes and Killen 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 abdominus.
- 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

Faecolith 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 or specific to alter the maxim “If the diagnosis of appendicitis remains in doubt, take appendix out”.

ULTRASONOGRAPHY

In 1989, Julien B.C.M. Puylaert described the value of graded compression sonography in the diagnosis 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. Ultrasonography is useful for doubtful diagnosis of acute Appendicitis on clinical examination. The sonographic finding of appendicitis is direct visualization of the inflamed appendix. The typical appearance is that of a concentrically layered, almost incompressible, sausage like structure demonstratedat the site of maximum tenderness.

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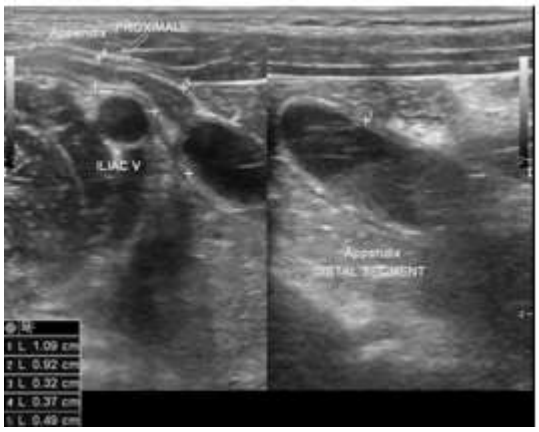


USG in Acute Appendicitis

The usual findings are:

- Visualization of non-compressible 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:

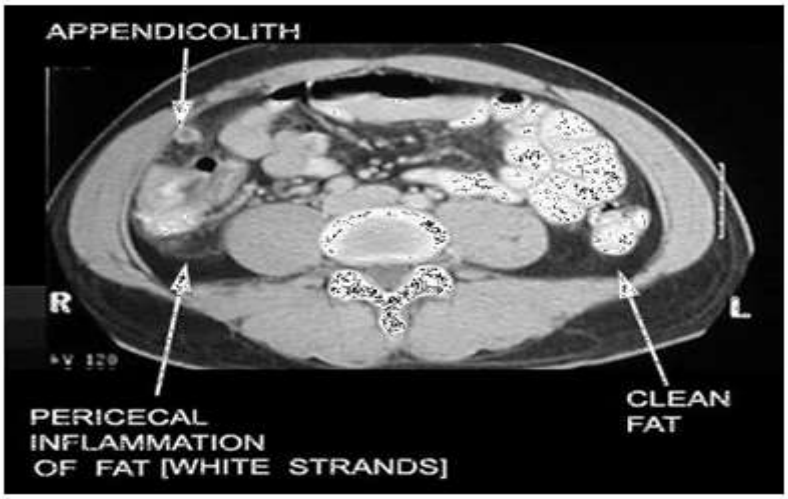
- Increased conspicuity (increase in size & number) of vessels in and around the appendix (hyperemia)
- Decreased resistance in arterial waveforms
- Continuous/pulsatile venous flow

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

Peritonism prevents visualising the appendix due to graded compression. 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 in diagnosing patients with atypical appendicitis. Studies show a decrease in negative laparotomy rate and appendiceal perforation rate when abdominal CT is used in patients with suspected appendicitis.



CT Showing inflammed appendix with faecolith

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Advantages of CT scanning include its better sensitivity and accuracy when compared with other imaging techniques, ready availability, non-invasiveness, and potential to reveal other diagnoses.

Disadvantages include radiation exposure, potential for anaphylactic reaction if intravenous (IV) contrast agent, lengthy acquisition time if oral contrast is used, and patient discomfort when rectal contrast is used.Initial study involved sequential (non-helical) CT in the diagnosis of acute appendicitis. In 1993, Malone evaluated non-enhanced, sequential CT in 211 patients and reported a sensitivity of 87% and a specificity of 97%. Adding IV and oral contrast agent increases sensitivity to 96-98% but increases the cost. Sequential CT with oral and IV contrast enhancement is highly accurate but time consuming and expensive; it is best used for equivocal presentations whenever helical CT is not available.

In 1997, Lane evaluated helical CT without contrast enhancement and found a sensitivity rate of 90% and specificity rate of 97%. Recent studies of non-contrast 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 paediatric patients, Kaiser found that non-enhanced CT was 66% sensitive. Sensitivity increased to 90% when IV contrast material was used. In 1997, Rao found that focused (lower abdominal and upper pelvic) Helical CT with 3% Gastrografin instilled into the colon (without IV contrast agent) had a superior sensitivity of 98% and specificity of 98%. Focused helical scanning without IV contrast eliminates the risk of anaphylaxis and reduces the cost. Acquisition time is <15 minutes.

Radiation exposure is less than standard obstruction series. Alternative diagnosis are revealed in 62% of patients and include diverticulitis, nephrolithiasis, adnexal pathology, RLQ tumour, small-bowel hernias, and ischemia.

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

SCORING SYSTEM

To reduce negative appendicectomy rates various scoring systems have been developed for making the diagnosis of acute appendicitis. Initial evaluation studies show 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.

It was based on 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

Characteristic	**Score**
M = migration of pain to the RLQ	1
A = anorexia	1
N = nausea and vomiting	1
T = tenderness in RLQ	2

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R = rebound pain	1
E = elevated temperature	1
L = leucocytosis	2
S = shift of WBC to the left	1
Total	**10**

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 where it was developed.

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

	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

- 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 decreased, especially in the last few decades because of antibiotics, early diagnosis, and improvements in anaesthesia and surgical techniques.

Since 1987, many surgeons do laparoscopic Appendicectomy. This procedure has now been improved and standardized. The reported results of both laparoscopic and open-procedure appendectomies seem to be the same. 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.

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

PREOPERATIVE DETAILS

Preoperative Preparation for patient undergoing appendicectomy is similar for both open and laparoscopic procedures. As the symptoms of underlying disease are masked, do not administer analgesics and antipyretics to patients with suspected appendicitis prior to evaluation by a surgeon. Complete routine laboratory and radiologic studies are performed 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 surgery.

Prior to the surgical procedure, the anaesthesiologist intubates to administer volatile anaesthetics 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 needs 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 fear of 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 entry 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 retracted medially. It is then taken out by a moist gauze sponge or Babcock's clamp, and the taenia coli are followed till they converge. The taenia coli converge at the base of the appendix, beneath the Bauhin valve (ie, the ileocecal valve), and the appendix is then visualised. If the appendix is hidden, it can be detected medially by retracting the cecum laterally by extending the peritoneal incision.

After exteriorization of the appendix, the mesoappendix is held between clamps, divided, and ligated. Appendiceal stump is crushed at the appendix base with a haemostat and then ligated. 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 cut remaining end of appendix may be inverted into the cecum with the use of a purse string suture or z-stitch.

Although performed by several surgeons, inversion of the appendix stump is not mandatory.

The cecum is placed back into the abdomen. When free perforation exists, peritoneal lavage with several litres of warm saline is advised. After the lavage, the irrigation fluid must be completely aspirated to avoid spreading of 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 the placement of drain.

The wound closure begins by closing the peritoneum with a running suture. Then, the fibres of the muscular and fascial layers are approximated 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. Some surgeons prefer immediate closure in these cases.

LAPAROSCOPIC APPENDICECTOMY

The surgeon typically stands on the left of the patient, and the assistant stands on the right. The anaesthesiologist and the anaesthesia 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 cannulas are placed during the procedure. Two of them have a fixed position (i.e., umbilical and suprapubic).

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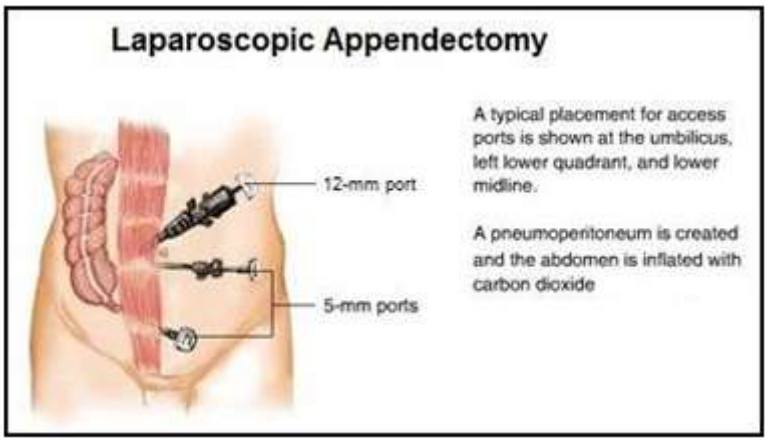
The third is usually placed in the right periumbilical region, but its position may vary greatly depending on the patient's anatomy. According to the surgeons preference, a short umbilical incision is made in order to allow the placement of a Hasson cannula or Veress needle that is secured with 2 absorbable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



Port Placement in Laparoscopic Appendicectomy

A 12-mm trocar is inserted suprapubically to allow instrumentation (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 in order 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 using linear Endostapler, or, alternately, the base of the appendix may be ligated in a similar manner to that in an open procedure. The appendix is now made free and may be removed via umbilical or suprapubic cannula using a laparoscopic pouch to prevent woundcontamination. Peritoneal irrigation is done with antibiotic or saline solution. Completely aspiration of the irrigant is done. The cannulae are then removed and the pneumoperitoneum is reduced.

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

POSTOPERATIVE DETAILS

Administeration of intravenous antibiotics is done postoperatively. The length of administration is based depending on the operative findings and the recovery of the patient. In complicated appendicitis, antibiotics may be required for days to weeks. Anti-emetics and analgesics are administered to patients complaining of nausea and wound pain. The patient is encouraged to mobilise early. When appendicitis is not complicated, the diet may be started as early as possible postoperatively and the patient is discharged from the hospital once the diet is tolerated. In patients with complicated appendicitis, start clear liquid diet when bowel function returns. These patients may be discharged after infection restitutes.

FOLLOW-UP CARE

After discharge from hospital, patients must have a light diet and limit their physical activity for a short period.

MORTALITY

The mortality rate following appendicitis has decreased since Sir Reginald Fitz in 1889

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described appendicitis. The statistics in England and Wales showed that in 1938, there were about 3000 deaths per year from appendicitis. By 1980, it had fallen to 179.

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

IV. MATERIALS AND METHODS

METHOD OF COLLECTION OF DATA

Patients who presented to the Emergency/General Surgery Department of Govt. Rajaji Hospital, Madurai Medical College for a period of 18 months from January 2019 to June 2020 with RIF pain and who were suspected of acute abdominal pain were considered for the study.

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

Patients who had non RIF pain, had history of trauma and who had been admitted with other complaints previously were excluded from the study. Similarly, patients with pain of more than 5 days, suspected to have appendicular lump/mass, having guarding, rigidity, previous history of urolithiasis or pelvic inflammatory disease were excluded from the study.

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

Evaluation was done based on RIPASA and Alvarado scoring in all these patients.

Post-operative specimen was sent for histopathological examination.

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

Period of Study

January 2019 – June 2020

Type of Study

Comparative study

Sample Size

100 Patients

Source of Data

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

Inclusion Criteria

Patients with acute abdominal pain (RIF pain) and suspicion of acute appendicitis.

Exclusion Criteria

- Patients admitted with other complaints and later developed RIF pain and with history of Trauma.
- Patients with pain >5 days.
- Suspected to have Appendicular lump/mass.
- Signs suggestive of Peritonitis as Guarding or Rigidity.
- Previous history of urolithiasis or pelvic inflammatory disease.

After the initial evaluation of the patient in the casualty/outpatient department of Govt. Rajaji 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 gynaecological consultation if felt necessary.

The detailed history, clinical examination, lab investigations were done which included routine haematological investigations, Urine routine, X-Ray KUB and USG Abdomen and Pelvis.

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 whether operate or not on the patient (vs conservative line of management)

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was based solely on the clinical suspicion of an experienced Surgeon who was not part of/involved in the study.

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

Confirmation of diagnosis by operative findings and histopathological assessment of the appendicectomy specimen with the ultimate criteria for the final diagnosis of acute appendicitis by the histological demonstration of polymorphonuclear leukocytes throughout the thickness of the appendix wall.

Those patients treated conservatively and discharged were reviewed in the surgical outpatient 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 taken 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 analysed 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

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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*						

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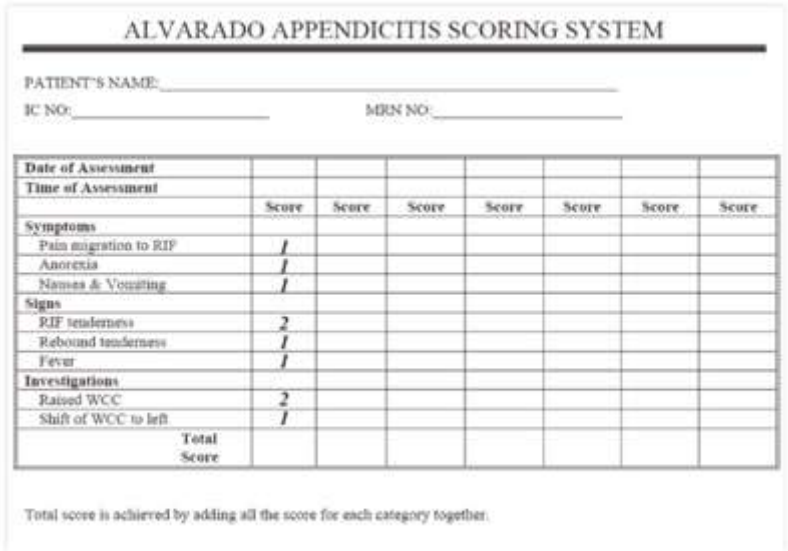

ALVARADO APPENDICITIS SCORING SYSTEM

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.

V. RESULTS

During the period of 18-months from Jan 2019 to June 2020, RIPASA and Alvarado scoring was made on a consecutive series of 96 patients admitted to the Department of General Surgery, Govt. Rajaji Hospital, Madurai Medical College, Madurai with signs and symptoms suggestive of Acute Appendicitis. The results were 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 years and the maximum age was 74 years.
- 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 young people. This shows that there is a predilection for younger age group and the incidence peaks between 20-40 years. and decreases as age progressed.

Age Distribution

Age(years)	**Total**
<20	16
20-30	39
30-40	22
40-50	8

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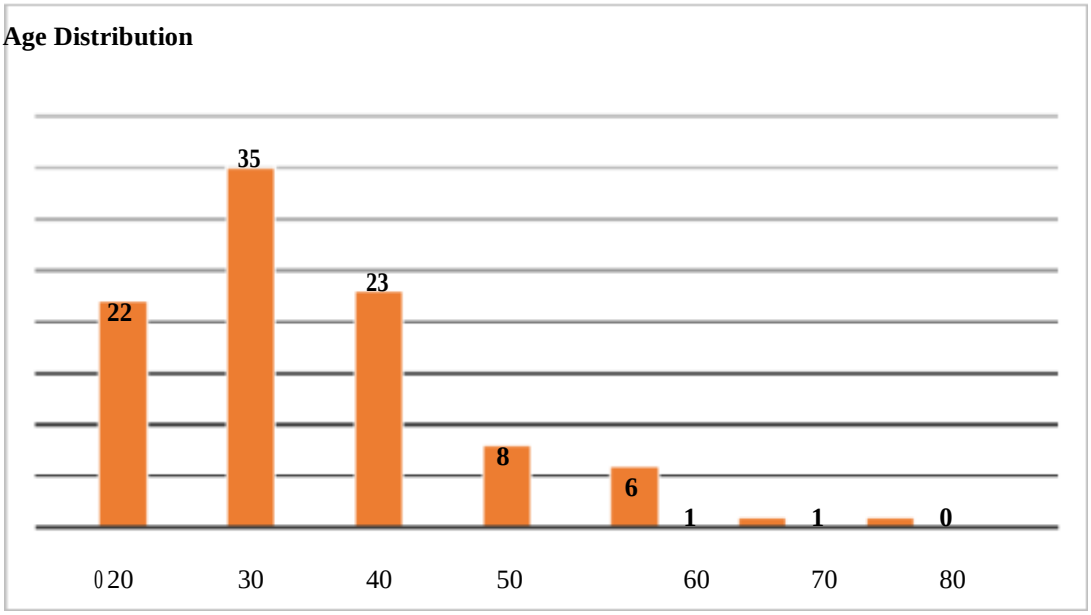
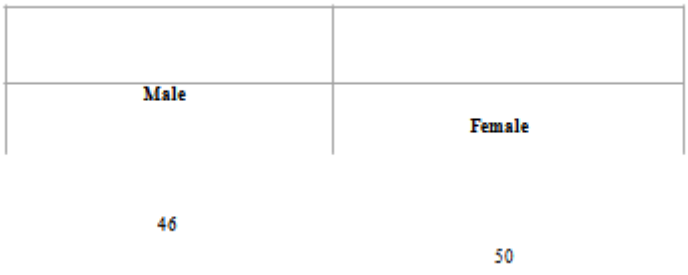
50-60	6
60-70	1
>70	1



58

Sex Distribution



Sex Distribution

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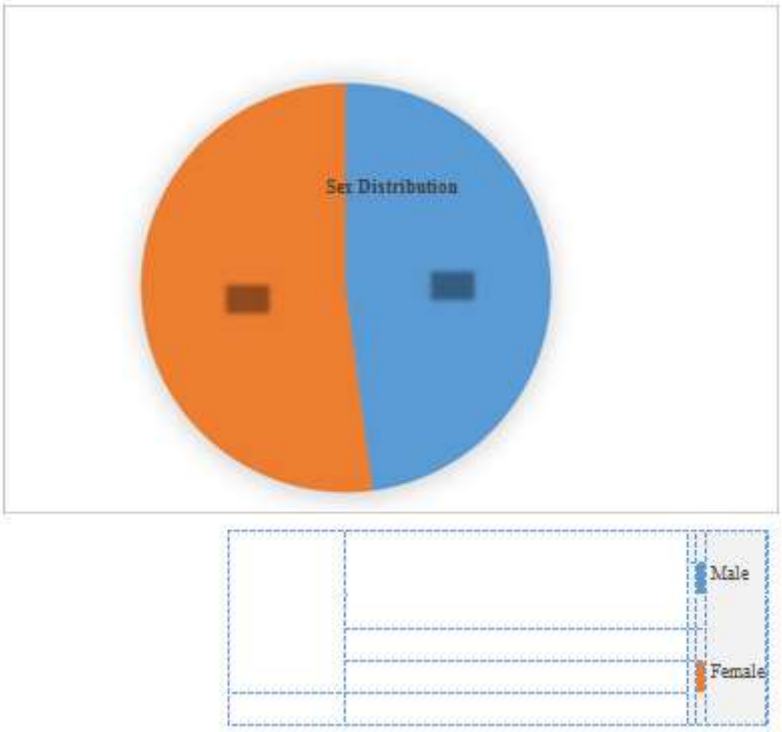

The operative details of the study group were as follows:

- 65 Patients underwent emergency appendicectomy. This was based on the surgeon's opinion.
- 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.

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- 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.

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

Distribution of patients according to RIPASA

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

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According to RIPASA score, 58 patients were diagnosed to have appendicitis. From these 58, 49 patients had evidence of appendicitis histopathologically. 9 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.

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 appendicitis histopathologically. Six patients were false diagnosed as appendicitis by Alvarado scoring system. Out of 56 patients diagnosed by Alvarado as not having appendicitis, 16 patients were missed by Alvarado scoring system.

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

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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

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.

Final Diagnosis (Operative + Histopathology)

Findings	**No. of Patients**
Acute Appendicitis	42
Gangrenous Appendix	4
Perforated Appendix	4
Normal Histology	15

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 statistically 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

Total Operated Patients	65

Position of Appendix According to Operative Findings

Position Of Appendix	**No. of Patients**	**Percentage**
Retrocaecal	36	55
Pelvic	16	25
Preileal	4	6
Subcaecal	6	9
Postileal	3	5

VI. DISCUSSION

Acute Appendicitis is the most common cause of acute abdomen requiring surgery. Over past centuries, the morbidity and mortality rates related to Acute Appendicitis condition have decreased significantly. This is because of the grave 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 almost nil mortality, it has associated morbidity rate of 10%.

Diagnosing 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 particularly difficult in the very young, the elderly and in the women of reproductive age group.

Appendicitis still poses a challenge in diagnosis and many methods to reduce the removal of a normal appendix without increasing the perforation rate have been investigated. Radiological methods such as ultrasonography and computed tomography, as well as laparoscopy are all methods that have been done 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 knowledge remains the mainstay of correct diagnosis of appendicitis. It is a scoring system that can be done in outpatient setting and a cheap and quick tool to apply in the emergency room.

The Alvarado criterion for diagnosing acute appendicitis which was later modified to accommodate additional parameters along with

original Alvarado scoring system. Since then the modified Alvarado has been 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, which included 14 fixed parameters. Data showed significantly increased 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 emergency settings, 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.

VII. CONCLUSION

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

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