"EVALUATION OF CRP AS AN ADDITIONAL MARKER IN THE DIAGNOSIS OF ACUTE APPENDICITIS IN A TERTIARY CARE HOSPITAL"

A DISSERTATION SUBMITTED TO THE TAMILNADU

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BRANCH – I

Register No: 221711355

DEPARTMENT OF GENERAL SURGERY

TIRUNELVELI MEDICAL COLLEGE

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PRINCIPAL INVESTIGATOR: PG STUDENT
DESIGNATION OF PRINCIPAL INVESTIGATOR: DR.JASON SAM PAUL.J, MBBS
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Dear Dr.JASON SAM PAUL.J, MBBS, The Tirunelveli Medical College Institutional Ethics Committee (TIREC) reviewed and discussed your application during The IEC meeting held on 01.09.2017.

THE FOLLOWING DOCUMENTS WERE REVIEWED AND APPROVED

1.	TIREC Application Form	☐
2.	Study Protocol	☐
3.	Department Research Committee Approval	☐
4.	Patient Information Document and Consent Form in English and Vernacular Language	☐
5.	Investigator's Brochure	☐
6.	Proposed Methods for Patient Accrual Proposed	☐
7.	Curriculum Vitae of The Principal Investigator	☐
8.	Insurance /Compensation Policy	☐
9.	Investigator's Agreement with Sponsor	☐
10.	Investigator's Undertaking	☐
11.	DCGI/DGFT approval	☐
12.	Clinical Trial Agreement (CTA)	☐
13.	Memorandum of Understanding (MOU)/Material Transfer Agreement (MTA)	☐
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1. The approval is valid for a period of 2 year/s or duration of project whichever is later
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This is to certify that this dissertation work titled **"EVALUATION OF CRP AS AN ADDITIONAL MARKER IN THE DIAGNOSIS OF ACUTE APPENDICITIS IN A TERTIARY CARE HOSPITAL"** of the candidate **Dr. JASON SAM PAUl J** with registration Number **221711355** for the award of **M.S.** Degree in the branch of **GENERAL SURGERY.** I personally verified the urkund.com website for the purpose of plagiarism check. I found that the uploaded thesis file contains from introduction to conclusion pages and result shows **1 Percentage** of plagiarism in the dissertation.

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https://wjes.biomedcentral.com/articles/10.1186/s13017-018-0221-2
https://www.researchgate.net/publication/6367474_CRP_in_Acute_Appendicitis_-_Is_It_a_Necessary_Investigation
https://www.researchgate.net/publication/283193886_Acute_appendicitis_Modern_understanding_of_pathogenesis_diagnosis_and_management
https://www.researchgate.net/publication/11854664_The_Diagnosis_of_Acute_Appendicitis_Clinical_Assessment_Versus_Computed_Tomography_Evaluation
https://cyberleninka.ru/article/n/acute-appendicitis
https://www.slideshare.net/maemartinquilla/appendix-23986675

Instances where selected sources appear:

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INTRODUCTION

Appendicitis is an inflammation of appendix vermiformis. Appendices vermiformis arises from caecum on the posteromedial aspect at around 2cm below the terminal ileum. It is seen almost exclusively in humans and higher primates. Occasionally it may be absent in humans.

Acute appendicitis is one of the most common surgical emergencies encountered worldwide. In many instances, it causes a diagnostic dilemma among clinicians. Early and accurate diagnosis of acute appendicitis is often necessary which decreases the mortality and morbidity in the patients.

Recent advances in imaging and laboratory studies have helped clinicians to diagnose appendicitis at an earlier stage of presentation. However, there are instances where the diagnosis of acute appendicitis is inconclusive. Negative appendicectomy rates have been reported to be as high as 15% - 20 % in the literature.

C reactive protein has been showed to be an emerging marker in predicting the severity of acute appendicitis. A comprehensive history with detailed clinical examination, scoring systems like Alvarado score, RIPASA score, Appendicitis Inflammation Response Score along with imaging modalities and laboratory investigations like Total Count, Differential Count, C reactive protein aids in the early diagnosis of acute appendicitis. It also decreases the rate of negative appendicectomies thereby reducing unwarranted surgical intervention.

REVIEW OF LITERATURE

HISTORICAL NOTE

Name	Year	Advancement
Leonardo da Vinci	1492	Showed appendix in drawings and called it "orecchio" (little ear); published in the 18th century
Berengario da Carpi	1521	The first person to describe the appendix
Andreas Vesalius	1543	Showed the appendix in a drawing but did not describe it in the text
Jean Fernel	1544	An early description of appendicitis
Lorenz Heister	1711	Unequivocal description of a perforated appendix with abscess formation

Name	Year	Advancement
Giovanni Battista Morgagni	1719	First detailed anatomic description of the appendix
Claudius Amyand	1736	Performed the first appendectomy
Mestivier	1759	Described perforation of the appendix by a pin; considered perforation the cause of the abscess; the second unequivocal case identifying appendix as the site of disease
John Hunter	1767	Described gangrenous appendix at autopsy
John Parkinson	1812	Described autopsy findings of a 5-year-old child with a perforated appendix containing a fecalith
Goldbeck	1830	Described acute suppurative appendicitis but said the cause was irritation of cecum; first use of term "perityphlitis"
Thomas Addison and Richard Bright	1839	Described symptomatology of appendicitis; stated that appendix was the cause of many or most of the inflammatory processes of the right iliac fossa

Name	Year	Advancement
A. Grisolle	1839	Advocated drainage of abdominal abscesses following watchful waiting until fluctuation
Charter-Symonds	1885	Extraperitoneal removal of fecalith
Reginald Heber Fitz	1886	Advocated early surgical removal of acute appendix; first used term "appendicitis"
Edward R. Cutler	1887	Performed one of the first "clean" unruptured appendectomies; reported in 1889
Charles McBurney	June 1894	Presented "gridiron incision" (McBurney's incision) to Chicago Medical Society (CMS)
A.J. Ochsner	1902	Advocated nonoperative treatment to localize spreading peritonitis
John B. Murphy	1904	Reported 2000 appendectomies without death
Arthur Rendle Short	1925	Investigated appendicitis as "a disease of Western civilization," low-fiber diet
A.J.E. Cave	1936	Described appendiceal duplications and abnormalities
D.C. Collins	1951	Described agenesis of the appendix

Name	Year	Advancement
Skandalakis et al.	1962	A collective review of cases of smooth muscle tumors of the colon and appendix as reported in the world literature
E. Higa et al.	1973	Described proliferative epithelial tumors of appendiceal mucosa
de Kok	1977	Laparoscope-aided appendectomy with mini-laparotomy
Semm	1983	Laparoscopic appendectomy

EMBRYOLOGY

The appendix is a midgut organ. The appendix is the terminal portion of the embryonic cecum. The appendix becomes distinguishable by its failure to enlarge as fast as the proximal cecum. At 8 weeks of gestation, It is identified as a small outpouching of the cecum. When cecum rotates medially, the Appendix becomes more elongated and tubular and the origin of the appendix shifts medially toward the ileocecal valve. It becomes fixed in the right lower quadrant of the abdomen.

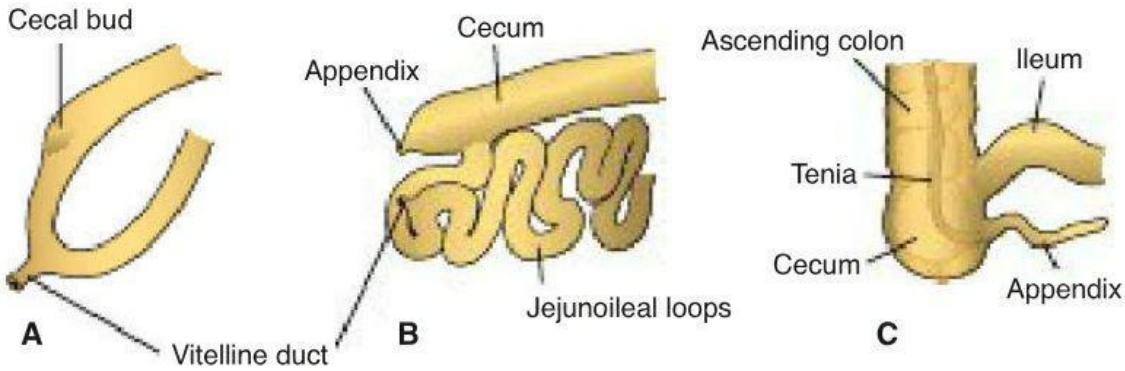


Fig 1: Embryology of Appendix

- Cross sectionally appendix is circular until the 12th week
- Villi are seen in the fourth and fifth months and they disappear before birth.
- By the 7th month, Lymph nodules appear in the wall of the appendix which increases till puberty.

Congenital Anomalies of Appendix

Absent Appendix

- The absence of the appendix was first reported by Morgagni[40].
- The absence of both absent appendix and cecum has been reported. The absence of the appendix may be due to failed formation in the eighth week[41,42].

Ectopic Appendix

The ectopic appendix has been noted in thorax along with malrotation and diaphragmatic defect by Fawcitt[43], in the lumbar area by Babcock[44], in the posterior cecal wall without serous coat by Abramson[45]

Left-Sided Appendix

Four conditions causing a left-sided appendix are

1. Situs inversus viscerum[46]
2. Nonrotation of the intestines
3. Wandering cecum with a long mesentery
4. Excessively long appendix crossing the midline.

If the cecum and appendix are not in the right iliac fossa, the right paravertebral gutter and the right subhepatic space should be searched.

Duplication of Appendix

Three types of duplication of appendix[47] commonly seen are

1. Double-barreled appendix
2. Bird-type paired appendix
3. Taenia coli-type duplication

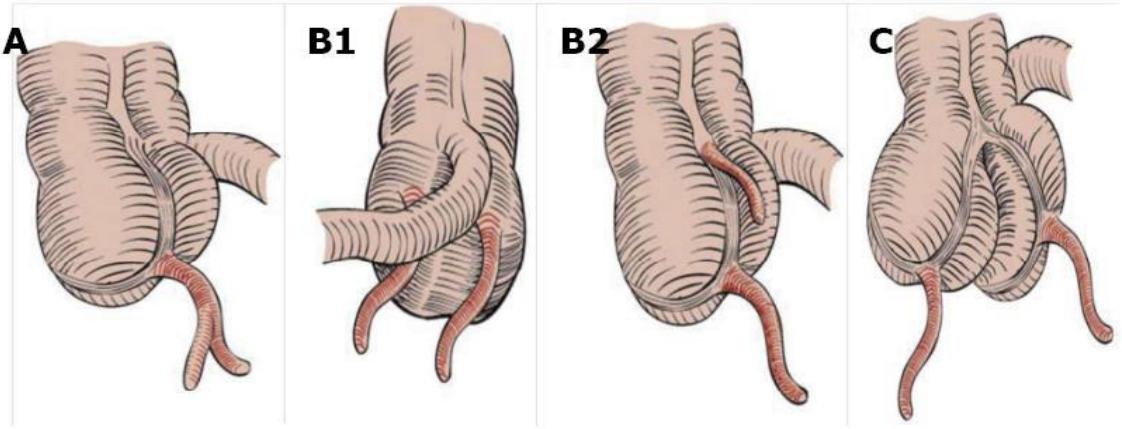


Fig 2: Cave and Walbridge Classification of Duplication of Appendix

Classification of Duplication was done by Cave[48] and Wallbridge[49].

1. Wallbridge type A anomaly. Single cecum and partial duplication of the appendix with a single base.
2. Wallbridge type B1 anomaly. Two completely separate appendices arising from a single cecum and are disposed on either side of the ileocecal valve.
3. Wallbridge type B2 anomaly. The second appendix is usually found arising from the taenia coli of the wall of the cecum.
4. Wallbridge type C anomaly. The double cecum, each with its appendix

MICROSCOPIC ANATOMY

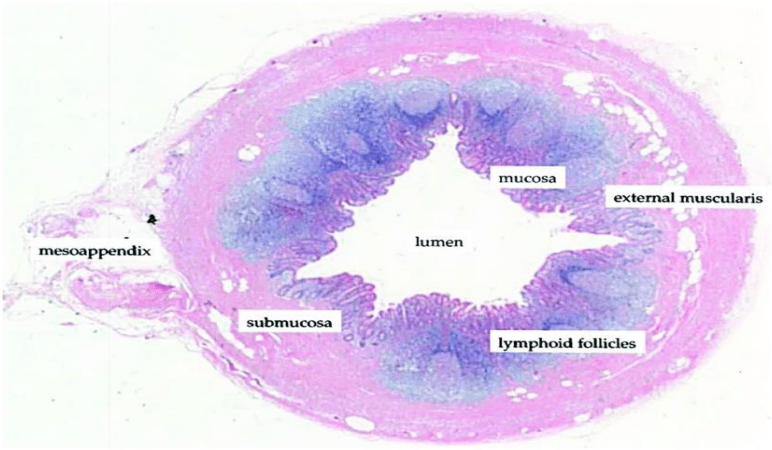


Fig 3: Histology of Appendix

- The mucosa is lined by columnar epithelium, neuroendocrine cells, and goblet cells.
- The submucosa contains Lymphoid tissue.
- Appendix also contains good bacteria that help in recolonization and sustenance of normal colonic flora.

ANATOMY

The appendix varies from a length of 2 to 20 cm with an average of 9 cm. It is longer in children than in adults. The diameter is about 5 mm. At birth, the appendix is short and broad at its junction with the caecum, but differential growth of the caecum produces the typical tubular structure by about the age of 2 years.

During childhood, the continued growth of the caecum commonly rotates the appendix into a retrocaecal but intraperitoneal position. When rotation of the appendix does not occur, it results in a pelvic, subcaecal or paracaecal position. Sometimes the tip of the appendix becomes extraperitoneal, lying behind the caecum or ascending colon. When the caecum does not migrate during development to its normal position appendix can be found near the gall bladder.

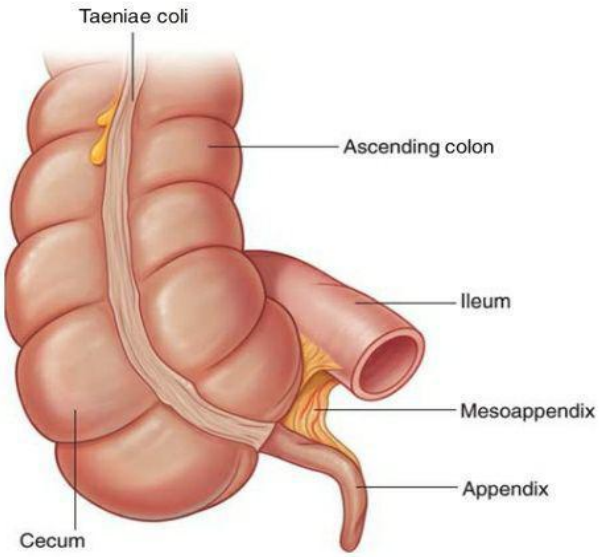


Fig 4: Anatomy of Appendix

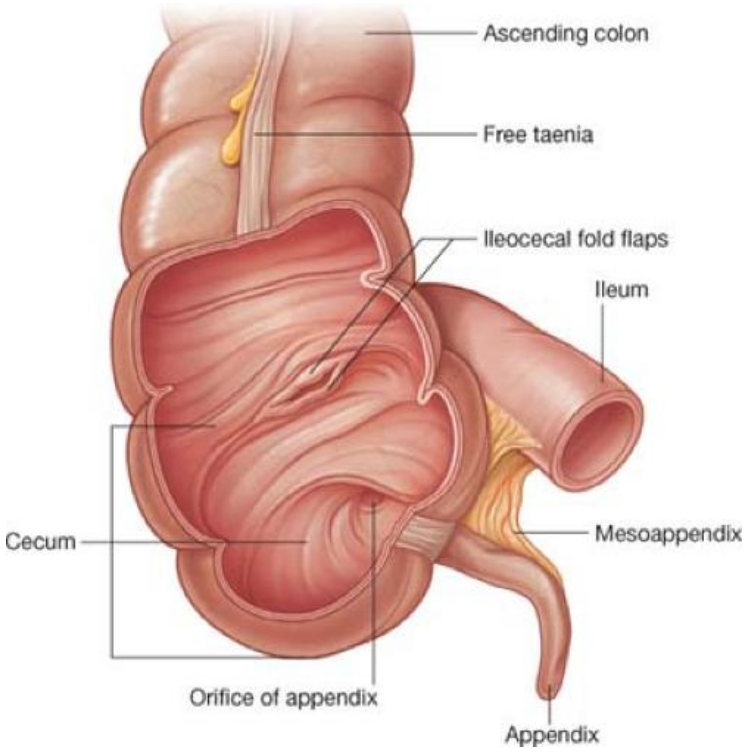


Fig 5: Anatomy of Appendix – Cut Section

In intestinal malrotation, the appendix is present in the left iliac fossa, causing diagnostic difficulty if appendicitis.

The lumen of the appendix is quite narrow and may be obliterated after mid-adult life. Appendicular Orifice is situated on the posteromedial aspect of the caecum 2 cm below the ileocaecal orifice. The appendicular orifice is occasionally guarded by an indistinct semilunar fold of mucous membrane, known as 'valve of Gerlacti. The orifice is marked on the surface by a point situated 2 cm below the junction of the trans-tubercular and right lateral planes. McBurney's point is the site of maximum tenderness in appendicitis which is at one-third of the distance from the line joining the right anterior superior iliac spine to the umbilicus

PARTS OF THE APPENDIX

The three parts of the appendix are,

- Base
- Body
- Tip

1. Base:

The base of the appendix is attached along the caecum on its poster medial wall, 2 cm below the ileocaecal junction. The three tenure of the caecum meets at the base. It serves as an anatomic landmark to identify the appendix during surgery.

2. Body:

The body of the appendix is between the base and the tip which is long, narrow and tubular.

3. Tip:

The tip may be pointing in several directions. It is the blind distal end of the appendix. It is the area of the least blood supply.

Mesoappendix

The appendix is suspended by a small, triangular fold of peritoneum, called the mesoappendix, or appendicular mesentery. The fold passes upwards behind the ileum and is attached to the left layer of the mesentery.

Positions

Based on the direction of the tip of the appendix, the position of the appendix is described.

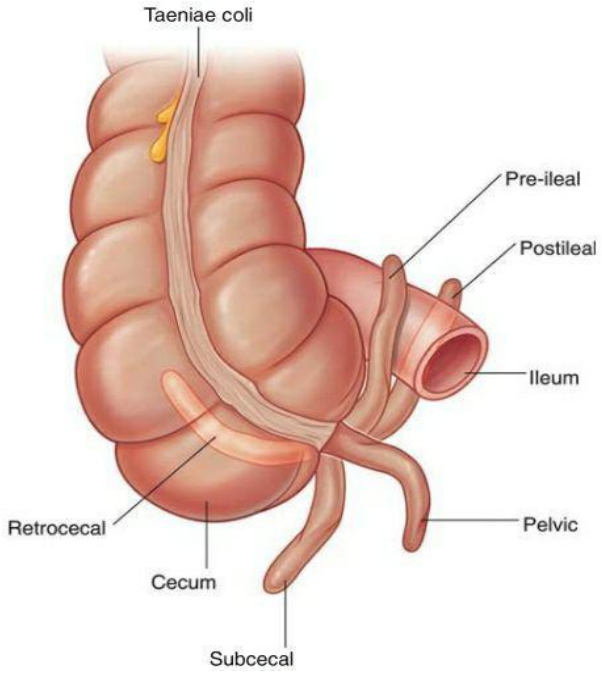


Fig 6: Position of Appendix

The positions of appendix[50]

Paracolic - The appendix may pass upwards and to the right at 11 o'clock position.

Retrocecal - It may lie behind the caecum or colon at the 12 o'clock position. This is the commonest position of the appendix

Splenic	-	The appendix may pass upwards and to the left pointing towards the spleen at 2 O'clock position.
Preilieal	-	The appendix may lie in front of the ileum
Post illegal	-	The appendix may lie behind the ileum
Promontric	-	It may pass horizontally to the left pointing to the sacral promontory at 3 O'clock position.
Pelvic	-	It may descend into the pelvis called pelvic at 4 O'clock position. This is the second most common position.
Sub Caecal	-	It may lie below the caecum and may point towards the inguinal ligament at the 6 o'clock position.

Blood Supply

The appendicular artery is a branch of the ileocolic artery[51]. It runs behind the terminal part of the ileum and enters the mesoappendix at a short distance from its base where it gives a recurrent branch which anastomoses with a branch of the posterior caecal artery.

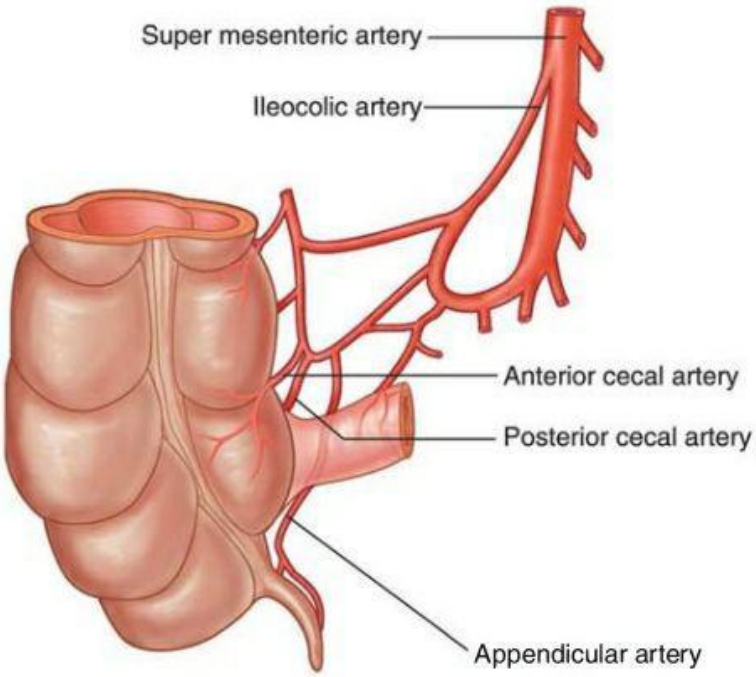


Fig 7: Blood Supply of Appendix

The main artery runs towards the tip of the appendix lying in the free border of the mesoappendix. Venous drainage is via appendicular, ileocolic and superior mesenteric veins, to the portal vein[52].

Nerve Supply

Sympathetic nerves are derived from thoracic nine and ten segments through the coeliac plexus. Parasympathetic nerves are derived from the vagus. Referred pain of appendix is felt at the umbilicus, similar to that of small intestine and testis.

Lymphatic Drainage

Most of the lymphatics pass directly to the ileocolic nodes, but a few of them pass indirectly through the appendicular nodes situated in the mesoappendix.

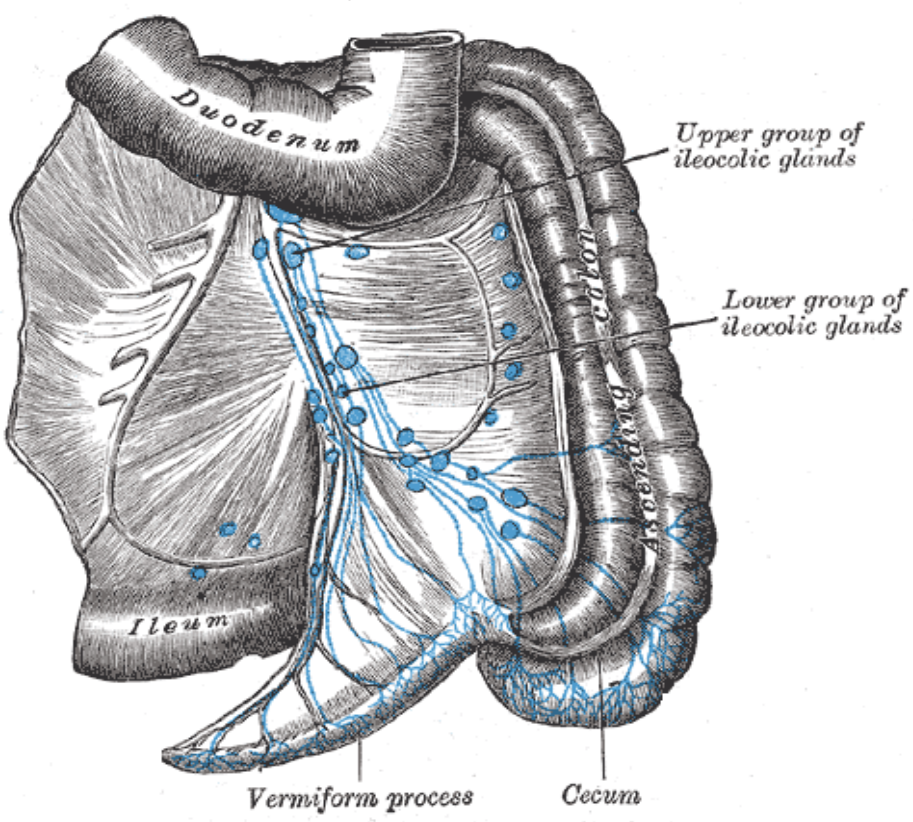


Fig 8: Lymphatic Drainage of Appendix

ACUTE APPENDICITIS

Inflammation of the appendix is a significant public health problem with the highest incidence occurring in the second and third decades of life. While the rate of appendectomy in developed countries has decreased over the last several decades, it remains one of the most frequent emergent abdominal operations.

Etiology

- Most commonly seen in young males
- It is more prevalent in white races
- Fiber-rich diet acts as a protective factor
- Epidemic appendicitis - More common in May and August- seasonal variation
- Viral infection causing mucosal edema and inflammation followed by infection of bacteria causing appendicitis
- Obstructive appendicitis due to fecolith, roundworms, foreign body causing luminal obstruction
- Distal colonic obstruction
- Carcinoma caecum and ileocaecal Crohn's disease-causing adhesion and kinking of appendix leading to appendicitis

ORGANISMS RESPONSIBLE

- E.coli (85%) - Most common organism causing appendicitis
- Enterococci (30%)
- Streptococci
- Anaerobic streptococci
- Clostridium welchii
- Bacteroides

Pathogenesis

Infection superimposed on luminal obstruction is thought to be the cause of acute appendicitis. The most common causes of luminal obstruction are Fecolith, lymphoid hyperplasia, stricture, tumor. Following obstruction, intraluminal pressure increases due to continuous mucus secretion and inflammatory exudation, obstructing lymphatic drainage. With the development of bacterial translocation to the submucosa, Oedema and mucosal ulceration develop. In response to antibiotic therapy or either spontaneously, resolution may occur at this point.

On further progression, appendicular distention causes ischemia of the appendix wall and venous obstruction. This leads to bacterial translocation into the muscularis propria and submucosa, which causes acute appendicitis. When left untreated, the ischemia progresses to gangrene leading to peritoneal contamination with bacteria

In several instances, greater omentum which is called the policeman of the abdomen covers the area of infective foci, wraps around the infected inflamed appendix forming an appendicular mass or Appendicular abscess[1]. The normal colonic flora is seen in the normal appendix. Escherichia Coli and Bacteroides fragilis are commonly seen in infective appendicular pathologies.

Catarrhal Appendicitis

Catarrhal appendicitis starts with inflammation of mucosa and submucosa. Initial stages of catarrhal appendicitis present as an externally normal-looking appendix or with minimal hyperemia with edema of the mucosal wall. As the disease progresses, hemorrhagic infarcts occur. Serosa thickens and is covered with inflammatory exudates. The appendix becomes swollen. However luminal potency is maintained except in cases of hyperplasia of lymphoid follicles where gangrene ensues due to luminal obstruction. Resolution of an episode of catarrhal appendicitis can lead to adhesion and twisting of the appendix causing appendicitis[1].

Obstructive Appendicitis

Obstruction of lumen of the appendix by facecloth or other foreign bodies can lead to obstructive appendicitis. The luminal obstruction causes distention of the appendix with mucus and bacterial overgrowth. This leads to increased intraluminal pressure causing mucosal atrophy and bacterial

transmigration. As the disease progresses, small vessels supplying appendicular wall become thrombosed and gangrene with a perforation at the tip of the appendix along the antimesenteric border ensues

The most common causes of luminal obstruction are faecolith which is less than 2cms in size, ovoid in shape and occasionally seen in an abdominal x-ray. Other causes are roundworms and food debris.

The appendix can be strangulated in the hernial sac leading to obstructive appendicitis.

Appendicular perforation leads to the development of either a localized right iliac fossa collection, pelvic collection or sometimes diffuse peritonitis.

Gangrenous Appendicitis

It is a dangerous type of appendicitis which occurs mostly when the appendix is in retrocaecal position. It has a high propensity to produce a localized abscess.

Recurrent appendicitis:

Recurrent appendicitis occurs in intermittent luminal obstruction. When the lumen obstructs, increased intra luminal pressure causes the elimination of the obstruction. It can cause adhesions, fibrosis and recurrent right iliac fossa pain.

Subacute appendicitis:

Subacute appendicitis occurs secondary to partial luminal obstruction. It is the milder form of appendicitis with the slow progression of symptoms. It is usually treated with antibiotics following which laparoscopic appendicectomy can be planned.

Stump appendicitis:

Stump appendicitis is defined as recurrent inflammation of the retained long stump of the appendix where the appendix was partially removed following appendicectomy.

CLINICAL DIAGNOSIS

History

Eliciting an accurate history from the patient or family along with classic signs of appendicitis like migratory pain in right iliac fossa will help in clinching the diagnosis of acute appendicitis. Inflammation results in anorexia, nausea, vomiting, and fever, ileus, diarrhea, small bowel obstruction, and hematuria. Other etiologies of abdominal pain should be ruled out with detailed pertinent negative history.

Physical Examination

Most patients lay quite still due to parietal peritonitis. They generally have a low-grade fever and demonstrate focal tenderness with guarding. With an anatomically normal appendix, the point of maximal tenderness will be in McBurney’s point, which is at the one-third distance from the anterior superior iliac spine to the umbilicus.

Signs in Appendicitis

Rovsing’s sign

Pain in the right lower quadrant after the release of gentle pressure on the left lower quadrant (Crossed Tenderness).

Dunphy’s sign

Pain in right iliac with coughing is called Dunphy's sign

Obturator sign

Pain with internal rotation of the hip which is commonly noted in the pelvic appendix.

Iliopsoas sign

Pain with flexion of the hip in retrocecal appendix. Besides, pain with rectal or cervical examinations is also suggestive of pelvic appendicitis.

Blumberg’s sign

Blumberg's sign is pain on the removal of pressure to the right iliac fossa after slow compression. It signifies localized peritoneal irritation.

Laboratory Findings:

Total White blood cells count:

One of the important features of acute appendicitis is poly morpho leukocytosis. Patients with acute appendicitis have leucocytosis in the range of 10000 cells/cu mm. In the case of gangrenous and perforated appendicitis, it may be as high as 17000 cells/cu mm.

Neutrophilia

In acute appendicitis and appendicular perforation, appendicular gangrene there is an increase in neutrophil count.

C-reactive protein CRP

CRP is an acute-phase reactant, which appears in the sera of individuals in response to appendicitis. In inflammatory appendicular pathologies, CRP is usually more than 10mg/L. Four to a fivefold elevation of CRP is seen in appendicular perforation and abscess

Imaging

Imaging is often utilized to confirm a diagnosis of appendicitis. Routine use of cross-sectional imaging aids in reducing the rate of negative laparotomies, especially in whom a diagnosis of appendicitis is unclear or at high risk from operative intervention and general anesthesia.

Plain X-ray of the Abdomen

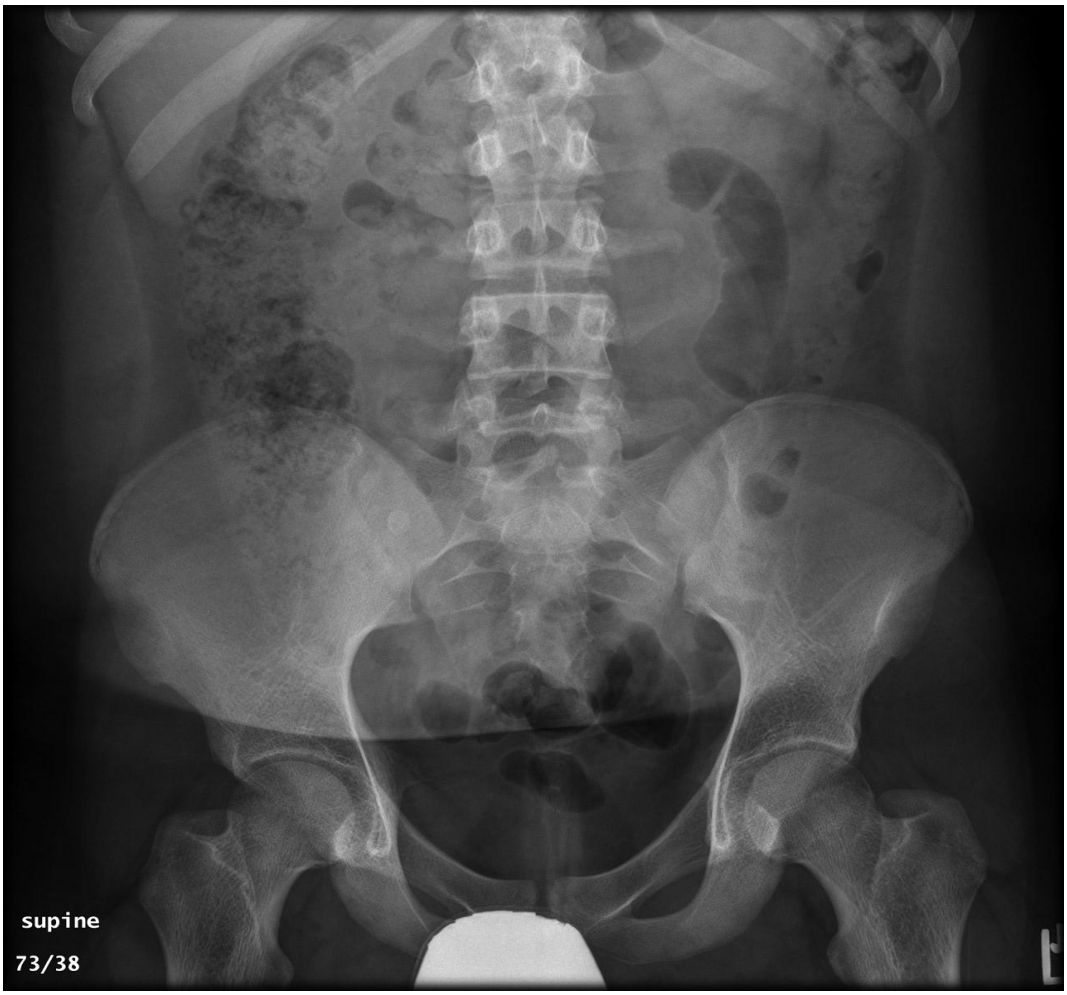


Fig 9: X-ray abdomen erect AP - Showing appendicolith

Plain x-ray abdomen helps in identifying free gas in the abdomen. Occasionally appendicolith may be visible in 10-15% of patients of appendicitis. Displacement of cecal gas with mural thickening may be seen in the presence of inflammatory phlegmon.

Ultrasound:

Ultrasonography has a sensitivity of 0.85 and a specificity of 0.90[14]. Ultrasound is cheaper and more readily available than the CT scan, and it does not expose patients to ionizing radiation.

The anteroposterior diameter of the appendix is identified by using Graded compression ultrasonography. An easily compressible appendix of <5 mm diameter generally rules out appendicitis. Sonological features suggestive of appendicitis include a diameter of greater than 6 mm, pain with compression, presence of an appendicolith, increased echogenicity of the fat, and periappendiceal fluid[15]. However, ultrasound is user-dependent and has limited utility in obese patients. Further, graded compression is usually painful for patients with peritonitis.

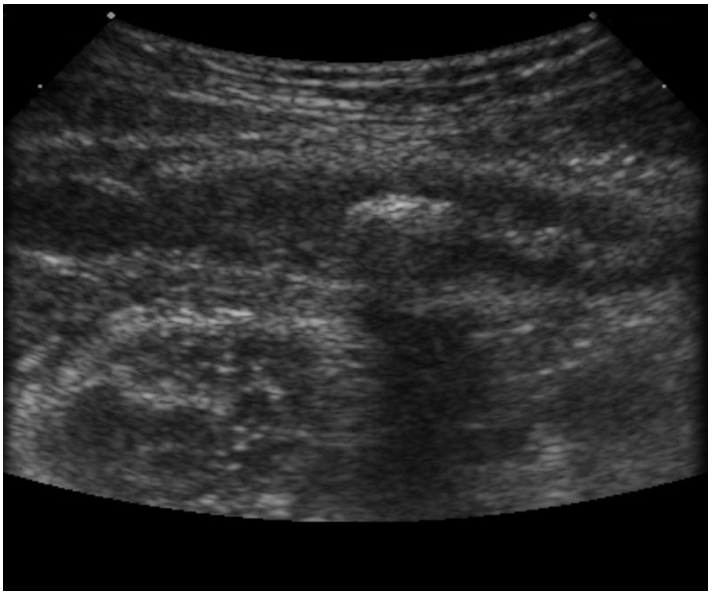


Fig 10.Ultrasound abdomen – Acute Appendicitis with Appendicolith

CT Scan

A contrast-enhanced CT scan has a sensitivity of 0.96 and specificity of 0.96 in diagnosing acute appendicitis[16,17]. Features on a CT scan that suggest appendicitis include enlarged lumen and double wall thickness greater than 6 mm, wall thickening greater than 2 mm, periappendiceal fat stranding, appendiceal wall thickening, with an appendicolith.

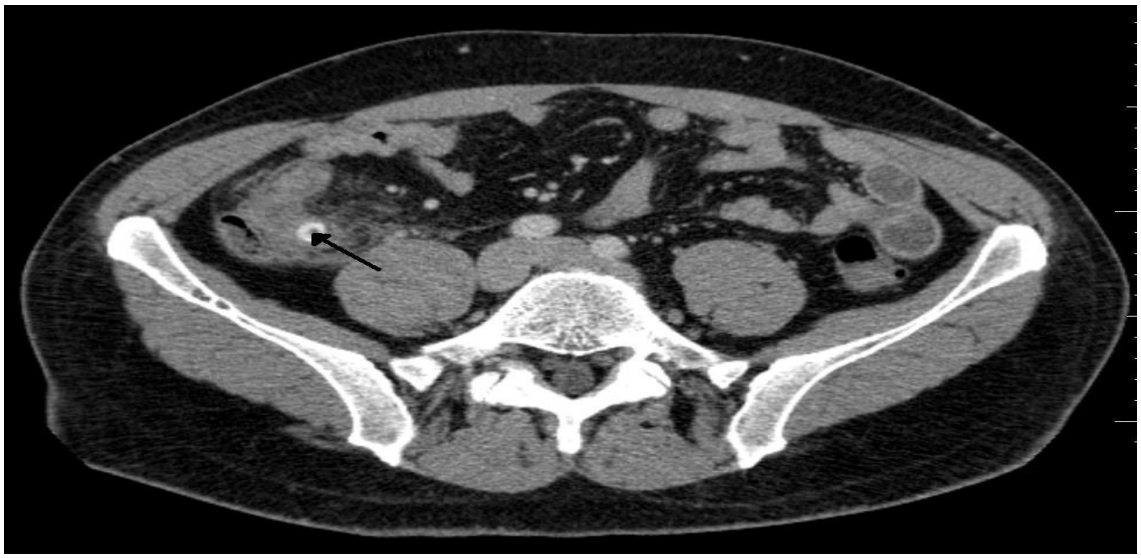


Fig 11. CT Abdomen - Acute Appendicitis with Appendicolith

The only concern with a CT scan is ionizing radiation exposure for which typical low-dose CT scans may be used. Intravenous contrast is generally preferred in these studies, but it can be avoided in patients with allergies or low EGFR. Several meta-analyses have suggested that a CT scan is more sensitive and specific than ultrasound in diagnosing appendicitis.

MRI

MRI of the abdomen has a sensitivity of 0.95 and specificity of 0.92 for the identification of acute appendicitis[18]. MRI is an expensive test that requires significant expertise to perform and interpret and is usually recommended in pregnant and pediatric patients.

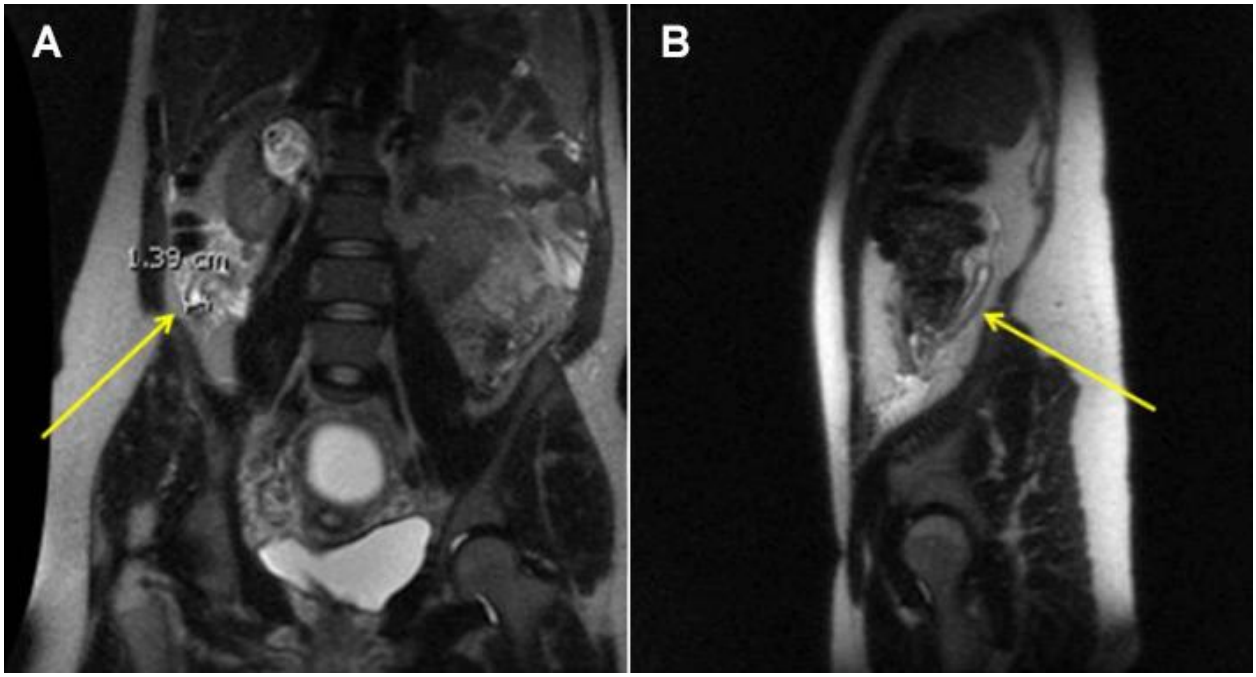


Fig 11. MRI Abdomen - Acute Appendicitis with Appendicolith

Differential Diagnosis

Obtaining an antecedent history of a viral infection and a cervical exam in women is essential before planning any intervention. Acute mesenteric adenitis, acute gastro enteritiscecal diverticulitis, Meckel's diverticulitis, acute ileitis, Crohn's disease, acute pelvic inflammatory disease, gastroenteritis, torsion of ovarian cyst or Graafian follicle, mittelschmerz, and ectopic pregnancies.

Pseudo Appendicitis

Yersinia enterocolitica is the most common cause of pseudo appendicitis. Growth of the bacteria is in the terminal ileum of the humans which progresses to mesenteric lymph nodes causes mesenteric lymphadenitis. This causes right iliac fossa pain which mimics appendicitis.

MANAGEMENT OF APPENDICITIS

Uncomplicated Appendicitis

The preferred approach is an appendectomy. Currently, conservative management is not the standard modality of management of appendicitis, except in patients with a significant phobia of surgery.[19]

Timing of Surgery

Emergent surgery is often performed in patients with appendicitis. Currently, delaying surgery less than 12 hours is acceptable in patients with short duration of symptoms less than 48 hours and nonperforated, nongangrenous appendicitis.

The Approach to Surgery.

Laparoscopic appendectomy results in a shorter length of stay, faster return to work, and lower superficial wound infection rates, especially in obese patients[20,21] Open appendectomy results in shorter operative times and lower intra-abdominal infection rates[22].

Complicated Appendicitis

Perforated and gangrenous appendicitis and appendicitis with abscess or phlegmon formation are considered complicated conditions. More than 80% of patients with perforated appendicitis present after 24 hours of onset. These patients are acutely ill and dehydrated and require resuscitation.

When left untreated, abscess in the right lower quadrant, retroperitoneal abscesses including psoas abscess, liver abscesses, fistulas, and pylephlebitis can also occur.

Perforated appendicitis is managed by surgery. In septic patients, immediate surgery is necessary. However, it is usually associated with higher complications, including abscesses and enterocutaneous fistulae.

The management of long-duration, complicated appendicitis is often staged with resuscitation, IV antibiotics, and adequate percutaneous image-guided drainage.[23,24,25] Interval Appendectomy is done in the majority of patients with perforated appendicitis where symptoms resolve with drainage and antibiotics.

OPERATIVE INTERVENTION

Preoperative Preparation

Resuscitative efforts are important in patients who present with significant dehydration. The majority of patients can be taken to the operating room within a short interval.

Preoperative antibiotics must be administered at least 30 to 60 minutes before skin incision. The choice of antibiotics includes cefoxitin, ampicillin/sulbactam, and cefazolin plus metronidazole for uncomplicated appendicitis. Clindamycin in combination with a fluoroquinolone, gentamicin, or aztreonam can be given in Patients with ß-lactam allergies

In patients with perforated appendicitis undergoing operative intervention, preoperative antibiotics are necessary to cover gram-negative bacteria and anaerobes. Monotherapy with piperacillin/tazobactam or combination of a cephalosporin with metronidazole is used. The duration of postoperative antibiotics is generally less than 4 days[27] except in patients with incomplete drainage, persistent catheters, complications from surgery, and uncertain resolution of inflammation that might need a longer duration of antibiotics.

OPERATIVE TECHNIQUE

Open Appendectomy

Anesthesia: General anesthesia or regional anesthesia

Incision

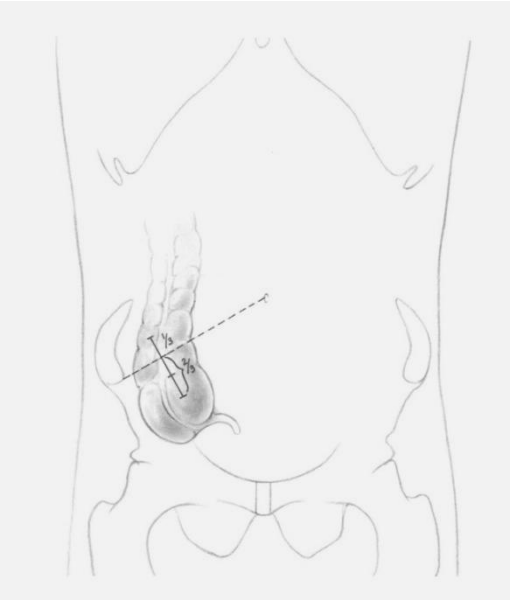


Fig 12. Gridiron incision

An imaginary line is drawn from the right anterior superior iliac spine to the umbilicus. At a point 3-4cm medial to the anterior spine, a line is drawn perpendicular to this line. About one-third of the incision should be above the imaginary line between the iliac spine and umbilicus and two-thirds below this line. The average length of this incision is 6 cm. Other incisions used are Rocky-Davis incision - Transverse incision over McBurney's point, Lower midline laparotomy incision - More appropriate for perforated appendicitis with a phlegmon.

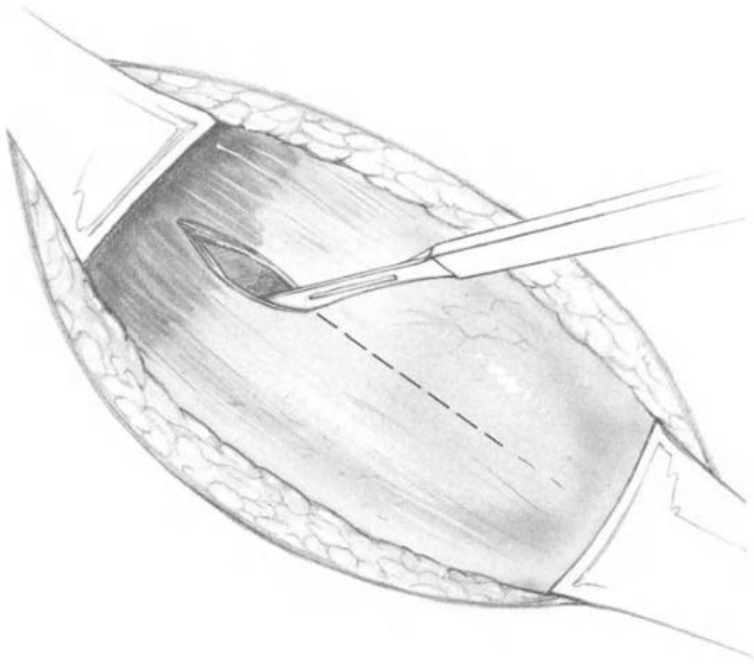


Fig 13. Incision through External Oblique Aponeurosis

The incision is deepened through the external oblique aponeurosis, along the line of its fibers.

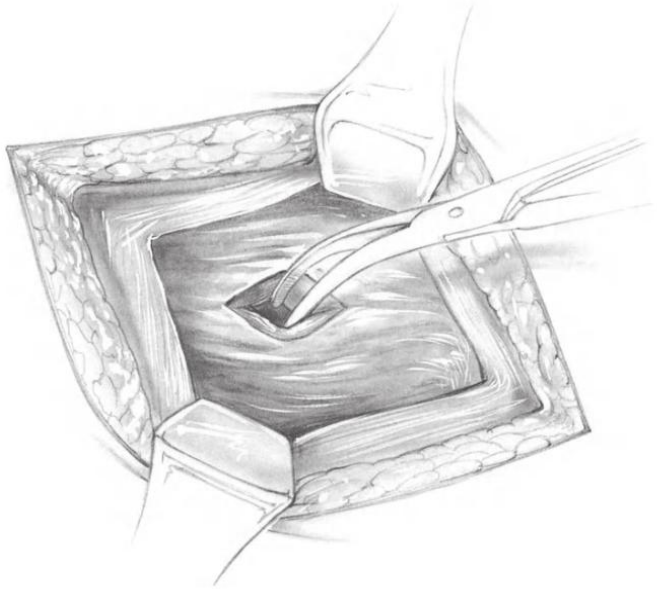


Fig 14. Splitting of Internal oblique aponeurosis

Then medial and lateral leaves of the external oblique aponeurosis are elevated from the underlying muscle and separated between retractors. Then Kelly hemostat is inserted to separate the muscle fibers of the internal oblique and underlying transversus muscle at the level just below the level of the anterosuperior iliac spine into the thin fascia of the internal oblique muscle.

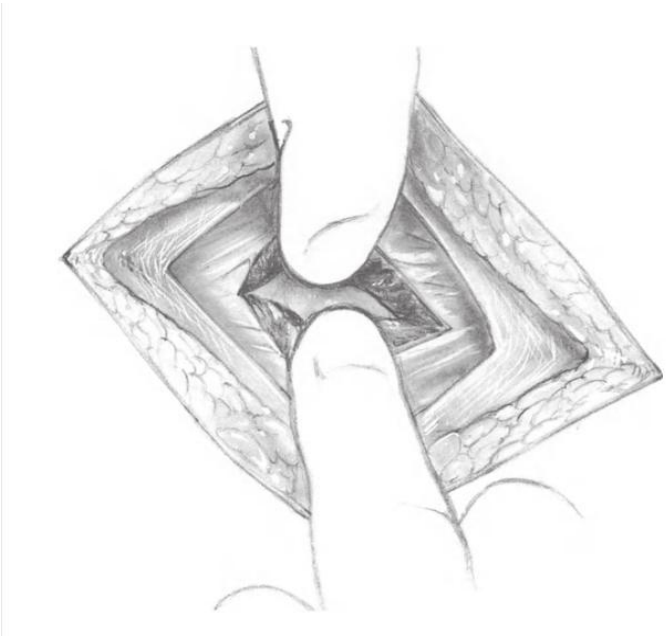


Fig 15. Enlargement of Incision

The incision is enlarged by using either two Kelly hemostats or both index fingers to insert small Richardson retractors. The peritoneum lateral to the rectus muscle is elevated between two hemostats and an incision is made into the peritoneal cavity.

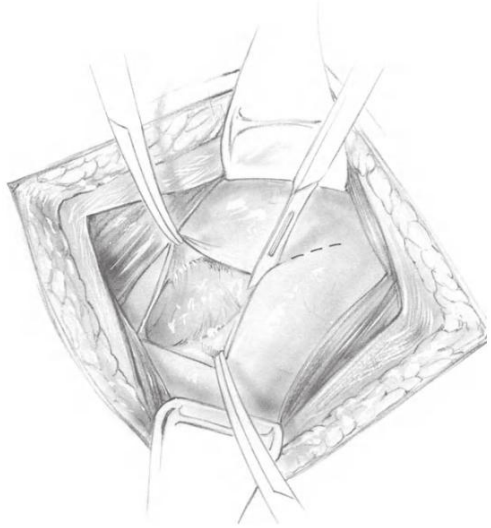


Fig 16. Opening of Peritoneal Cavity

The incision is sufficiently enlarged to insert Richardson retractors into the peritoneal cavity and the anterior wall of the cecum is grasped with a moist gauze pad.

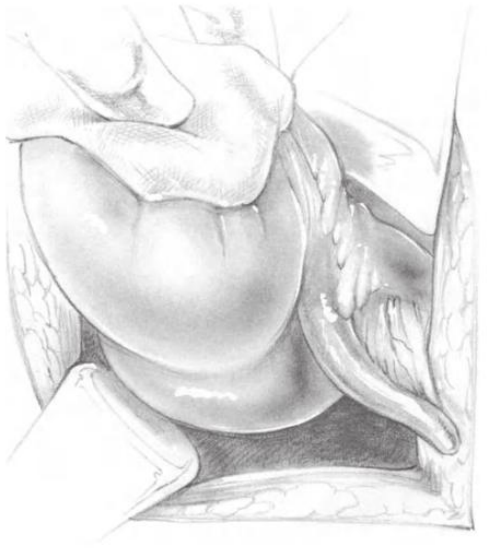


Fig 17. Grasping anterior wall of Caecum

With the cecum partially exteriorized, the appendix is identified. If the appendix cannot be seen, exploration with the index finger may reveal an inflammatory mass consisting of inflamed appendix and mesoappendix. If this palpatory maneuver is not successful in locating the appendix, the taenia on the anterior wall of the cecum is followed in a caudal direction. This leads to the base of the appendix, which can then be grasped in a Babcock clamp. A second Babcock clamp is applied to the tip of the appendix and delivered into the incision.

Division of Mesoappendix

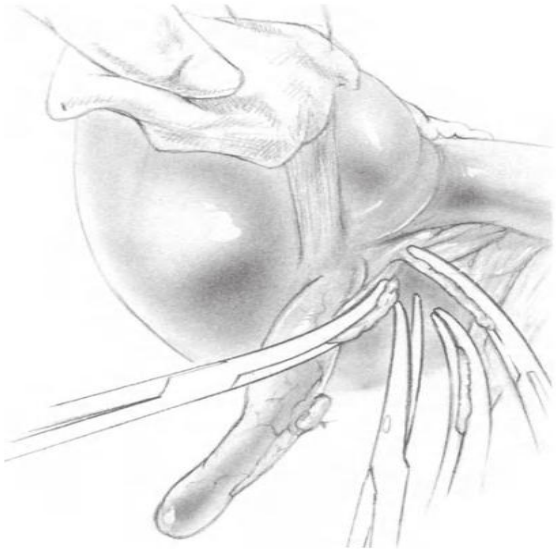


Fig 18. Division of Mesoappendix

The mesoappendix is divided between serially applied hemostats and ligated each with 2-0 or 3-0 vicryl until the base of the appendix has been dissected free.

Ligation of Appendiceal Stump

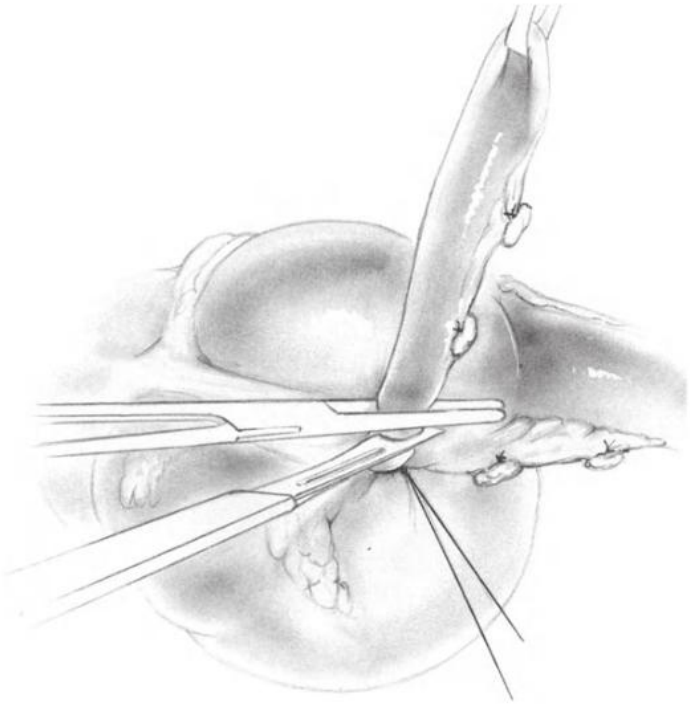


Fig 19. Transection of Appendix

The tip of the appendix is held in a Babcock clamp and the base is double ligated with 2-0 vicryl or chromic catgut at a point 4-6 mm from the cecum. A straight hemostat is applied to the appendix 1 cm distal to the ligature. Then the appendix is transected with a scalpel 5-6 mm distal to the ligature and the specimen is removed.

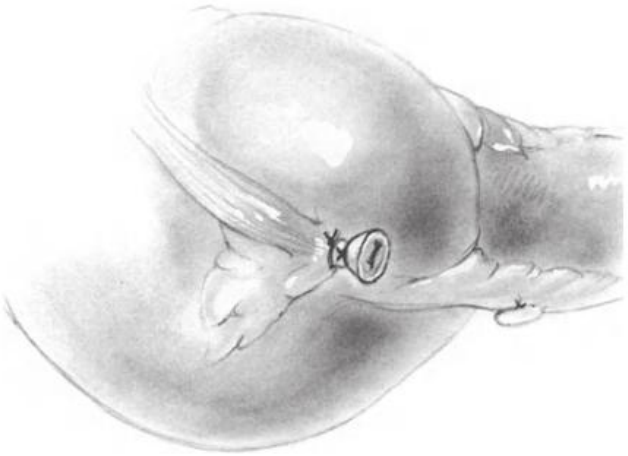


Fig 20. Visualization of Appendiceal Stump

The appendiceal stump is visualized for bleeding and is returned to the abdominal cavity

Closure of Incision

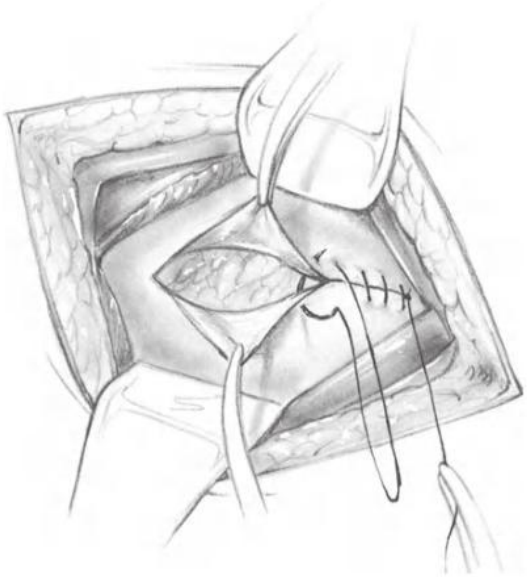


Fig 21. Closure of Peritoneum

The right lower quadrant and pelvis are irrigated with a dilute antibiotic solution and four hemostats are applied to the cut ends of the peritoneum which is closed with continuous 3-0 atraumatic vicryl sutures.

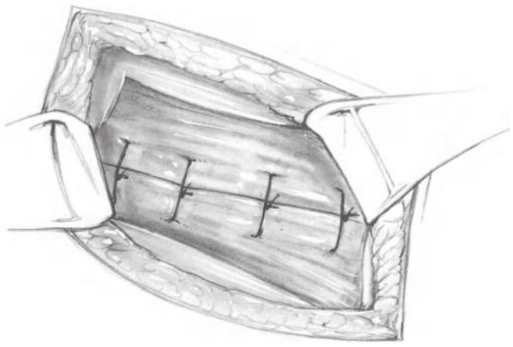


Fig 22. Closure of Internal oblique and Transverse muscles

The internal oblique and transversus muscles are closed as a single layer with interrupted sutures of 2-0 vicryl tied loosely.

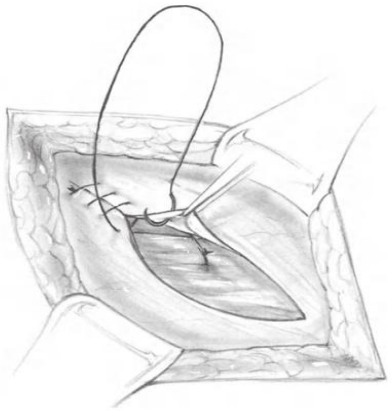


Fig 23. Closure of External Oblique Aponeurosis

The external oblique aponeurosis is closed with continuous or interrupted sutures of 2-0 vicryl

LAPAROSCOPIC APPENDICECTOMY

OPERATIVE STRATEGY

The laparoscopic approach allows the surgeon to make a thorough visual inspection of the abdominal cavity and hence is especially useful in cases in which the diagnosis is questionable. The procedure differs from an open appendectomy in that the base of the appendix usually presents first and is divided first followed by the mesentery. A pretied ligature or staples are used to secure the base. The stump is generally not inverted.

Other causes of lower abdominal pain, such as an inflamed Meckel's diverticulum or torsion of an ovarian cyst, may also be treated laparoscopically.

OPERATIVE TECHNIQUE

The patient is positioned supine on the operating table. Both arms are tucked at the sides. The monitors are positioned at the foot of the bed. The bladder is decompressed with a Foley catheter. It is important to have sufficient working distance from the right lower quadrant. The location of the umbilicus relative to McBurney's point is noted. Supraumbilical location is best for the first trocar. Secondary trocars are placed in the right mid-clavicular or anterior axillary line and left lower quadrant. Thoroughly the abdomen is explored and the diagnosis is confirmed.

Examination of the female adnexa is facilitated by gently sweeping up one tube and ovary to displace the uterus to one side and then the other. Closed grasper or Babcock clamp is used to push and elevate gently, rather than grasp, the adnexa.

Exposure is enhanced by placing the patient in a Trendelenburg position with the right side up. The omentum and small intestine are gently swept medially to expose the cecum, which may be recognized by its size and white color and the presence of taeniae. In the most common situation, the appendix lies underneath the terminal ileum and is tethered posteriorly by its mesentery. Pulling the cecum cephalad causes at least part of the appendix, most commonly the base, to come into view. A straight cephalad pull, toward the patient's right shoulder, avoids this problem. An endoscopic Babcock clamp is passed through the left lower quadrant trocar and gently the cecum is pulled toward the patient's left shoulder in such a way as to roll the lateral aspect of the cecum toward the surgeon. Now the base of the appendix comes into view.

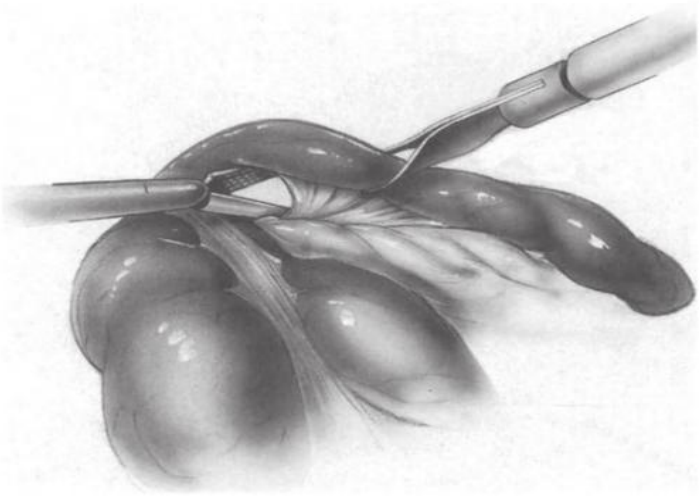


Fig 24. Dissection of Appendix

The appendix is grasped near its base with a Babcock or an atraumatic grasper and pulled straight up toward the anterior abdominal wall. The base is identified and confirmed by the convergence of taeniae on the cecum. The base of the appendix: is secured with a pretied suture ligature.

Pretied Ligature

The mesentery is divided first by clips or an ultrasonic dissecting forceps. A pretied ligature is then used to secure the base. Individual branches of the appendicular artery are identified and windows are made in the mesentery between these vessels using a Maryland dissector or a right angle clamp. The Clips are placed on the vessels and divided. Sequentially the mesentery is divided along a line from the free edge toward the appendiceal base.

Fig 25. Knot ligation at base of the appendix

After completely dividing the mesentery, a pretied ligature is passed into the field through the left lower quadrant trocar. The loop is shortened slightly. The appendix is dropped and a Babcock clamp or atraumatic grasper is passed through the loop of the ligature, grasping the appendix at its midportion. The appendix is pulled through the loop while maneuvering and shortening the loop. The knot-pusher is used as a finger to position the knot at the base and the ligature is tightened slowly.

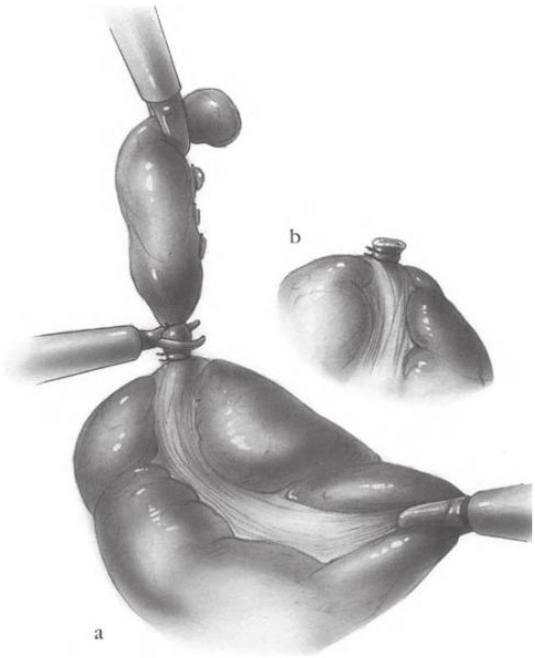


Fig 26. a) Division of Appendix, b) Appendicular stump

Two ligatures side by side on the base are preferred with a clip or a third ligature on the specimen side. The appendix is divided. The Stump is inspected to verify the ligatures are in a good position.

Removal of the Appendix:

A small, minimally inflamed appendix may be drawn completely into the left lower quadrant trocar and the trocar containing the specimen can then be completely removed and replaced. A specimen bag is used for larger, more inflamed, gangrenous or perforated appendices.

Management of the Retrocecal Appendix:

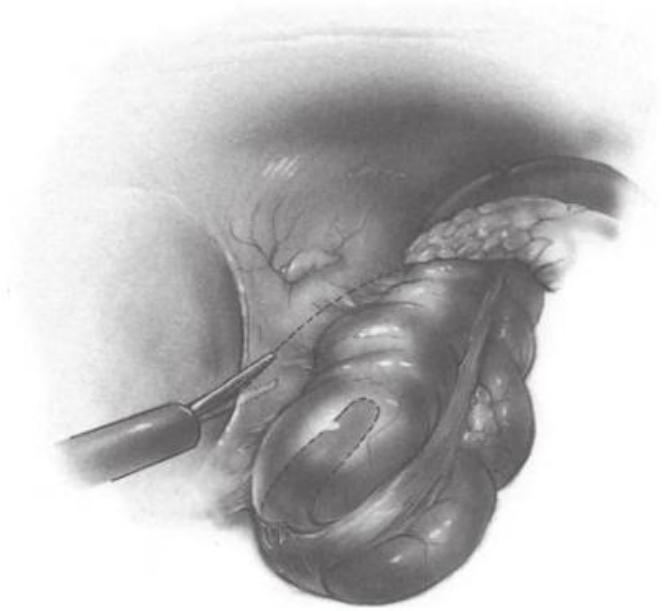


Fig 27. Incision of the Line of Toldt

The appendix is occasionally completely retrocecal and cannot be visualized without mobilizing the cecum and right colon. In such patients, the line of Toldt from the cecum up to the vicinity of the hepatic flexure is incised with hook cautery, scissors, or ultrasonic shears.

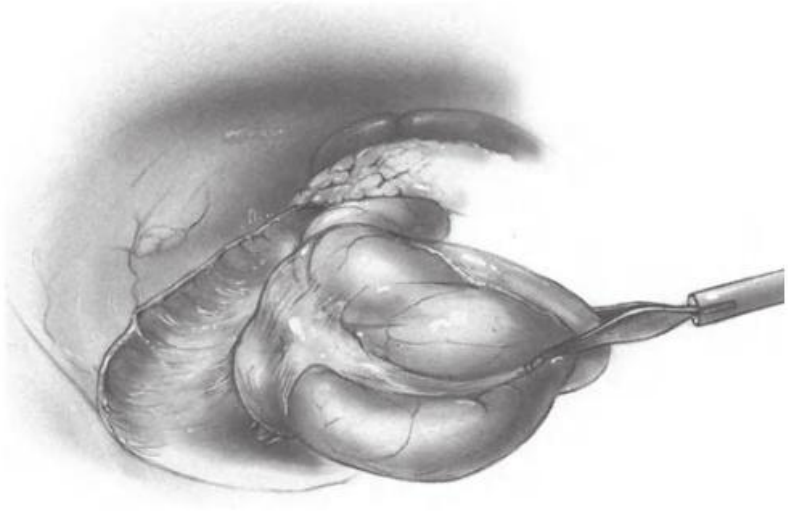


Fig 28. Mobilization of Caecum

The cut edge of peritoneum adherent to the right colon is grasped and the right colon is pulled medially while lysing any residual adhesions by sharp and blunt dissection. The appendix is then found on the back wall of the cecum, generally adherent to the cecum with fibrous bands.

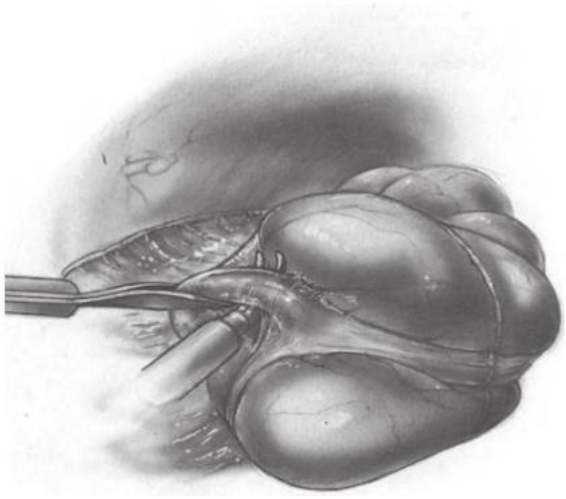


Fig 29. Lysing the adhesions of the appendix with Caecum

The appendix is grasped near its base and the fibrous adhesions that tether the appendix to the cecum are sequentially lysed. Sharp dissection with scissors or ultrasonic shears is best. The appendix is removed in the usual fashion.

Closure of Trocar Sites and Postoperative Care

The tracer sites are closed with 2-0 vicryl sutures and skin can be closed with staplers.

Novel Techniques

- Single-incision appendectomy
- Natural orifice transluminal endoscopic surgery (NOTES)
- Robotic appendectomy.

Negative Exploration

If there is no evidence of appendicitis on performing a laparoscopy or laparotomy for suspected appendicitis, a thorough exploration of the peritoneum must be performed to rule out contributing pathology. A normal appendix is often removed to reduce future diagnostic dilemmas.

Postoperative complications

1. Ileus
2. Surgical site infection
3. Intraabdominal abscess
4. Deep vein thrombosis
5. Respiratory tract infection
6. Fecal fistula
7. Adhesive intestinal obstruction

Ileus

A period of ileus usually occurs following appendicectomy for gangrenous appendicitis. Generally, it settles in 4-5 days. Persistence of ileus more than 5 days, indicates intraabdominal sepsis. Emergency surgical intervention is warranted in intraabdominal sepsis.

Surgical site infection

It is documented in around 10% of patients following appendicectomy. Signs of surgical site infection are warmth, local tenderness with purulent discharge. Management is with intravenous antibiotics, pus drainage, daily wound dressing.

Intraabdominal abscess

It is seen in less than 5% of patients undergoing appendicectomy. Incidence has been drastically decreased with the use of higher antibiotics. It presents with fever vomiting within a week of surgery. Ultrasound abdomen is used to localize the site of an abscess. Image-guided drainage of the abscess is done under antibiotic cover. If unresolved, patients proceed with laparotomy

Deep vein thrombosis

Though the incidence of deep vein thrombosis following appendicectomy is very rare, it is most commonly seen in elderly female on OCP. Early ambulation helps to prevent deep vein thrombosis.

Respiratory tract infection

Pre-existing respiratory illness can be precipitated post appendicectomy. Early ambulation along with chest physiotherapy helps to prevent the worsening of symptoms. Antibiotics can also be used

Fecal fistula

The incidence of feral fistula following appendicectomy is very low. It can occur due to appendicular stump leak or from the inflamed caecal wall. It is also reported in patients with chron’s disease complicating appendicitis. It is usually managed conservatively.

Adhesive intestinal obstruction

Adhesive intestinal obstruction is one of the late complications of appendicectomy. It can present with chronic abdominal pain. Intraoperatively, a band may be present in the right iliac fossa. It is treated with laparoscopy which can be used for diagnosis and also for therapeutic management by laparoscopic adhesiolysis.

SPECIAL CIRCUMSTANCES

Appendicitis in Children

Although appendicitis in children almost demonstrates the same symptoms in adults, Neonates can present with abdominal distension and lethargy, irritability. The Pediatric Appendicitis Score has components similar to the Alvarado Score and is scored of 10 points, with 2 points each for right lower quadrant tenderness and pain with cough, percussion or hopping. A score of 7 or greater indicates a high chance of appendicitis[28].

Differential diagnoses in children are intussusception, gastroenteritis, malrotation, ectopic pregnancy, mesenteric adenitis, torsion of the omentum, and ovarian or testicular torsion.

Management of children with appendicitis involves early intervention preferably with a laparoscopic appendectomy.[29,30]

For patients with complicated appendicitis, an urgent laparoscopic appendectomy is advocated in the setting of no abscess or mass.

In perforation, antibiotics are continued after surgery, preferably for 5 days

Management of perforated appendicitis with an abscess is similar to adults, Nonoperative management of appendicitis may be safe for children with early presentation less than 48 hours, limited inflammation with WBC less than 18,000/cu.ml, with no appendicolith and no evidence of rupture on imaging.[31]

They are administered IV antibiotics until the inflammation reduces and then transitioned to oral antibiotics.[32] But it has a recurrence rate[33].

Appendicitis in Older Adults

Older adult patients are at higher risk for complications and often presents with perforation or abscess due to diminished inflammation[34,35]. Hence it is prudent to obtain definitive diagnostic imaging before planning the surgery. Laparoscopic appendectomy is safe and might allow patients to reduce pain and their hospital stay[36].

Appendicitis in Pregnancy

Appendicitis mostly occurs in the first and second trimesters. Patients present with heartburn, bowel irregularity, flatulence, or a change in bowel habits. The point of maximum tenderness is usually displaced on a physical exam. Ultrasonography is the preferred imaging modality.

MRI can also be done.[37]

The risk of fetal loss is high if appendiceal perforation occurs.[38]

Laparoscopic appendectomies can be safely performed in pregnant patients although higher fetal loss has been reported.

Lower intra-abdominal pressures during insufflation have been suggested to reduce early labor.

Chronic or Recurrent Appendicitis

Patients with recurrent right lower quadrant abdominal pain not associated with a febrile illness with imaging findings suggestive of an appendicolith or dilated appendix are classified as having chronic appendicitis.[39]

The resolution of symptoms is with an appendectomy.

AIMS AND OBJECTIVES

Primary Objective:

To predict the CRP levels in patients confirmed with histopathological diagnosis of acute appendicitis and appendicular perforation

Secondary Objective:

To statistically correlate the CRP levels with

- Alvarado score
- Total counts
- Neutrophils
- Sonological appendicular diameter
- Duration of hospital stay
- Complications.

MATERIALS AND METHODS

It is a prospective descriptive study done from November 2017 to August 2019 in the Department of General Surgery, Tirunelveli Medical College, Tirunelveli

Our study population was 100 patients who were diagnosed, admitted and operated as a case of acute appendicitis with histopathological evidence of either acute appendicitis or appendicular perforation. Cases were selected by purposive sampling

Inclusion criteria

Patients above the age of 13 years, who are clinically diagnosed as acute appendicitis in the emergency ward, operated, with histopathological evidence of acute appendicitis or appendicular perforation

Exclusion criteria

Patients with age less than 13 years

Appendicular mass

History of trauma to the right iliac fossa

Pregnant females

Patients with any other comorbidities that may cause elevated CRP

Methodology:

- Patient Information Sheet
- Complete haemogram
- Estimation of C - Reactive Protein using ELISA
- Ultrasound of Abdomen
- Histopathology of appendix specimen

Procedure:

After getting clearance from the Ethical Committee and informed written consent in the native language of the patient, details of the patients who are diagnosed as acute appendicitis and operated, with histopathological diagnosis of acute appendicitis or appendicular perforation was entered in the questionnaire.

Ultrasound of the abdomen and Blood samples was obtained from the patients for measurement of Complete hemogram and C - Reactive Protein before surgery.

After surgery, the histopathological report of the patient was obtained from the pathology department to look for the evidence of acute appendicitis or appendicular perforation

Data Entry and Analysis:

Data collected from the questionnaire was entered using Numbers software.

Statistics were derived using SPSS 21 software.

Descriptive data were tabulated in frequency, mean, standard deviation.

A comparison of continuous variables was done by one way ANOVA.

Correlation of CRP levels with Alvarado score, Total counts, Neutrophils, appendicular diameter, duration of hospital stay and was done using Pearson correlation curve

RESULTS

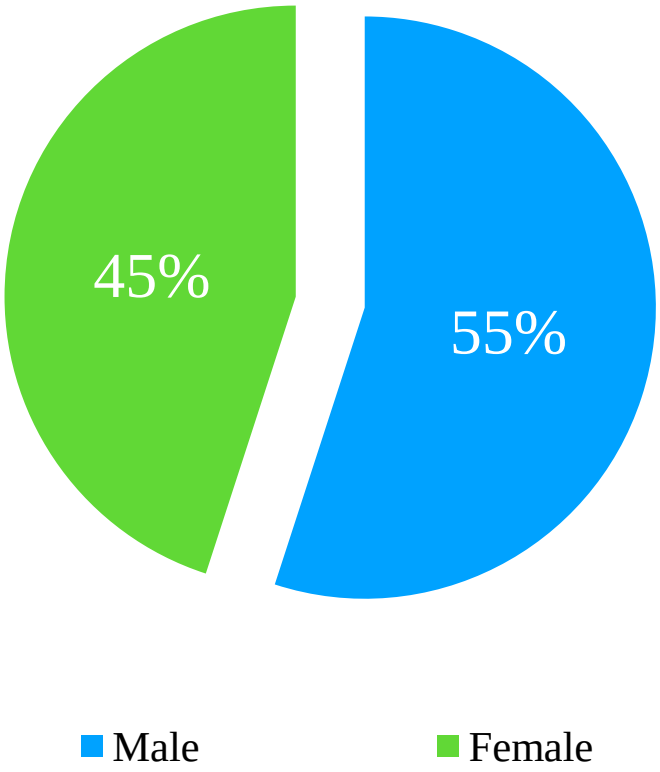


Chart 1: Sex Distribution

Age	Number of Patients
<18	34
19-30	38
31-40	12
41-50	9
>51	7

Table 1: Age Distribution

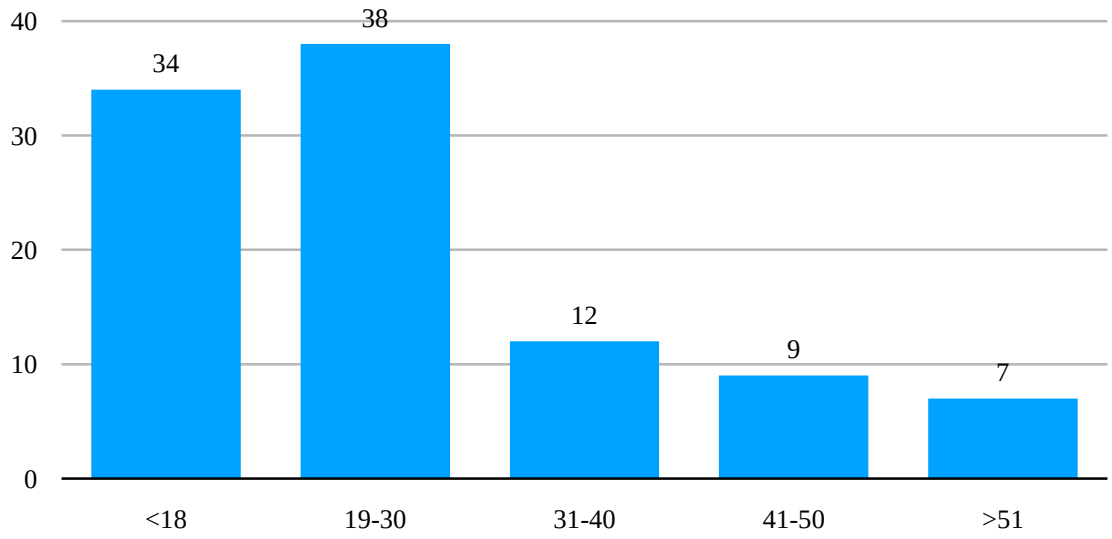


Chart 2: Age Distribution

		N	Mean	Std. Deviation	P value
CRP	AA	63	13.06	16.12	<0.0001
	AP/AG	37	36.95	18.13	
	Total	100	21.90	20.41	

Table 2: Mean and SD of CRP in Acute Appendicitis and Appendicular Perforation

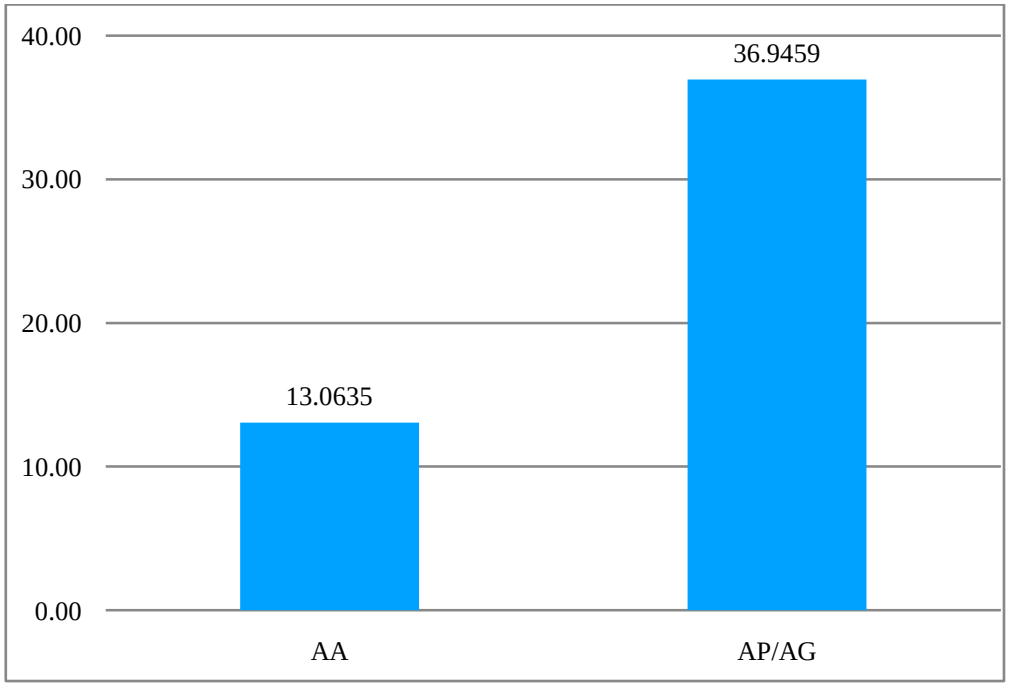


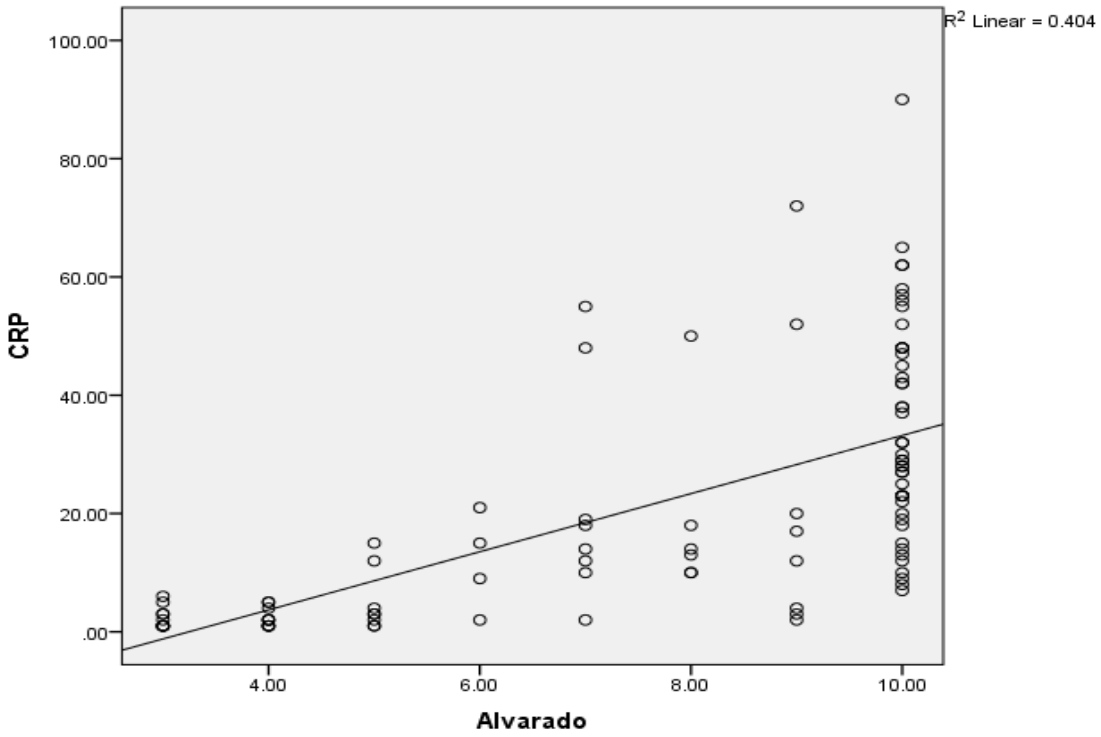
Chart 3: Mean and SD of CRP in Acute Appendicitis and Appendicular Perforation

		N	Mean	Standard Deviation	95% Confidence Interval for Mean		Minimum	Maximum	P value
					Lower Bound	Upper Bound			
CRP	AA	63	13.06	16.12	9.00	17.12	1.00	90.00	<0.0001

Table 3 : 95% Confidence Interval for CRP in Acute Appendicitis

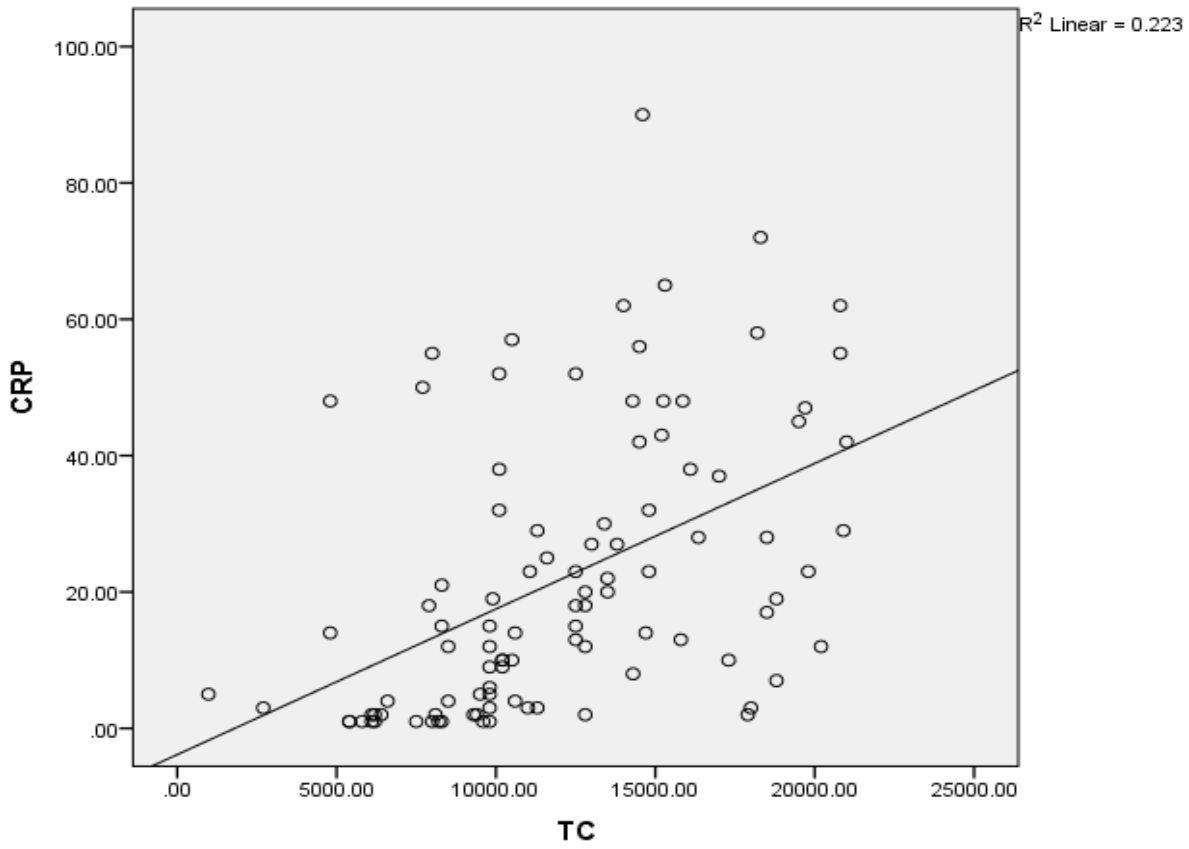
		N	Mean	Standard Deviation	95% Confidence Interval for Mean		Minimum	Maximum	P value
					Lower Bound	Upper Bound			
CRP	AP	37	36.95	18.13	30.90	42.99	1.00	72.00	<0.0001

Table 4: 95% Confidence Interval for CRP in Appendicular Perforation



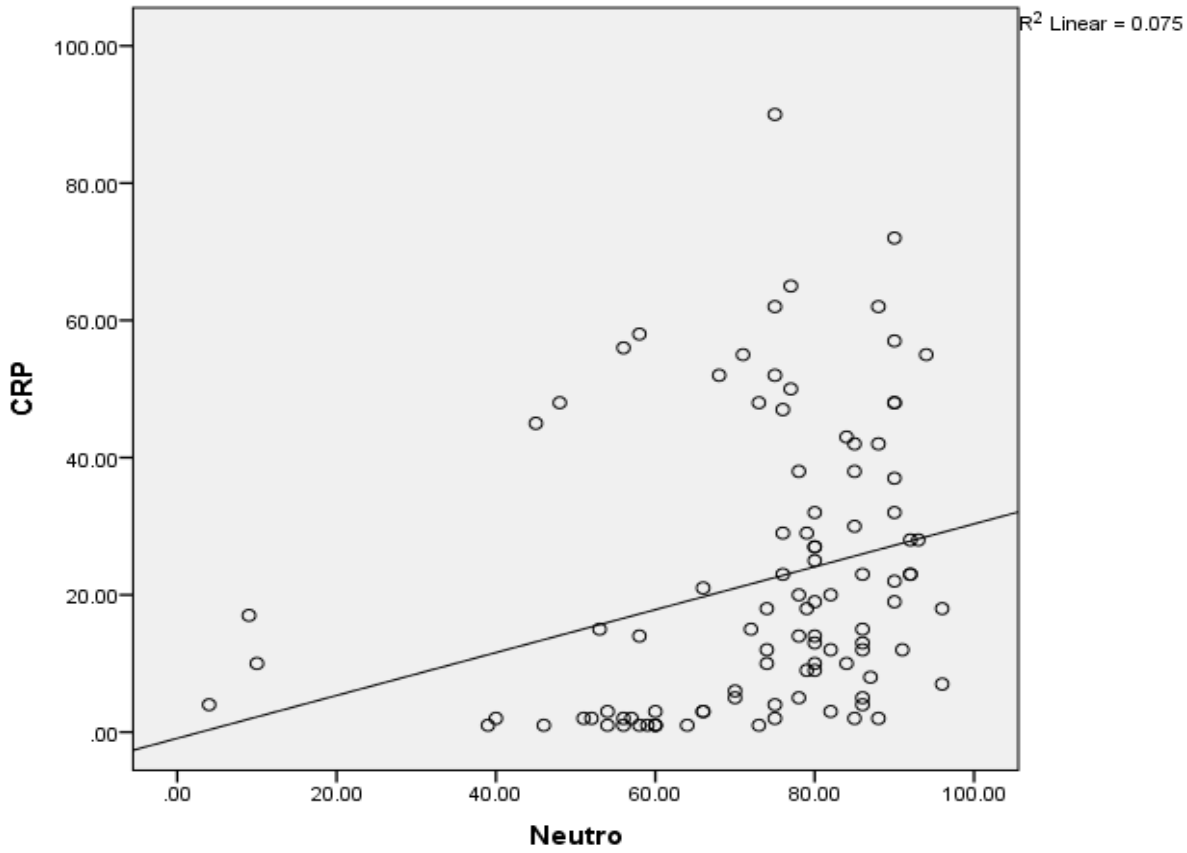
r	0.635
p value	<0.0001

Chart 4: Pearson Correlation CRP vs Alvarado score



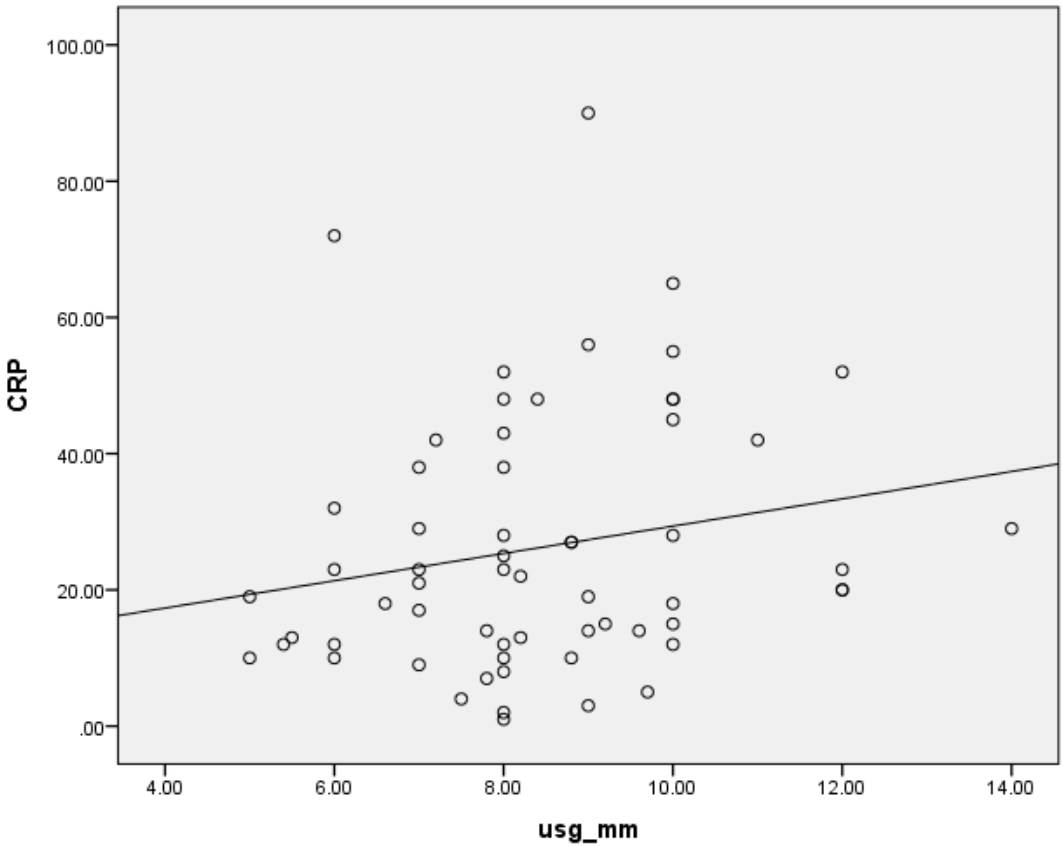
r	0.413
p value	<0.0001

Chart 5: Pearson Correlation CRP vs Total Count



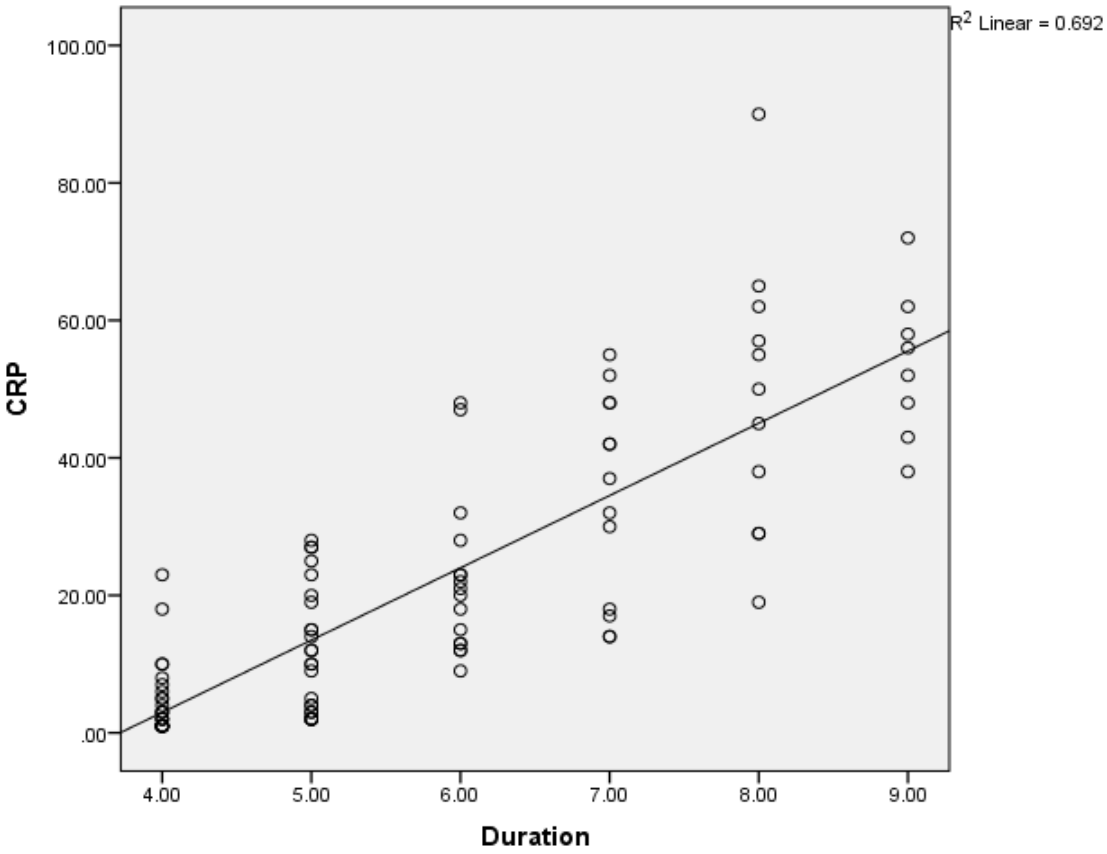
r	0.199
p-value	0.125

Chart 6: Pearson Correlation CRP vs Neutrophils



r	0.199
p-value	0.125

Chart 7: Pearson Correlation CRP vs Sonological appendix diameter



r	0.832
p value	<0.0001

Chart 8: Pearson Correlation CRP vs Duration of hospital stay

Complication		N	Mean	Std. Deviation	P value
CRP	Yes	28	41.61	19.27	<0.0001
	No	72	14.24	15.06	

Table 5: Independent student t-test comparing CRP with Post-operative complications

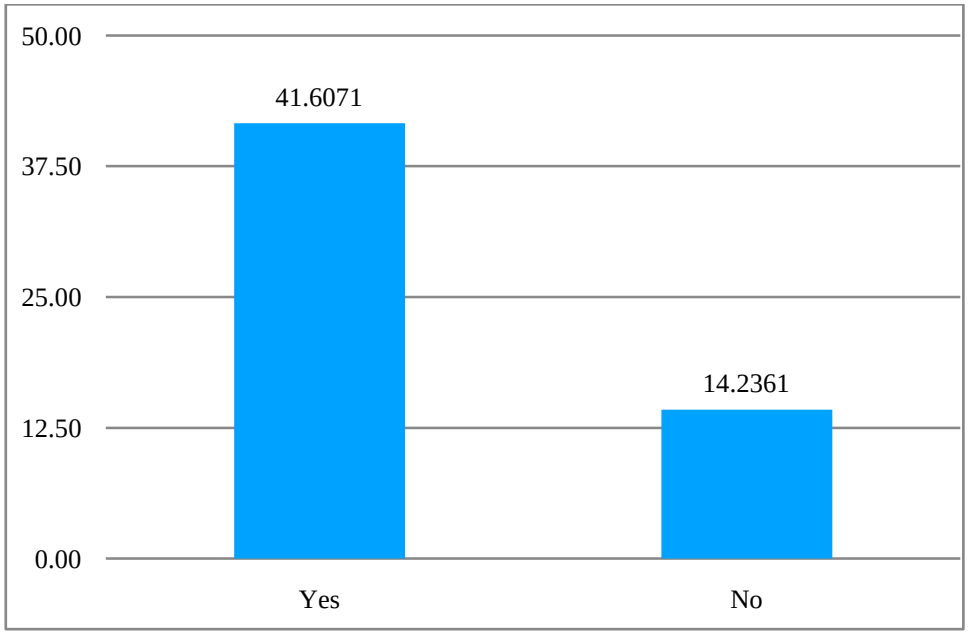


Chart 9: Independent student t-test comparing CRP with Post-operative complications

REVIEW OF ARTICLES

1. In a study conducted by Anshuman Sengupta et al[59] - "White Cell Count and C Reactive Protein Measurement in Patients with Possible Appendicitis", compared the WBC count and CRP values on admission in patients with acute appendicitis who are proceeded with appendicectomy. The mean and median white blood cell count, CRP values were co-related between those with the normal appendix, appendicitis and appendicitis with complications like peritonitis, gangrene and perforation and these groups were compared using the t-test. They concluded that normal values of CRP have a 100% negative predictive value for appendicitis. They also suggested that judicious use of C reactive protein may spare unnecessary hospital admission and surgical procedure for appendicitis
2. The study - "Role of C Reactive Protein in Acute Appendicitis" by Ghimire et al[60] analyzed the value of C Reactive protein as a diagnostic marker of appendicitis and assessed the levels of C reactive protein in acute appendicitis along with its quantitative relationship with the degree of inflammation of the appendix. Their results showed significant CRP rise in the inflamed appendix. The sensitivity, specificity, positive predictive value and negative predictive value of CRP in diagnosing acute appendicitis were

84.31%, 66.66%, 97.72%, and 20% respectively. They concluded that the values of C reactive protein exponentially increased with the degree of inflammation of the appendix and raised C reactive protein aids in diagnosing acute appendicitis

3. Mazhar Raja et al[61] did a study on "The value of C Reactive Protein in Enhancing Diagnosis of Acute Appendicitis". They analyzed the role of CRP in increasing the diagnostic accuracy of acute appendicitis and comparing it with histopathological findings. They concluded that in more than 90% of patients, the raised value of CRP was related to the severity of inflammation. They also stated that very high levels of CRP may be related to necrotizing appendicitis while CRP above 40mg/l may suggest suppurative or complicated appendicitis.
4. Yokoyama et al[63] study on "C Reactive Protein is an Independent Surgical Indication Marker for Appendicitis: Retrospective study" investigated whether CRP is a surgical indication marker as well as a diagnostic marker for the decision of emergency operation for acute appendicitis. They concluded that the CRP level is an independent marker in ascertaining the severity of acute appendicitis by logical regression analysis. The optimal cut off value of CRP for surgical indication was around 45 mg/l.

5. The study on “The Diagnostic Value of C Reactive Protein and White Blood Cell Count in Diagnosis of Acute Appendicitis” by Essam Ebied et al[63] aimed at assessing the diagnostic value of quantitative CRP and WBC count in patients suspected to have acute appendicitis. Their results showed that raised CRP had a sensitivity of 93.3% and specificity of 86.6 %. The CRP in uncomplicated appendicitis was 40mg/l whereas in complicated appendicitis it was 90 mg/l. They concluded that elevated C reactive protein levels correlate with the clinical diagnosis of appendicitis. They also stated that CRP must be routinely done in patients suspected with acute appendicitis
6. Ja Shelton et al[58] did a study on “Preoperative C Reactive Protein Predicts the Severity and Likelihood of Complications following Appendicectomy” aimed to look for factors that predict complications occurring in patients undergoing appendicectomy. The risk of complications was assessed independently for age, sex, perforation on pathology, preoperative WBC count and preoperative CRP where only preoperative CRP was a strongly significant factor predicting complications. They concluded that high preoperative CRP predicts an increased rate of postoperative complications like ileus, prolonged intravenous antibiotics, chest infection, collection, readmission, and placement of a percutaneous drain

7. Nauman Ahmed et al[64] study on “C Reactive Protein: An Aid for Diagnosis of Acute Appendicitis” aimed at identifying the role of CRP as a complementary test to decrease negative appendicectomy in a tertiary care hospital. The study concluded that CRP more than 48mg/l is an indication of perforated appendix and specificity of CRP in predicting appendicitis was 100%
8. The study “Predictive Factors to Distinguish between Patients with Non Complicated Appendicitis and those with Complicated Appendicitis” done by Tae Hyung sam et al[65] determined predictive factors to distinguish patients with non-complicated appendicitis from those with complicated appendicitis. Their results showed statistically significant factors in predicting complicated appendicitis by univariate analysis where appendiceal junction’s diameter, appendiceal maximal diameter, appendiceal wall enhancement, periappendiceal fat infiltration, ascites, abscesses, neutrophil proportion, C reactive protein, aspartate aminotransferase, and total bilirubin. However, in multivariate analysis, the appendiceal maximal diameter, periappendiceal fat infiltration, ascites, and CRP were statically significant. The sensitivity and specificity of CRP were 78% and 90% respectively. They concluded that CRP levels can be used to accurately differentiate non-complicated and complicated appendicitis.

9. Usha Rani Rathnam et al[66] study “C Reactive Protein as a Diagnostic Tool in Acute Appendicitis” aimed at comparing the C Reactive levels in diagnosing acute appendicitis. Their results showed CRP had a specificity of 91% with a positive predictive value of 88% in diagnosing acute appendicitis. They concluded stating that a normal preoperative serum CRP is a predictor of the normal appendix on histopathological examination.
10. The study on “Preoperative High C- Reactive Protein Level is Associated with an Increased Likelihood for Conversion from Laparoscopic to Open Appendicectomy in Patients with Acute Appendicitis” was done by Mitsugi Shimoda et al[67]. Their study aimed at clarifying the preoperative predictors of conversion from laparoscopic to open appendicectomy. Among the factors like age, gender, BMI, CRP, albumin, WBC, neutrophils, lymphocytes, neutrophil-lymphocyte ratio, presence of an abscess, appendicolith, gangrenous appendix - only CRP, Albumin and BMI were statistically significant factors in Bivariate analysis. Multivariate analysis done among these three factors showed that the CRP level was an only significant adverse prognostic factor for conversion to open appendicectomy. They concluded that in patients with high CRP levels of more than 99 mg/dl, the first approach would be conventional open appendicectomy instead of laparoscopic appendicectomy.

DISCUSSION

The mainstay of treatment of appendicitis is by surgical management. Conservative management of appendicitis in selected cases has also been documented[53,54]. On diagnosing a patient with appendicitis, the severity of appendicitis has to be ascertained before selecting optimal treatment. WBC counts, CRP, neutrophil percentage can be used as predictors of management.

This study aimed to evaluate whether CRP predicts the severity of appendicitis. The most common age group diagnosed with appendicitis is 19-30 years which is similar to the study done by Rathnam U et al[53]. The mean value of CRP in acute appendicitis was 13.06 mg/dl and in appendicular perforation was 36.95 mg/dl which was similar to the results by the study of Jangjoo et al[54] and Han ping wu et al[55]. As compared to study by Faith Dal et al., [56] our study showed strong statistical correlation between CRP and Alvarado score in diagnosing acute appendicitis and appendicular perforation. CRP values have been identified statistically using 95% Confidence value with the range of 9 mg/dl to 17.12 mg/dl in Acute Appendicitis and 30.90 mg/dl to 42.99 mg/dl in Appendicular Perforation by our study

Pearson correlation for CRP with Alvarado Score, Total counts, neutrophils showed a strong correlation with Alvarado score, medium correlation with total count and small correlation with neutrophil counts.

However, Pearson's for CRP with Appendicular Diameter in USG showed a statistically insignificant correlation. As per our study, the surgical cutoff for appendicitis is greater than 9mg/dl which is similar to the results of Yokoyama et al[57]

The results of this study also showed that there is a very high statistically significant correlation between CRP and prolonged hospital stay by Pearsons correlation curve. Further Independent student t-test compared CRP values with the development of complications and showed a statistical correlation of increased postoperative complications with increased preoperative CRP values. This is similar to the results of the study done by Ja Shelton et al[58]

These results suggest the consideration of the CRP level for the diagnosis and choice of the treatment of appendicitis. Diagnostic precision of acute appendicitis has been increased significantly with the use of CRP. CRP values are highly significant statistically in predicting acute appendicitis and appendicular perforation, at par with time tested Alvarado Score. The current study suggests that CRP helps in the prediction of the severity of appendicitis for treatment, and the high frequency of development of post-operative complications with high preoperative CRP values.

Hence CRP can be a cost-effective investigation not only in predicting Appendicular pathologies but also in anticipating postoperative complications

SUMMARY

In the present study, of the total 100 patients, 45 were male and 55 were female.

The most common age group of presentation is 19-30 years followed by 13 - 18 years

Mean value of CRP in acute appendicitis is 13.06 mg/dl and in appendicular perforation is 36.95 mg/dl

95% Confidence value for CRP is in the range of 9 mg/dl to 17.12 mg/dl in Acute Appendicitis and 30.90 mg/dl to 42.99 mg/dl in Appendicular Perforation.

Pearson correlation was statistically significant for CRP values with Alvarado score, total count, neutrophils, duration of hospital stay and insignificant correlation was noted for sonological appendicular diameter.

Independent student t-test showed a statistically significant correlation between the development of postoperative complications with high preoperative CRP values.

CONCLUSION

CRP could be a cost-effective easy method to aid the clinicians in diagnosing appendicitis.

A detailed history, clinical examination, Alvarado scores to establish a diagnosis of appendicitis, along with CRP values will help in increasing the accuracy of diagnosing appendicitis and help in decreasing negative appendicectomy rates.

Further CRP can also be used as a predictor of morbidity and complications in patients undergoing appendicectomy.

Grossly elevated CRP values warrants for early referral to a tertiary center for expert management since complication rates are high in these patients.

BIBLIOGRAPHY

1. Abdominal Operations, MaingotsVol 2,10th Edition 1997.
2. Schwartz Principles of surgery, 10th Edition 2015
3. Thomas WEG, Vowles KDJ, et al. Appendicitis in external herniae. Ann R CollSurg Engl. 1982;64:121.
4. Smith P.H, The diagnosis of Appendicitis. Post Graduate Med – journal Jar 1965;42:2-5.
5. Muller BA, Daling JR, Moore DE et al. Appendectomy and the risk of tubal infertility. N Eng J Med. 1986;315:-1509.
6. Silen W. Cope's Early diagnosis of the acute abdomen. New York. N Y: Oxford University Press Inc 1991;17-106.
7. Pieper R, Kager L et at. Acute appendicitis: A clinical study of 1018 cases of emergencyappendicectomy. ActaChirn Scand. 1982;148:51.
8. Andersson MD et al. Diagnostic value of disease history, clinical presentation and inflammation parameters of appendicitis. Eorld J Surg. 1999;23:133-140.
9. Colelmaln C, Thompson JE, Bennion RS, Schmitt PJ. White Cell Count is a poor indicator of severity of disease in the diagnosis of appendicitis. Am J Surg. 1998;64:983-985.
10. Bailey & Love, Short practice of surgery. 24th edition 2005.
11. Sabiston Textbook of surgery, South Asia 1st Edition, 2017.
12. Andersson MD et al. Diagnostic value of disease history, clinical presentation and inflammation parameters of appendicitis. Eorld J Surg. 1999;23:133-140.
13. Brooks DW, Killen DA. Roentgenographicfindings in acute appendicitis.Surgery. 1965;57:377.
14. Keyzer C, Zalcman M, De Maertelaer V, et al. Comparison of US and unenhanced multi-detector row CT in patients suspected of having acute appendicitis. Radiology. 2005;236(2):527-534.

15. Kessler N, Cyteval C, Gallix B, et al. Appendicitis: evaluation of sensitivity, specificity, and predictive values of US, Doppler US, and laboratory findings. Radiology. 2004;230(2):472-478.
16. Anderson SW, Soto JA, Lucey BC, et al. Abdominal 64-MDCT for suspected appendicitis: the use of oral and IV contrast material versus IV contrast material only. AJR Am J Roentgenol. 2009;193(5):1282-1288
17. Smith MP, Katz DS, Lalani T, et al. ACR Appropriateness Criteria right lower quadrant pain—suspected appendicitis. Ultrasound Q. 2015;31(2):85-91.
18. Barger RL Jr, Nandalur KR. Diagnostic performance of magnetic resonance imaging in the detection of appendicitis in adults: a meta-analysis. AcadRadiol. 2010;17(10):1211-1216.
19. Sartelli M, Viale P, Catena F, et al. 2013 WSES guidelines for management of intra-abdominal infections. World J Emerg Surg. 2013;8(1):3.
20. Katkhouda N, Mason RJ, Towfigh S, et al. Laparoscopic versus open appendectomy: a prospective randomized double-blind study. Ann Surg. 2005;242(3):439-448; discussion 448-450.
21. Enochsson L, Hellberg A, Rudberg C, et al. Laparoscopic vs open appendectomy in overweight patients. SurgEndosc. 2001;15(4):387-392.
22. Wei HB, Huang JL, Zheng ZH, et al. Laparoscopic versus open appendectomy: a prospective randomized comparison. SurgEndosc. 2010;24(2):266-2699
23. Ciftci AO, Tanyel FC, Büyükpamukçu N, Hicsonmez A. Comparative trial of four antibiotic combinations for perforated appendicitis in children. Eur J Surg. 1997;163(8):591-596.
24. Schropp KP, Kaplan S, Golladay ES, et al. A randomized clinical trial of ampicillin, gentamicin and clindamycin versus cefotaxime and

clindamycin in children with ruptured appendicitis. SurgGynecol Obstet. 1991;172(5):351-356.

25. Andersson RE. The natural history and traditional management of appendicitis revisited: spontaneous resolution and predominance of prehospital perforations imply that a correct diagnosis is more important than an early diagnosis. World J Surg. 2007;31(1):86-92.
26. St Peter SD, Aguayo P, Fraser JD, et al. Initial laparoscopic appendectomy versus initial nonoperative management and interval appendectomy for perforated appendicitis with abscess: a prospective, randomized trial. J Pediatr Surg. 2010;45(1):236-240.
27. Sawyer RG, Claridge JA, Nathens AB, et al. Trial of shortcourse antimicrobial therapy for intraabdominal infection. N Engl J Med. 2015;372(21):1996-2005.
28. Bundy DG, Byerley JS, Liles EA, Perrin EM, Katznelson J, Rice HE. Does this child have appendicitis? JAMA. 2007;298(4):438-451.
29. Bickell NA, Aufses AH Jr, Rojas M, Bodian C. How time affects the risk of rupture in appendicitis. J Am Coll Surg. 2006;202(3):401-406.
30. Nomura O, Ishiguro A, Maekawa T, Nagai A, Kuroda T, Sakai H. Antibiotic administration can be an independent risk factor for therapeutic delay of pediatric acute appendicitis. PediatrEmerg Care. 2012;28(8):792-795.
31. Minneci PC, Mahida JB, Lodwick DL, et al. Effectiveness of patient choice in nonoperative vs surgical management of pediatric uncomplicated acute appendicitis. JAMA Surg. 2016;151(5):408-415
32. Tanaka Y, Uchida H, Kawashima H, et al. Long-term outcomes of operative versus nonoperative treatment for uncomplicated appendicitis. J Pediatr Surg. 2015;50(11):1893-1897.

33. Steiner Z, Buklan G, Stackievicz R, et al. Conservative treatment in uncomplicated acute appendicitis: reassessment of practice safety. Eur J Pediatr. 2017;176(4):521-527.
34. Sheu BF, Chiu TF, Chen JC, Tung MS, Chang MW, Young YR. Risk factors associated with perforated appendicitis in elderly patients presenting with signs and symptoms of acute appendicitis. ANZ J Surg. 2007;77(8):662-666.
35. Young YR, Chiu TF, Chen JC, et al. Acute appendicitis in the octogenarians and beyond: a comparison with younger geriatric patients. Am J Med Sci. 2007;334(4):255-259.
36. Harrell AG, Lincourt AE, Novitsky YW, et al. Advantages of laparoscopic appendectomy in the elderly. Am Surg. 2006;72(6):474-480
37. Bree RL, Ralls PW, Balfe DM, et al. Evaluation of patients with acute right upper quadrant pain. American College of Radiology. ACR Appropriateness Criteria. Radiology. 2000;215(suppl):153-157.
38. Cohen-Kerem R, Railton C, Oren D, Lishner M, Koren G. Pregnancy outcome following non-obstetric surgical intervention. Am J Surg. 2005;190(3):467-473.
39. Giuliano V, Giuliano C, Pinto F, Scaglione M. Chronic appendicitis “syndrome” manifested by an appendicolith and thickened appendix presenting as chronic right lower abdominal pain in adults. EmergRadiol. 2006;12(3):96-98.
40. Morgagni JB. The seats and causes of disease investigated by anatomy. Alexander LB (trans). New York: Hafner Publishing, 1960
41. Collins DC. 71,000 human appendix specimens: a final report, summarizing forty years' study. Am J Proctol 1963; 14:365-81.

42. Collins DC. The chronic inflammatory and obliterative reactions of the vermiform appendix. Thesis. Post-Graduate School, University of Minnesota, June 1932.
43. Fawcitt R. Appendix situated within thorax. Br J Radiol 1948; 21:523-5.
44. Babcock WW. Lumbar appendicitis and lumbar appendectomy. SurgGynecolObstet 1946; 82:414-6.
45. Abramson DJ. Vermiform appendix located within the cecal wall. Dis Colon Rectum 1983; 26:386-9.
46. Smith DE, Jacquet JM, Virgilio RW. Left upper quadrant appendicitis. Arch Surg 1974; 109:443. [PubMed: 4852649]
47. Waugh TR. Appendix vermiformis duplex. Arch Surg 1941; 42:311-320.
48. Cave AJE. Appendix vermiformis duplex. J Anat1936;70:283-292.
49. Wallbridge PH. Double appendix. Br J Surg1963;50:346-347.
50. Treves F. Lectures on the anatomy of the intestinal canal and peritoneum in man. Br Med J 1885; 1:527-30.
51. Ajmani ML, Ajmani K. The position, length and arterial supply of vermiform appendix. AnatAnz (Jena) 1983; 153:369-74.
52. Kelly HA, Hurdon E. The Vermiform Appendix and Its Diseases. Philadelphia: Saunders, 1905.
53. Rathnam U, Kumar SK, Suggaiah L. C-reactive protein as a diagnostic tool in acute appendicitis. IntSurg J (2019);6:2386-9.
54. A. Jangjoo, A.-R. Varasteh, M. MehrabiBahar, N. TayyebiMeibodi, M. Aliakbarian, M. Hoseininejad, H. Esmaili& A. Amouzeshi (2014) Is C-reactive Protein Helpful for Early Diagnosis of Acute Appendicitis?,ActaChirurgicaBelgica, 111:4, 219-222
55. Han-Ping Wu MD, Ching-Yuang Lin MD, PhD, Chin-Fu Chang MD, Yu-Jun Chang, Chin-Yi Huang: Predictive value of C-reactive protein at

different cutoff levels in acute appendicitis. American Journal of Emergency Medicine (2016) 23, 449–453

56. Dal F, Çiçek Y, Pekmezci S, Kocazeybek B, Bahartokman H, Konukoğlu D, et al. Role of Alvarado score and biological indicators of C-reactive protein, procalicitonin and neopterin in diagnosis of acute appendicitis. Ulus TravmaAcilCerrahiDerg (2019);25:229-237.

57. Shozo Yokoyama, Katsunari Takifuji, Tsukasa Hotta, Kenji Matsuda, Toru Nasu, MikihitoNakamori, Naoki Hirabayashi, Hiroyuki Kinoshita and Hiroki Yamaue. C-Reactive protein is an independent surgical indication marker for appendicitis: a retrospective study. World Journal of Emergency Surgery (2015), 4:36

58. JA Shelton , JJS Brown, JA Young "Preoperative C Reactive Protein Predicts the Severity and Likelihood of Complications following Appendicectomy. Ann R CollSurgEngl 2014 Jul; 96 (5):369 -372

59. Sengupta A, Bax G, Paterson-Brown S. White cell count and C-reactive protein measurement in patients with possible appendicitis. *Ann R CollSurg Engl*. 2009;91(2):113–115.

60. Ghimire R[1], Sharma A[1], Bohara S[1]. Role of C-reactive Protein in Acute Appendicitis. Kathmandu Univ Med J (KUMJ). 2016 Apr-Jun;14(54):130-133.

61. Raja, Mazhar&Elshaikh, Elamin& Williams, Lisa & Ahmed, Mohamed. (2017). The value of CRP in enhancing diagnosis of acute appendicitis. Journal of Current Surgery. 7. 7-10. 10.14740/jcs316w.

62. Yokoyama S, Takifuji K, Hotta T, et al. C-Reactive protein is an independent surgical indication marker for appendicitis: a retrospective study. *World J Emerg Surg*. 2009;4:36. Published 2009 Oct 31. doi:10.1186/1749-7922-4-36

63. Essam F Ebied, HossamEbiedThe diagnostic value of C-reactive protein and white blood cell count in diagnosis of acute appendicitis The Egyptian journal of surgery 2019; 1: 1-4
64. Ahmed N[1] C-Reactive Protein: An Aid For Diagnosis Of Acute Appendicitis.J Ayub Med Coll Abbottabad. 2017 Apr-Jun;29(2):250-253.
65. Kim TH, Cho BS, Jung JH, Lee MS, Jang JH, Kim CN. Predictive Factors to Distinguish Between Patients WithNoncomplicated Appendicitis and Those With Complicated Appendicitis. *Ann Coloproctol*. 2015;31(5):192–197. doi:10.3393/ac.2015.31.5.192
66. Rathnam, U., Kumar K., S., &Suggaiah, L. (2019). C-reactive protein as a diagnostic tool in acute appendicitis. *International Surgery Journal, 6*(7), 2386-2389
67. Shimoda M, Maruyama T, Nishida K, et al. Preoperative high C-reactive protein level is associated with an increased likelihood for conversion from laparoscopic to open appendectomy in patients with acute appendicitis. *ClinExpGastroenterol*. 2019;12:141–147

PATIENT INFORMATION SHEET

IRB No.: Case No.

Name:

Age: Years Unit:

Sex: M F Date of Admission:

In patient No. Date of Surgery:

Biopsy No. / Date of Discharge:

Pre OperativeDiagnosis

Intra Operative Diagnosis

Post OperativeDiagnosis

History

Abdominal pain Y N

Location RH E LH RL U LL R/F H L/F

Duration Days

Nausea Y N

Vomiting Y N

Fever Y N

Diarrhea Y N

Vitals

Temperature [ ][ ][ ] F

Blood Pressure [ ][ ][ ] / [ ][ ][ ] mm Hg

Pulse rate [ ][ ][ ] / min

Examination

Tenderness [Y] [N]

Location [RH] [E] [LH] [RL] [U] [LL] [R/F] [H] [L/F]

Guarding [Y] [N] Rovsing's Sign [Y] [N]

Rigidity [Y] [N] Psoas Sign [Y] [N]

Blumberg's Sign [Y] [N] Obturator Sign [Y] [N]

Pointing sing [Y] [N] Free fluid [Y] [N]

Investigation

Total count [ ][ ][ ][ ][ ] Cells / cumm

Differential count

Neutrophils [ ][ ] % Basophils [ ][ ] %

Eosinophils [ ][ ] % Monocytes [ ][ ] %

C-Reactive protein [ ][ ][ ] Mg/L Lymphocytes [ ][ ] %

Radiological Investigations

USG Abdomen [ ]

CT Abdomen [ ]

நோயாளிகளுக்கு அறிவிப்பு மற்றும் ஒப்புதல் படிவம்
(மருத்துவ ஆய்வில் பங்கேற்பதற்கு)

ஆய்வு செய்யப்படும் தலைப்பு:
பங்கு பெறுவரின் பெயர்:
பங்கு பெறுவரின் வயது:

		பங்கு பெறுவர் இதனை ✓ குறிக்கவும்
1.	நான் மேலே குறிப்பிட்டுள்ள மருத்துவ ஆய்வின் விவரங்களை படித்து புரிந்து கொண்டேன். என்னுடைய சந்தேகங்களை கேட்கவும், அதற்கான தகுந்த விளக்கங்களை பெறவும் வாய்ப்பளிக்கப்பட்டுள்ளது என அறிந்து கொண்டேன்.	☐
2.	நான் இவ்வாய்வில் தன்னிச்சையாக தான் பங்கேற்கிறேன். எந்த காரணத்தினாலோ எந்த கட்டத்திலும், எந்த சட்ட சிக்கலுக்கும் உட்படாமல் நான் இவ்வாய்வில் இருந்து விலகி கொள்ளலாம் என்றும் அறிந்து கொண்டேன்.	☐
3.	இந்த ஆய்வு சம்பந்தமாகவோ, இதை சார்ந்து மேலும் ஆய்வு மேற்காள்ளும் போதும் இந்த ஆய்வில் பங்குபெறும் மருத்துவர் என்னுடைய மருத்துவ அறிக்கைகளை பார்ப்பதற்கு என் அனுமதி தேவையில்லை என அறிந்து கொள்கிறேன். நான் ஆய்வில் இருந்து விலகிக் கொண்டாலும் இது பொருந்தும் என அறிகிறேன்.	☐
4.	இந்த ஆய்வின் மூலம் கிடைக்கும் தகவலையோ, முடிவையோ பயன்படுத்திக் கொள்ள மறுக்க மாட்டேன்.	☐
5.	இந்த ஆய்வில் பங்கு கொள்ள ஒப்புக் கொள்கிறேன் எனக்கு கொடுக்கப்பட்டஅறிவுரைகளின் படி நடந்து கொள்வதுடன், ஆய்வை மேற்கொள்ளும் மருத்துவ அணிக்கு உண்மையுடன் இருப்பேன் என்று உறுதியளிக்கிறேன். என் உடல் நலம் பாதிக்கப்பட்டாலோ, அல்லது எதிர்பாராத, வழக்கத்திற்கு மாறான நோய்குறி தென்பட்டாலோ உடனே இதை மருத்துவ அணியிடம் தெரிவிப்பேன் என உறுதி அளிக்றேன்.	☐

பங்கேற்பவரின் கையொப்பம் / ..... இடம் .....
கட்டைவிரல் ரேகை
பங்கேற்பவரின் பெயர் மற்றும் விலாசம் .....
ஆய்வாளரின் கையொப்பம் /..... இடம் .....
ஆய்வாளரின் பெயர் .....
மையம் .....
கல்வியறிவு இல்லாதவற்கு (கைரேகை வைத்தவர்களுக்கு) இது அவசியம் தேவை
சாட்சியின் கையொப்பம் /..... இடம் .....
பெயர் மற்றும் விலாசம் ....

Sl.No.	Name	Age	Sex	IP No.	Diagnosis			M	A	N	T	R	E	L	S	SCORE	CRP	Total Count	Neutrophils	USG		Duration	Complications
					Pre-Op	Intra-Op	Post-Op													App Dia	Diag.		
1	Saravanan Marimuthu	22	M	66698	AA	AP	AP	1	1	1	2	1	1	2	1	10	38	10102	78	8	AP	9	Y
2	Nachiyar	29	F	68563	AA	AA	AA	1	0	0	2	1	0	0	0	4	1	5400	54	-	PT	4	N
3	Murugeshwari	26	F	68524	AA	AA	AA	1	0	0	2	1	0	0	0	4	1	8000	64	-	PT	4	N
4	Neelavathy	50	F	68691	AA	AP	AP	1	1	1	2	1	1	2	1	10	32	10100	80	6	AP	6	N
5	Muthuganesh	20	M	72477	AA	AA	AP	1	0	0	2	0	0	0	0	3	1	5400	60	-	PT	4	N
6	Rangasamy	16	M	76787	AA	AA	AA	1	0	1	2	0	0	0	0	4	2	6400	51	-	PT	4	N
7	Kiruthiga	19	F	72653	AA	AA	AA	1	0	0	2	0	0	0	0	3	3	2700	66	-	PT	4	N
8	Ayyappan	36	M	72469	AA	AP	AP	1	1	1	2	1	1	1	1	10	47	19700	76	-	AP	6	N
9	Gopinath	13	M	80730	AA	AA	AA	1	0	0	2	0	0	0	0	3	1	5800	39	-	ML	4	N
10	Kalpana Devi	43	F	80780	AA	AA	AA	1	0	0	2	0	0	2	0	5	3	11000	54	-	ML	5	N
11	Fathima	75	F	83110	AA	AA	AA	1	1	1	2	1	0	1	1	8	14	14700	80	7.8	AA	5	N
12	Balasubramaniyan	45	M	93105	AA	AP	AP	1	1	1	2	1	1	2	1	10	52	12500	75	12	FF/AP	9	Y
13	Sathguru	48	F	66703	AA	AP	AP	1	1	1	2	1	1	2	1	10	9	10200	79	-	PT	5	N
14	Saravanan Marimuthu	27	M	68552	AA	AP	AP	1	1	1	2	1	1	2	1	10	14	10600	78	9	AP	7	Y
15	Thinesh	15	M	668537	AA	AA	AA	1	1	1	2	1	0	0	0	6	2	8100	56	-	ML	5	N
16	Thivakar	13	M	78007	AA	AP	AP	1	1	1	2	1	1	0	0	7	55	8000	71	10	AP	7	N
17	Shenbagaraj	13	M	78827	AA	AA	AA	1	0	0	2	0	0	0	0	3	1	9600	59	-	PT	4	N
18	Malathy	40	F	82919	AA	AA	AA	1	0	1	2	0	0	0	0	4	1	7500	60	-	PT	4	N
19	Mano Ranjith	51	M	83040	AA	AP	AP	1	1	1	2	1	1	2	1	10	29	11300	76	7	AA	8	Y
20	Raja	14	M	4664	AA	AP	AP	1	1	1	2	2	1	2	1	10	29	20900	79	14	FF/AP	8	Y
21	Mupidathy	23	M	4751	AA	AA	AA	1	1	1	2	1	1	2	1	9	2	17900	88	8	AA	5	N
22	Pushpam	68	F	4851	AA	AA	AA	1	0	0	2	1	1	2	0	9	52	10100	68	8	AA	7	N
23	Selvi	31	F	4714	AA	AA	AA	1	0	0	2	0	0	0	1	4	2	6100	85	-	PT	4	N
24	Muthulakshmi	35	F	8372	AA	AP	AP	1	1	1	2	1	1	2	1	10	58	18200	58	-	FF / AP	9	Y
25	Lakshmanan	17	M	8350	AA	AP	AP	1	1	1	2	1	1	2	1	10	65	15300	77	10	AA	8	Y
26	Muthulakshmi	49	F	10015	AA	AA	AA	1	1	1	2	1	1	0	0	6	21	8300	66	7	AA	6	N
27	Nalina	24	F	15260	AA	AA	AA	1	1	1	2	0	0	0	0	5	1	6100	73	-	PT	4	N
28	Sankaran	61	M	18520	AA	AP	AP	1	1	1	2	1	1	2	1	10	30	13400	85	-	AP	7	Y
29	Pappusamy	14	M	18460	AA	AA	AA	1	0	0	2	0	0	0	0	3	1	8300	56	-	PT	4	N
30	Muthumari	14	F	20153	AA	AA	AA	0	0	0	2	0	0	0	1	4	2	9400	75	-	PT	5	N
31	Aruna	18	F	20261	AA	AA	AA	1	1	1	2	1	1	0	1	8	50	7700	77	-	PT	8	N
32	Kumar	28	M	21755	AA	AP	AP	1	1	1	2	1	1	2	1	10	37	17000	90	-	FF / AP	7	Y
33	Daniel	14	M	23609	AA	AP	AP	1	1	1	2	1	1	2	1	10	38	16100	85	7	AA	8	Y
34	Paulraj	15	M	25288	AA	AA	AA	1	0	0	2	0	0	0	0	3	1	8200	46	-	PT	4	N
35	Petchimuthu	28	M	25186	AA	AA	AA	1	1	1	2	1	1	2	1	10	23	11062	76	6	AA	5	N
36	Murugan	29	M	26878	AA	AA	AA	1	0	0	2	1	0	0	0	4	1	9800	58	8	AA	4	N
37	Abilash	23	M	28749	AA	AA	AA	1	1	1	2	1	0	2	1	9	20	13500	78	12	AA	5	N
38	Arunkumar	19	M	28817	AA	AA	AA	1	1	1	2	1	0	2	1	9	12	20200	91	10	AA	5	N
39	Iyyappan	19	M	66819	AA	AP	AP	1	1	1	2	1	1	2	1	10	42	14500	88	7.2	FF/AP	7	N
40	Thanga Selvi	15	F	80737	AA	AA	AA	1	1	1	2	0	0	0	0	5	2	6200	40	-	PT	5	N
41	Sivaperumal	25	M	66775	AA	AP	AP	1	1	1	2	1	1	2	1	10	32	14800	90	-	PT	7	Y
42	Subbulakshmi	52	F	18375	AA	AP	AP	1	1	1	2	1	1	2	1	10	55	20800	94	-	FF	8	Y
43	Rosy	19	F	20119	AA	AA	AA	1	1	1	2	0	0	0	0	5	1	6200	60	-	PT	4	N
44	Uma	32	F	25383	AA	AA	AA	1	1	1	2	1	1	2	1	10	10	17300	84	8.8	AA	4	N
45	Veni	16	F	18535	AA	AA	AA	1	0	0	2	0	0	0	0	3	2	9300	57	-	PT	4	N

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					Pre-Op	Intra-Op	Post-Op													App Dia	Diag.		
46	Baskar	47	M	89995	AA	AP	AP	1	1	1	2	1	1	2	1	10	48	15860	90	8.4	FF/AP	9	Y
47	Banumathi	16	F	6498	AA	AA	AP	1	1	1	2	0	1	0	0	7	14	4800	58	9.6	AA	7	Y
48	Balammal	60	F	12009	AA	AA	AG	1	1	1	2	1	1	2	1	10	57	10500	90	-	FF/AP	8	N
49	Anantha Selvan	22	M	15962	AA	AP	AP	1	1	1	2	1	1	2	1	10	62	20800	88	-	FF/AB	8	Y
50	Akilan	15	M	91830	AA	AP	AP	1	1	1	2	1	1	2	1	10	48	15250	90	10	AA	7	Y
51	Durai	13	M	72325	AA	AA	AA	1	1	1	2	1	1	2	1	10	27	13800	80	8.8	AA	5	N
52	Manjula	14	F	89978	AA	AP	AP	1	1	1	2	1	1	2	1	10	48	14290	48	8	AA	6	N
53	Sivaramakrisvanan	22	M	67052	AA	AA	AA	1	1	1	2	1	1	2	1	10	42	21000	85	11	AA	7	N
54	Sathishkumar	18	M	47835	AA	AA	PP	1	1	1	2	1	1	2	2	10	43	15200	84	8	AA	9	Y
55	Velraj	14	M	4569	AA	AP	AP	1	1	1	2	1	1	2	1	10	13	12500	86	5.5	AA	6	N
56	Sumathy	36	F	74004	AA	AA	AA	1	1	1	2	0	1	0	0	6	15	8300	72	10	AA	5	N
57	Mathiarasi	35	F	73975	AA	AA	AA	1	0	0	2	0	0	2	1	5	3	11300	66	-	PT	4	N
58	Sabari	18	M	88201	AA	AA	AA	1	1	1	2	1	1	2	1	10	7	18800	96	7.8	AA	4	N
59	Muniyasamy	16	M	1210	AA	AA	AA	1	1	1	2	1	1	2	1	10	12	12800	86	6	AA	5	N
60	Durai	13	M	72325	AA	AA	AA	1	1	1	2	1	1	2	1	10	27	13000	80	8.8	AA	5	N
61	Abinaya	18	F	45828	AA	AA	AA	1	1	1	2	1	1	2	1	10	23	12500	92	8	AA	4	N
62	Arumugakani	18	F	24871	AA	AA	AA	1	1	1	2	1	1	2	1	10	18	12500	96	6.6	AA	7	Y
63	Manikandan	29	M	28103	AA	AA	AA	1	0	0	2	0	0	0	0	3	5	980	70	9.7	AA	5	N
64	Ponnusamy	45	M	51363	AA	AP	AP	1	1	1	2	1	1	2	1	10	56	14500	56	9	AA	9	Y
65	Rukmani	24	F	45868	AA	AA	AA	1	1	1	2	0	0	2	0	7	2	12800	52	-	PT	5	N
66	Sankar	21	M	34144	AA	AP	AP	1	1	1	2	1	1	2	1	10	62	14000	75	-	FF/AP	9	Y
67	Saravanan	38	M	43869	AA	AP	AP	1	1	1	2	1	1	0	0	7	48	4800	73	10	AA	7	Y
68	Senthil Kumar	37	M	21419	AI	AP	AP	1	1	1	2	1	1	0	0	7	18	7900	74	-	FF	6	N
69	Tamil Amuthan	17	M	67047	AA	AA	AA	1	1	1	2	0	1	2	1	9	3	18000	82	9	AA	4	N
70	Vairamuthu	15	M	32245	AA	AP	AP	1	1	1	2	1	0	2	1	9	72	18300	90	6	AA	9	Y
71	Vinayagam	14	M	28094	AA	AP	AP	1	0	0	2	1	1	0	0	5	15	9800	53	-	ML	6	N
72	Venkatesh	24	M	51313	AA	AA	AA	1	1	1	2	1	1	2	1	10	25	11600	80	8	AA	5	N
73	Paul Jency	27	F	49489	AA	AA	AA	1	1	1	2	1	1	2	1	10	90	14600	75	9	FF/AP	8	Y
74	Mariammal	55	F	45945	AA	AA	AA	1	1	1	2	0	1	2	1	9	4	10600	86	7.5	AA	5	N
75	Vanmathy	30	F	59813	AA	AA	AA	1	1	1	2	0	0	0	1	6	9	9800	80	7	AA	6	N
76	Sundari	20	F	67600	AA	AP	AP	1	1	1	2	1	1	2	1	10	23	19800	86	12	AA	6	Y
77	Abirami	27	F	72321	AA	AA	AA	1	1	1	2	1	0	2	1	9	17	18500	9	7	AA	7	Y
78	Sankara Narayanan	20	M	51279	AA	AA	AA	1	1	1	2	1	1	2	1	8	18	12800	79	10	AA	4	N
79	Bharathi	19	F	46056	AA	AA	AA	1	1	1	2	1	1	2	1	10	15	12500	86	9.2	AA	5	N
80	Poomariammal	39	F	19592	AA	AA	AA	1	0	0	2	0	0	0	1	4	5	9800	78	-	PT	4	N
81	Ponammal	17	F	21077	AA	AP	AP	1	1	1	2	1	1	2	1	10	19	18800	90	9	AA	8	Y
82	Rajesh	27	M	6483	AA	AA	AA	1	0	1	2	0	1	0	1	5	12	8500	82	8	AA	6	N
83	Ramakrishnan	20	M	56630	AA	AA	AA	1	0	1	2	1	0	0	0	3	3	9800	60	-	PT	5	N
84	Rajeshwari	20	F	87746	AA	AA	AA	1	1	1	2	0	0	2	1	8	10	10500	80	8	AA	5	N
85	Kasthuri	20	F	30143	AA	AA	AA	1	1	1	2	1	1	2	1	7	12	9800	74	5.4	AA	6	N
86	Sarada	21	F	71247	AA	AA	AP	1	1	1	2	1	1	2	1	10	22	13500	90	8.2	FF/AP	6	N
87	Rasathy	27	F	86897	AA	AA	AA	1	1	1	2	1	0	2	0	8	10	10200	74	6	AA	5	N
88	Kaviyarasu	18	M	47835	AA	AP	AP	1	1	1	2	1	1	2	1	10	23	14800	92	7	FF/AP	6	Y
89	Sankaravel	31	M	47712	AA	AA	AA	1	1	1	2	1	1	0	1	7	19	9900	80	5	AA	5	N
90	Mariselvam	18	M	14188	AA	AA	AA	1	0	0	2	0	0	0	1	4	5	9500	86	-	PT	4	N

Sl.No.	Name	Age	Sex	IP No.	Diagnosis			M	A	N	T	R	E	L	S	SCORE	CRP	Total Count	Neutrophils	USG		Duration	Complications
					Pre-Op	**Intra-Op**	**Post-Op**													**App Dia**	**Diag.**		
91	Sudalaiyandi	45	M	6420	AA	AP	AP	1	1	1	2	1	1	2	1	10	28	18500	92	8	AA	6	N
92	Eswaran	29	M	1249	AA	AA	AA	1	1	1	2	1	1	2	1	10	45	19500	45	10	AP	8	Y
93	Kasthuri	20	F	30143	AA	AA	AA	1	0	1	2	0	0	2	1	7	10	10200	10	5	AA	4	N
94	Antony Davdd Vincent	15	M	28075	AA	AA	AA	1	0	0	2	0	0	0	1	4	4	8500	75	-	PT	4	N
95	Muthumari	27	F	23054	AA	AA	AA	1	0	1	2	1	0	2	1	8	13	15800	80	8.2	AA	6	N
96	Blessy	17	F	22859	AA	AA	AA	1	0	1	2	0	0	0	1	5	4	6600	4	-	PT	5	N
97	Rajalakshmi	20	F	14245	AA	AA	AA	1	0	1	2	0	0	0	0	3	6	9800	70	-	PT	4	N
98	Lakshmi	35	F	56400	AA	AP	AP	1	1	1	2	1	1	2	1	10	28	16350	93	10	AA	5	N
99	Kalaiarasan	14	M	61702	AA	AA	AA	1	1	1	2	1	1	2	1	10	20	12800	82	12	AA	6	N
100	Kalimuthu	50	M	53050	AA	AA	AA	1	1	1	2	1	1	2	1	10	8	14300	87	8	AA	4	N

Diagnosis: AA - Acute Appendicitis, AP - Appendicular Perforation

USG: PT - Probe Tenderness, AA - Acute Appendicitis, AP - Appendicular Perforation, ML - Mesentric Lymphadenitis, FF - Free Fluid