# "EVALUATION OF MODIFIED ALVARADO SCORE IN THE DIAGNOSIS OF ACUTE APPENDICITIS AND ITS CORRELATION WITH ULTRASONOGRAPHY AND HISTOPATHOLOGY"

**By**

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**SDUAHER**

Dissertation Submitted to the
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**MASTER OF SURGERY
IN
GENERAL SURGERY**

Under the guidance of

**Prof. A. BHASKARAN.** M.S.

**DEPARTMENT OF GENERAL SURGERY
SRI DEVARAJ URS MEDICAL COLLEGE,
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**2012**

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Above all I want to thank the almighty; not only for His blessings throughout the period of my study but also for everything He has done for me throughout my life. After all, He is the reason for my existence and the existence of all the people who have brought positive aspects to my life. I can't thank you enough dear Lord.

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# LIST OF ABBREVIATIONS USED

| | | |
|---|---|---|
| CRP | — | C reactive protein |
| TLC | — | Total Leucocyte count |
| WBC | — | White Bloode Corpuscles |
| USG | — | Ultrasonography |
| CT | — | Computerized Tomography |
| MRI | — | Magnetic Resonance Imaging |
| TB | — | Tuberculosis |
| CMV | — | Cytomegalovirus |
| HIV | — | Human Immunodeficiency Virus |
| IV | — | Intravenous |
| ESR | — | Erythrocyte Sedimentation Rate |
| VUJ | — | Vesico Ureteric Junction |
| LFT | — | Liver function test |
| MAS | — | Modified Alvarado Score |
| TP | — | True positive |
| FP | — | False positive |
| TN | — | True Negative |
| FN | — | False negative |
| RIF | — | Right iliac fossa |

# ABSTRACT

**BACKGROUND**

Acute appendicitis is the most common acute surgical condition of the abdomen which approximately 7% of the population will have appendicitis in their life time. The diagnosis of appendicitis is still based primarily on the clinical history examination. Prompt diagnosis and surgical intervention may reduce the risk and prevent complications.

**OBJECTIVES**

To evaluate the usefulness of the modified Alvarado score in the diagnosis and of acute appendicitis; and to quantify it by correlating it with ultrasonological findings and the histopathological report.

**METHODS**

100 consecutive patients presenting to the Department of Surgery at R. L. Jalappa Hospital and Research centre with right iliac fossa pain during the time period of November 2009 to December 2010 were included in the study. This was a randomized prospective study. The patients with suspected acute appendicitis were evaluated on the basis of the modified Alvarado Scoring System.

**RESULTS**

Patients with a score >7 were confirmed as acute appendicitis and underwent appendicectomy. A total of 94 patients underwent surgery. The sensitivity of the modified Alvarado score was 98.8%. The negative appendicectomy rate was 7.6%.

**CONCLUSION**

The modified Alvarado scoring system is a good diagnostic indicator for acute appendicitis. It helps in minimizing the rates of negative appendicectomy. It can be used as an adjunct to surgical decision-making along with ultrasonography in doubtful cases.

**KEY WORDS**

Acute appendicitis, Appendicectomy, Alvarado Scoring system.

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# INTRODUCTION

# INTRODUCTION

It is goes without saying that the abdomen is a magic box and poses new surprises to the surgeon each time. As the abdomen accommodates innumerable viscera and other anatomical compliments, diseases of the abdomen constitute an area full of clinical curiosity. A meticulous examination of abdomen is one of the most rewarding diagnostic procedures available to the doctor, especially the surgeon. Whilst clinical skills remain the mainstay of all medical practice, clinical medicine is changing. Increased sophistication of imaging and diagnostic techniques is resulting in greater diagnostic accuracy; however, the first meeting with the patient remains much the same. Despite the advancements in the fields of diagnosis the surprises never cease.[1]

The appendix is a cul-de-sac, crudely referred as "worm of the bowel" in ancient medical books and also called as abdominal tonsil. Acute appendicitis is the most common acute surgical condition of the abdomen[2]; approximately 7% of the population will have appendicitis in their life time[3], with the peak incidence occurring between 10 and 30 years.[4]

The diagnosis of appendicitis is still based primarily on the clinical history and the physical examination. Prompt diagnosis and surgical intervention may reduce the risk and prevent complications.[5] The mortality rate in non-perforated appendicitis is less than 1%, but it may be as high as 5% in young and elderly patients in whom the diagnosis may often be delayed thus making perforation more likely. Preoperative diagnosis of acute appendicitis is sometimes challenging despite all round improvements in medical field and ultrasonography. Diagnostic scores are useful easy methods, which help to reach in decision-making. Delay in diagnosis will lead to complication, which increases morbidity where as overzealous diagnosis may lead to

negative appendicectomy rate.[6] The surgical principle of "when in doubt, take it out", is not correct in view of the number of major and minor complications following appendicectomy.

This study is designed to assess whether the modified Alvarado score can be used as a criterion for admission of patients presenting with right iliac fossa pain and also help in making the decision to take up the patients for surgery and the role of ultrasound. Post operatively histopathological correlation of the resected sample is done to the clinical presentation, the score of the patient and the ultrasound findings to quantify the credibility of the scoring system.

All patients presenting to the Department of Surgery at R. L. Jalappa hospital and RC with right iliac fossa pain during the time period of November 2009 to December 2010 were included in the study.

# OBJECTIVES OF THE STUDY

# OBJECTIVES OF THE STUDY

1. To apply and evaluate the usefulness of the modified Alvarado scoring system in the accurate diagnosis and management of acute appendicitis.

2. To quantify the usefulness of the modified Alvarado scoring system by correlating it with ultrasonological findings and the histopathological report.

# REVIEW OF LITERATURE

# REVIEW OF LITERATURE

## HISTORICAL ASPECT

Leonid Ivanovich Rogozov, a surgeon on an expedition to the Antarctic in 1960 fell ill with symptoms of pain in the upper part of his abdomen, which shifted to the right lower quadrant. As a surgeon Rogozov had no difficulty diagnosing acute appendicitis. He knew that if he was to survive he had to undergo surgery. But he was in the frontier conditions of a newly founded Antarctic colony where transportation was impossible and flying was out of the question, because of the snowstorms. And there was one further problem: he was the only physician on the base. All the available conservative treatment was given but his general condition worsened. Then he thought of only possible way out: to operate on himself. Following Rogozov's instructions, the team members assembled an improvised operating theatre. Rogozov scrubbed and positioned himself in a semi-reclining position, at an angle of 30°. After infiltrating with procaine he made a 10-12 cm incision. He used a mirror at times for visibility. With short breaks because of general weakness he finally removed the severely affected appendix and completed the surgery in an hour and 45 minutes.[7]

There are some references to auto-appendicectomies in the literature. The earliest one was possibly that performed by Dr Kane in 1921 which was completed by his assistants. Rogozov's self operation was probably the first such successful act undertaken out of hospital settings and it remains an example of determination and the human will for life.

Aryateus of Cappedocia, one of the most celebrated of the ancient Greek physicians in

3rd century AD is reported to have described accurately appendicular abscess and cured the patient by incision and drainage through the abdominal wall.

The appendix was first described by the physician, anatomist Berengario Da Carpi in 1521. Appendix was clearly depicted in the anatomical drawings of Leonardo da vinci, made in 1492, but published in 18th century. "Defabrica Corporis Humani Fabrica" published in 1543 by Andres Versalius has illustrated the normal appendix.

Morgagni in 1719 published a detailed account of the appendix, its site and relations in his "Achersaria Anatomica". Verneys in 1710, coined the term "Vermiform appendix", vermiform meaning worm-like. Lieberkuhn in 1739 described the mucosal crypts which now bear his name. Weibrucht described a valve situated at the junction of appendix and caecum in 1749. Lorenz Heister in 1711 described a perforated appendix with abscess on autopsy. Mestivier in 1759 described perforation of the appendix by a pin and abscess formation in the right lower quadrant. John Hunter in 1767 described a gangrenous appendix on autopsy. Francis Melier in 1827 published autopsy description of 8 appendicitis cases and suggested the surgical removal of appendix. It was ignored as Baron Guillaume Dupuytren he had developed the concept of inflammation arising from the cellular tissues surrounding the appendix.

In 1839, Bright and Addison, in their book called "Elements of practical medicine" clearly described the symptomatology of appendicitis and stated that appendix was the cause of many of the inflammatory processes of the right iliac fossa. Dr Reginald Fitz in 1886 presented a paper entitled "perforating inflammation of vermiform appendix" in which he emphasized that

most inflammatory diseases of the right lower quadrant began in the appendix and urged its early surgical removal.

Claudius Amyand in 1735 performed the first known surgical removal of appendix from an 11-year-old boy with a longstanding scrotal hernia and feacal fistula in the thigh. The appendix was perforated by a pin giving rise to the feacal fistula.  In 1867 Willard Parker of New York advocated surgical drainage of an appendicular abscess after the 5th day of the illness.

In 1880 Lawson Tait performed the first planned appendicectomy and removed a gangrenous appendix from a 17 year old girl. In 1884, Mickley performed an appendicectomy but the patient did not survive. In 1885 Charter Symonds, performed an appendicectomy through an extra-peritoneal approach. In 1886 R.J. Hall performed appendicectomy from an irreducible inguinal hernia containing perforated appendix and drained a pelvic abscess successfully.

Willard Parker operated on a patient with appendicitis, removed 2 feacoliths and closed the perforation with sutures. Although the patient recovered, the surgeon's thoughts on appendicitis changed after this operation. In 1887, Dr. Edward Keith operated on Dr. Alfred Worcester and drained an abscess, the patient recovered after 1 month of convalescence.

In 1889, Dr. Charles Mc Burney published several important papers.  He described the point of maximum tenderness on the anterior abdominal wall, which is known after him, corresponding to the base of the appendix. He also described the Grid-iron approach to appendix which was described first by Mc Arthur.

In 1902, Dr. A.J. Oschner published a handbook on appendicitis, in which he advocated non-operative treatment for spreading peritonitis by keeping the patient nil-orally, gastric lavage and nutrient enemas to allow the peritonitis to localize and permit a safer surgery.

Herrington, Weir and Fowler described medial extension of grid-iron incision by dividing the lateral portion of rectus sheath known as Fowler-Weir extension. Rockey and Davis described the transverse skin incision by splitting of the muscle in the direction of its fibers.

In 1902, Sir Frederick Treves operated upon King Edward III for appendicitis successfully few days before his coronation. It was one of the most famous cases of appendicectomy and did much to popularize the operation.

Attempts to sterilize the appendix stump with chemicals or cautery became popular early and are still employed by surgeons. Increased understanding of the pathophysiology of peritonitis, fluid resuscitation and antibiotic therapy in the early 1940's decreased the mortality rate.

Semm is widely credited with performing the first successful laparoscopic appendectomy in 1982.[14]

Puyleart JBCM et al (1986) used ultrasonography as a tool to diagnose appendicitis. Ultrasonography was performed with 5MHz or 7.5 MHz transducer using graded compression technique. The appendix was visualized and diameter, thickness, free fluid, ileus, tenderness at Mc Burney's point was noted.[16] Abu-Yousef MM et al (1989) used transducers to compress the

bowels and displace the interfering gas in the right lower quadrant and directly visualize the inflamed appendix with a sensitivity that varied from 80 to 95%, a specificity of 95 to 100% and an accuracy of 91 to 95%. It was also possible to differentiate acute appendicitis from the gangrenous and a perforated appendix.[17] Paulman AA et al (1991) described CT findings an inflamed appendix.[18]

Gupta H et al (1997) reported that ultrasonography is appropriate in patients in whom the diagnosis is equivocal by history and physical examination. It is especially well suited in evaluating right lower quadrant or pelvic pain in pediatric and female patients. A normal appendix must be identified to rule out appendicitis. An inflamed appendix usually measures greater than 6mm in diameter and is non compressible and tender with focal compression. Other right lower quadrant conditions such as inflammatory bowel disease, caecal diverticulitis, Meckel's diverticulitis, endometrosis and pelvic inflammatory disease can cause false positive ultrasonography results.[19]

Gallindo Gallego et al (1998) reported ultrasonography combined with clinical diagnostic scoring increases the diagnostic accuracy in patients with suspected appendicitis. Fingerhut A et al (1999) described diagnostic scoring has been advocated as a potential tool to decide the number of negative appendecectomies performed.[20] Sudhir Kumar Mohanty et al (2000) quoted the modified Alvarado's score combined with ultrasound can be used as a cheap inexpensive use way of confirming acute appendicitis thus reducing negative appendectomy rate.[21]

Bhattrarcharjee PK et al (2002) did a study on modified Alvarado score and concluded high score was found to be a dependable aid both in pre operative diagnosis of acute

appendicitis in the reduction of negative appendectomy.[22]

George Mathews John et al (2002) done a study on 140 cases of right lower quadrant pain studied over 2 years period that underwent abdominal and pelvic ultrasonography. Ultrasonography is a noninvasive procedure, which can be done in all setups and can be applied to all age groups and in safe on all pregnant women. USG is found to diagnose inflamed appendix up to specificity of 90 to 99 percent and sensitivity of 75 to 90%.[23]

Joseph J Naoum et al (2002) performed a retrospective study on 194 appendicectomy performed, 114 prior to the guide line and 80 after the development of the guide line the rate of miss diagnosis is decreased from 25 to 6%, the rate of CT use increased from 32 to 84%, and the perforation rate unchanged. CT evaluation of patients suspected to have appendicitis has significantly reduced the negative appendecectomy rate to 3.5 to 8.6%.[24]

Sivit CJ (2003) did a study about use of cross sectional imaging has proven useful for the evaluation of suspected acute appendicitis in children. Both graded compressions sonagraphy and CT have been widely utilized in the imaging assessment lot the conditions. The principal advantages of sonography are its lower cost lack of ionizing radiation and ability to assess ovarian pathology that can often mimic acute appendicitis in female patients. The principal advantages of ct include lesser operator dependency than sonagraphy as reflected by higher diagnostic accuracy, and enhanced delineation of disease extent in perforated appendicitis.[25]

De U. De Krishna K (2004) reported a case having right lower quadrant abdominal pain in a 26-year-old female who underwent appendicectomy 1 year back is presented. Recurrent appendicitis was noted in appendiceal stump. All though rare stump appendicitis should be considered in the differential diagnosis of right lower quadrant abdominal pain.[26]

Nguyen NT et al (2004) analyzed the outcomes of laparoscopic versus open

appendicectomy, he obtained data from the university health system consortium clinical data base for all patients who underwent   appendicectomy for acute and perforated appendicitis between 1999 and 2003 (n=60,236) trends in utilization  of laparoscopic appendicectomy were examined over the  5 year period. Over all 41,085 patients underwent open appendicectomy and 19,151 patients underwent laparoscopic appendicectomy.  The percentage of appendicectomy performed by laparoscopy increased from 20% in 1999 to 43% in 2003. Compared patients who underwent open appendicectomy, patients who underwent laparoscopic appendicectomy were more likely female more likely white, has a lower severity of illness, and were less likely to have perforated appendicitis.   Laparoscopic appendicectomy was associated with a shorter length of hospital stay (2.5 days vs 3.4 days), lower rate of 30 days readmission (1.0% vs 1.3%), and a lower rate of overall complication (6.1% vs 9.6%).  There was no significant difference in the observed to expected mortality ratio between laparoscopic and open appendicectomy (0.5 vs 0.6 respectively).  The mean cost per case was similar in both groups.[27]

Jones K et al (2004) studied, if there was a significant change in the negative appendicectomy rate with the increased use of CT.  389 appendicectomies were performed for appendicitis.  There was a progressive increase in the use of CT: 52% in 2000, 74% in 2001 and 86% in 2002. There was also a decrease in the NA rate over 3 years: 17% in 2000, 9% in 2001 and 2% in 2002.   The perforated appendicitis rate decreased from 25% in 2000 to 9% in 2002. The appropriate utilization as an aid in the diagnosis of acute appendicitis should decrease the NA rate to 2%.[28]

Hansen AJ et al (2004) done a study on CT finding alone can accurately predict the histological severity of   acute appendicitis in patients who have high disease likelihood. He has taken consecutive sample of 105 patients (50 women and 55 male, aged 15 to 89 years)

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undergoing non incidental appendicectomy within 3 days of non focused abdominal CT. CT scans and histological features were retrospectively reinterpreted. CT variables used in the model were fat stranding, appendix diameter, dependent fluid, appendolithiasis, extra luminal air, and radiologist overall confidence score. CT findings, when used with regression model can accurately predict the histological severity of acute appendicitis in patients initially seen with a high clinical suspicion.[29]

Kumar S et al (2004) analyze the treatment of appendicular mass over a 30 year period, 60 consecutive patients with appendicular mass were randomly allocated to 3 groups: group A- initial conservative treatment followed by interval appendicectomy 6 weeks later; Group B- appendicectomy as soon as appendicular mass resolved using conservative means: Group C- conservative treatment alone. In patients in group A, operative time was less, adhesions were encountered less frequently, the incision has to be extended less often and post operative complication were fewer, as comparative to Group B. patients in Group C had the shortest hospital stay and duration of work-days lost: only 2 of 20 patients in this group developed recurrent appendicitis during a follow up period of 24-52(median 33.5) months. Of the 3 treatment modalities compared, conservative treatment without subsequent appendectomy appears to be the best.[30]

Blab E et al (2004) studied regarding advancement in the diagnosis of acute appendicitis in children and adolescents. All diagnostic parameters from the patients' medical history (duration and quality of abdominal pain, stool behavior), the laboratory (leucocytes, C-reactive protein), the clinical signs (tenderness on percussion, nausea, vomiting, dry tongue) and repeated ultrasound investigations (visualization of the appendix, indirect signs of an inflammatory process in the appendix region) were documented prospectively and were re-assessed with regard

to diagnostic value. As an additional parameter, prolactin was determined. 1156 patients (593 males/563 females) with a mean age of 9.51 years (+/-1.2 years) (max.15 years/min.2.3years), referred to the department with acute abdominal pain, were examined. 233(141 male/92 female; 20.1%) of these patients with a mean age of 10.47 years (+/-1.1 year) had appendicitis. Based on patients medical history laboratory findings, the initial clinical investigation and the initial ultrasound investigation, 173 patients (74.3% of the later operated 233 children with appendicitis) were diagnosed with certainty. The diagnosis in 60 patients (25.7%) of this group remains uncertain. These patients received a saline enema and were subjected to a second clinical and sonographic investigation after 4 hours of parentral fluid substitution. The other 923 patients (79.83%) were discharged and were followed up as out-patients in the following days. Based on this stepwise procedure, the percentage of correctly diagnosed appendicitis could be increased to 97.4%. The measurement of procalcitonin proved to be of no value in the diagnosis of acute appendicitis. In the children with abdominal pain, high diagnostic can only be achieved by a carefully combined evaluation of all individual diagnostic parameters and repeated investigations.[31]

Old JL et al (2005) did a study on imaging for suspected appendicitis. The overall diagnostic accuracy achieved by traditional history physical examination, and a laboratory has been approximately 80%. The ease and accuracy of diagnosis varies by the patients' sex and age, and is more difficult in women of child bearing age, children, and elderly persons. If the diagnosis of the acute appendicitis is clear from the history and the physical examination, prompt surgical referral is warranted. In atypical cases, ultrasonography and CT may help lower the rate of false-negative appendicitis diagnosis, reduced morbidity from perforation, and lower hospital expenses. Ultrasonography is safe and readily available, with accuracy rates between 71 and

97%. All though it is highly sonologist dependent and difficult in patients with a large body habitus. While there is a controversy regarding the use of contrast media and which CT technique is the best, the accuracy rate of CT scanning is between 93 and 98%. Disadvantages of CT include radiation exposure, cost, and possible complications from contrast media.[32]

Sakellaris G et al (2005) done a study on acute appendicitis in preschool-age children during the last 11years, 122 children aged less than 5 years underwent appendectomy with a preoperative diagnosis of acute appendicitis. At surgery, 29 children presented with acute suppurative appendicitis, 64 children perforated appendices and 25 children with appendicular abscess. In 3 cases there was no acute intra abdominal process. In this study the following data were analyzed: age, gender, symptoms, duration of symptoms, whether seen by a physician prior to admission and surgery, physical findings, stage of the disease at operation, histology, postoperative complications and mortality. The accurate diagnosis in early childhood appendicitis is still a difficult matter the responsibility of the paediatric surgeon is mainly the clinical examination with all his clinical skills and facilities and if serious doubt still exist, to proceed with a laparotomy in order to reach a definite diagnosis.[33]

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# EMBRYOLOGY [34, 35, 37]

Appendix develops as an under-developed distal end of the caecum in the 6th week of intra-uterine life. Appendix develops from the post arterial segment of the midgut, along with the caecum, ascending colon and the right 2/3 of the transverse colon. Initially a bud called the caecal bud arises from the post arterial segment very near to the apex of the loop. The proximal part of the bud grows rapidly to form the caecum but the distal part remains narrow and forms the appendix. Subsequently, the lateral wall of the caecum grows much more rapidly than the medial wall, thus the point of attachment of appendix comes to lie on the posteromedial aspect of the caecum.

Initially, the caecum lies just below the liver and the ascending colon cannot be demarcated. Gradually, the caecum descends to the right iliac fossa and the ascending, transverse and descending parts of the colon become distinct.

In the final stage, the duodenum, ascending colon and the descending colon become retroperitoneal by the fusion of their mesenteries to the posterior abdominal wall. But the mesentery of the small intestine, transverse colon, sigmoid colon and appendix remain free.

# CONGENITAL VARIATIONS

## CONGENITAL ABSENCE

J.O. Robinson (1952) reported 68 cases of congenital absence of appendix.

## DUPLICATION AND TRIPLICATION

In 1968, Tinkler reported on operating on a triple appendix in a Chinese male child aged 12 months with other congenital anomalies.

## WALLBRIDGE CLASSIFICATION

Wall Bridge (1962) classified duplication of appendix as follows (Figure 1)

**Type A**

- A single caecum and a single appendix, exhibiting various degrees of partial duplication

**Type B**

- A single caecum with 2 complete separate appendices, further divided into:
- Type B-1
    - Bud like 2 appendices symmetrically placed on either side of the ileo-caecal valve.
- Type B-2
    - 'Taenia colic' type - One appendix from the usual site and the other from the caecum above the lining of taenia, at varying distance from the first

**Type C**

- A double caecum each bears an appendix
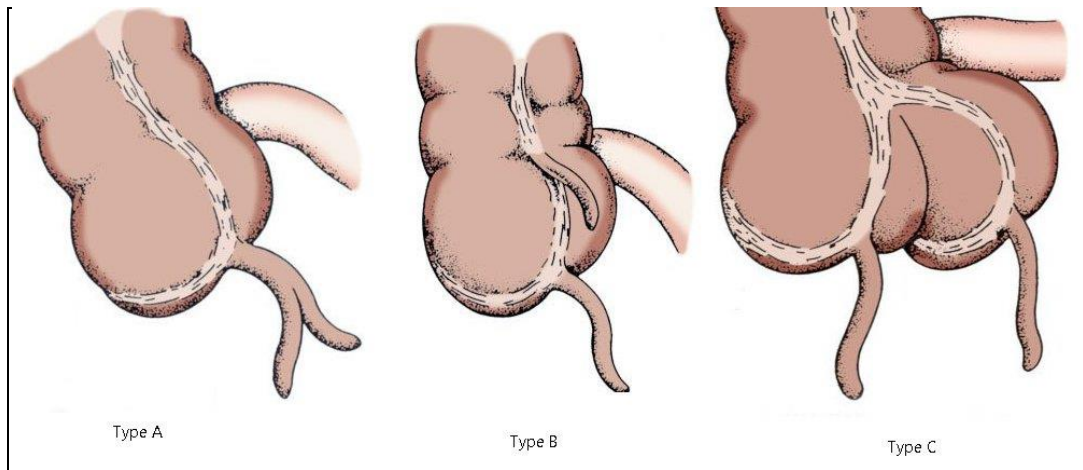
Figure 1 - Wallbridge Classification

## VARIATIONS IN POSITION

• Due to incomplete downward descent of caecum, the appendix may remain in subhepatic position.

• Due to overgrowth of ascending colon, appendix may sometimes descend down to a pelvic position along the caecum.

• Due to incomplete or non-rotation of the midgut loop, appendix may assume a position on the left side of the abdomen. This may be associated with transposition of viscera.

• Caecum may have a long mesentery and may be mobile. Because of its mobility, appendix may assume a variable position in the abdomen.

# ANATOMY[36, 37, 38]

Vermiform appendix is described as a narrow, vermian (worm-shaped) tube arising from the posteromedial caecal wall or elsewhere below the end of the ileum. It constantly arises from the site at which the 3 teania coli converge. It has no constant anatomical position. The three taenia coli merge into a complete longitudinal muscle layer over the appendix. The anterior taenia is usually distinct and traceable to the appendix, offering a guide to it.

Appendix varies from 2 –20cm in length, the average being about 9cm. It is longer in children and may atrophy or diminish after mid adult life.

## VARIOUS POSITIONS OF APPENDIX[36, 37]

Treves described the following anatomical types comparing the appendix with the face of the clock (Figure 2).

11'O Clock - Paracolic (lies on the sulcus in the lateral aspect of the caecum)

12'O Clock - Retrocaecal (lies behind the caecum and may even be totally or partially retrocaecal)

1'O   Clock - Pre-ileal

2'O   Clock - Post- ileal

3' O   Clock - Promontoric (the tip of the organ points towards the promontory of the sacrum)

4' O   Clock - Pelvic (Appendix dips into the pelvis)

6' O   Clock - Subcaecal or mid inguinal

According to Wakely, the incidence in a study of 10,000 cases is as follows:

Table 1 – **POSITIONS OF THE APPENDIX**

| POSITION OF THE APPENDIX | INCIDENCE |
|---|---|
| Retrocaecal | 65.28% |
| Pelvic | 30.00% |
| Subcaecal | 2.26% |
| Pre-ileal | 1.00% |
| Right paracolic and Post - ileal | 0.4% |
| Others | 1.06% |
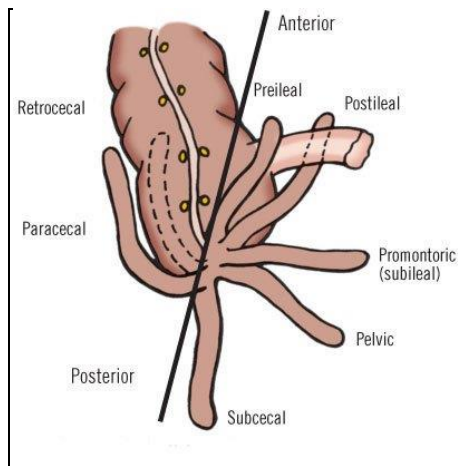
Figure 2 - Various positions of appendix                    Figure 3 - Blood Supply of the appendix
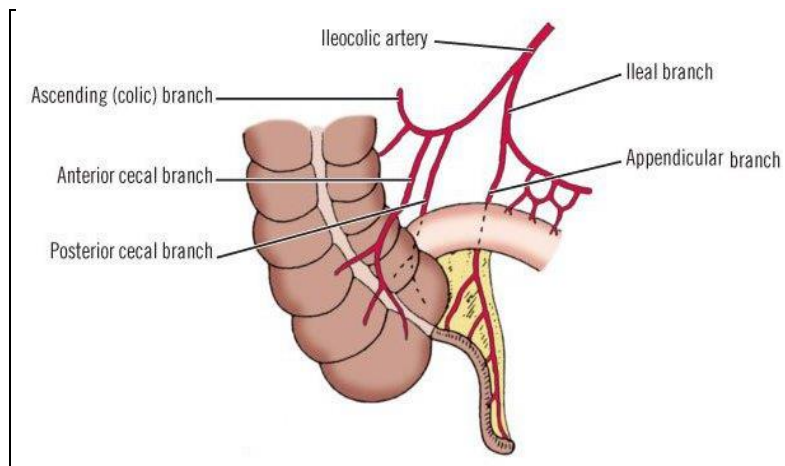
# MESENTERY OF APPENDIX

The appendix has a complete peritoneal investment and a small mesentery. This fold is derived from the left leaf of peritoneum and is a continuity of the mesentery. It is triangular in shape and is attached along the whole length of the appendix.

## BLOOD SUPPLY AND LYMPHATIC DRAINAGE

### ARTERIAL SUPPLY

Main appendicular artery is a branch from the lower division of the ileocolic artery, runs behind the terminal ileum to enter the mesoappendix a short distance from the appendicular base (Figure 3). Here it gives off a recurrent branch which anastamoses at the base of the appendix with a branch of the posterior caecal artery. The terminal part of the main artery lies on the wall of the appendix and may be thrombosed in appendicitis resulting in distal gangrene or necrosis. Variations are considerable. In nearly 50% of the cases there is an accessory appendicular artery, a branch of posterior caecal artery (named after Seshachalam).

### VENOUS DRAINAGE

Appendicular vein is a radicle of the ileocolic vein which drains into the portal system.

**LYMPHATIC DRAINAGE**

Lymphatic channels drain from the lymphatic follicles through the muscle wall into nodes in the mesoappendix. These drain into the paracolic nodes lying along the ileo-colic artery and then to the superior mesenteric group.

**NERVE SUPPLY**

SYMPATHETIC: Coeliac and superior mesenteric ganglia (T11, T12).

PARASYMPATHETIC: Vagus.

Both these nerves form the plexus around the artery supplying the appendix.

**PARA- APPENDICEAL FOSSA**

Peritoneal folds near the base of the appendix are sometimes found.

Superior ileocaecal recess opens medially and downwards just above the terminal part of the ileum. It is bounded anteriorly by the vascular fold of the caecum, which contains the anterior caecal vessels, medially by the medial upper part of the caecum and ascending colon and posteriorly by terminal ileum and its mesentery.

Inferior ileocaecal recess opens downwards and medially below the terminal ileum. Its anterior wall is formed by the bloodless fold of Treves extending from the lower border of the ileum to the caecum and anterior surface of the mesoappendix. Its posterior wall is formed by mesoappendix.

Retrocaecal recess lies behind the caecum, bounded anteriorly by the caecum, posteriorly by parietal peritoneum, and on each side by caecal folds of peritoneum.

## SURFACE MARKING

The base of the appendix corresponds to the Mc Burney's point. It is formed by the junction of the lateral one-third and medial two-third of the line joining the umbilicus with the anterior superior iliac spine. It is merely a surgical approximation with considerable variation.
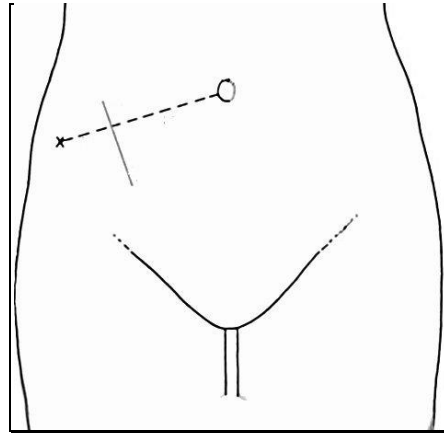


Figure 4 – Surface marking of appendix – Mc Burney's Point

## LUMEN OF THE APENDIX

Canal is small and opens into the caecum by an orifice lying below and a little behind the ileocaecal opening. The orifice is guarded by a semilunar mucosal fold forming a valve. The appendix is lined by columnar cell intestinal mucosa of colonic type. Crypts are present but are not numerous. In the base of crypts lie the special cells (Kultschizsky cells) which give rise to carcinoid tumous, and appendicitis can be caused by them.

# HISTOLOGY[39, 40]

Histologically the structure of the appendix has serosa, muscularis mucosa, submucosa and mucosa (Figure 5a and 5b).
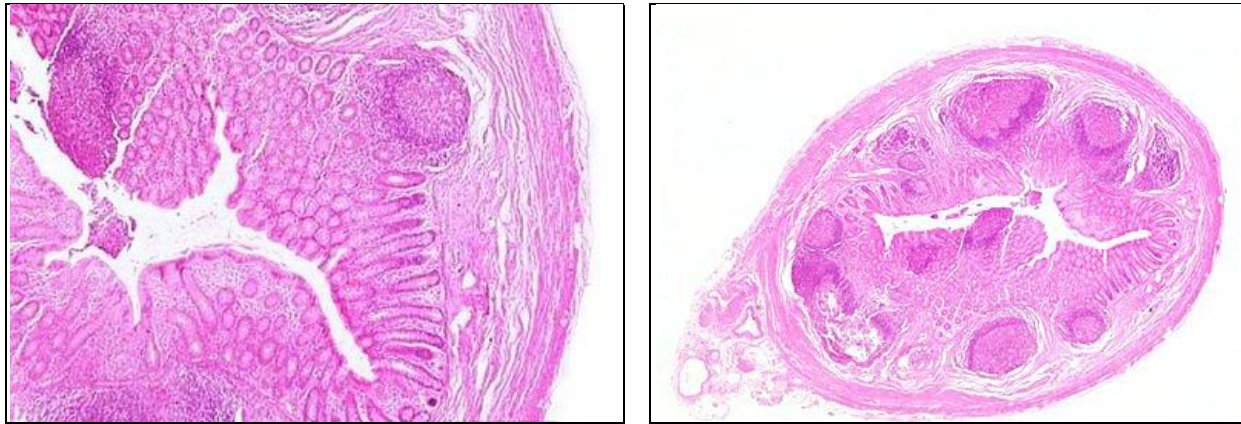


Figure 5a & 5b – Normal histology of the appendix

## SEROSA

It is a complete investment except along the mesenteric attachment and there is a sub-serosal layer of connective tissue.

## MUSCULARIS LAYER

Longitudinal muscle fibres form a complete uniformly thick layer, except over a few small areas where both muscular layers are deficient leaving serosa and submucosa in contact. At the base the longitudinal muscle thickens to form the rudimentary taeniae. The circular muscle fibers form a thicker layer separated by connective tissue.

**SUBMUCOSA**

It contains many lymphoid masses, causing the mucosa to bulge into the lumen, narrowing it irregularly. This profusion of lymph tissue has promoted the description of 'Abdominal Tonsil' for appendix.

**MUCOSA**

It is covered by columnar epithelium and attenuated antigen transporting M-cells.

Glands are few, penetrating deeply into lymphoid tissue. Lymphoid tissue in the lamina propria contains many plasma cells with lymphocytes, eosinophils, mast cells, macrophages embedded in fibro-cellular reticulum.

In many mammals, particularly herbivorous, the caecum and appendix are large and constitute a highly important site of digestion of cellulose by Symbiotic bacteria.

<h1 style="text-align:center">FUNCTIONS OF HUMAN APPENDIX [41-47]</h1>

## EMBRYOLOGICAL

During the 5th fetal week it is the appendix which develops from a bud at the junction of small and the large bowel and under goes rapid growth into a pouch. In the 6th week there is a transient nubbin surmounting the pouch indicative of being involved in the rapid development of the pouch. It is only after the 5th fetal month that the proximal end of this pouch starts growing differentially to give rise to the true caecum which continues to develop into infancy.

## PHYSIOLOGICAL

The goblet cells lining the appendix and adjacent caecum and colon secret a special type of mucus, which can be regarded as an antibacterial paint which controls the growth of organisms in the bowel. The paint contains a high concentration of IgA type immunoglobulins, secretory antibodies produced for mucosal or surface immunity and are a part of the bowel-blood barrier.

## BACTERIOLOGICAL

Through the cells within and over lining the lymphoid follicles and their production of secretory and humoral antibodies the appendix would be involved in the control of which essential bacteria come to reside in the caecum and colon in the neonatal life. As well it would be involved in the development of systemic tolerence to certain antigenic agents within the alimentary track whether they are derived from bacteria, food stuffs or even the body's own proteolytic enzymes.

**BIOCHEMICAL**

One in three hundred or so appendicectomy specimens contain a caricinoid tumor composed of highly specialized type of cell rich in serotonin. The exact function of such agents in the entire bowel is still being elucidated, but the fact majority of such tumours within the appendix.

**IMMUNOLOGICAL**

This is the area were the appendix would seem to have its predominant function due to its content of lymphoid follicles. Although it was thought the appendix itself could be the site for B-lymphocyte induction, the appendix also has a role in antibodies production. These antibodies are of two types; IgA type immunoglobulins for secretory or surface immunity and the IgM and IgG immnoglobulins for humoral immunity. The above functions have proven the appendix to be part of the G.A.L.T (Gut associated lymphatic tissue).

# ETIOLOGY [1, 48 - 50]

The riddle of the appendicitis-its actual cause and its meteoric rise from an insignificant disease to the most common serious intra-abdominal inflammatory affection of western civilised raises has been a matter for much speculation. So far no satisfactory explanation has been forthcoming. The following etiological factors are important, but for the most part they are purely contributed.

## AGE

It is common in the 2nd and 3rd decades. It is rare in infancy and old age. In infancy the lumen of the appendix is relatively large. In old age appendix often undergoes involution.

## SEX

Males are affected more commonly. Before puberty ratio is 1: 1, after puberty 2:1 upto 25 years.

## RACE AND DIET

The disease is common in highly civilized countries and certain communities, but rare in remote rural districts and among primitive people. Natives who live on a diet abundant in cellulose are immune to the disease, but when they adopt the diet of other civilizations they gain susceptibility. The severe gangrenous type of appendicitis is confined to meat eating people. Acute appendicitis occurs in lifelong vegetarians and even in babies at the breast. Denis P Burkitt after extensive research concluded that undue refining of dietary carbohydrates is the most

important causative factor.

**SOCIAL STATUS**

Acute appendicitis is more common between the upper and middle classes than those belonging to working class. The use of water closets instead of squatting position in defecation has been said to increase incidence of appendicitis (Bowers 1939).

**FAMILIAL SUSCEPTIBILITY**

This can be accounted for by a hereditary abnormality in position of the organ, which predisposes to infection. Thus the whole family may have long retrocaecal appendix with comparatively poor blood supply.

**OBSTRUCTION TO THE LUMEN OF THE APPENDIX**

When an acutely inflamed appendix has been removed, some form of obstruction to its lumen can be demonstrated in 80% of cases. Obstructing agents are:

IN THE LUMEN - Faecolith and hyperplasia of submucosal lymphoid. They are laminated composed of inspissated faecal material, calcium, and magnesium phosphate and carbonates, bacteria and epithelial debris.  Rarely a foreign body is incorporated in the mass. The presence of faecoliths postulates some form of appendicular stasis, which may be related to initial swelling of the lymphoid tissue causing partial obstruction to the lumen of the organ. Radiological demonstration of a stone is an absolute indication for surgery irrespective of signs and symptoms. Worms – round worm, threadworm, pinworm and parasites can occlude the lumen.

Any foreign body like pin, inspissated barium from previous studies may also contribute.

IN THE WALL - Stricture due to fibrosis from earlier inflammation or neoplasm, of which the carcinoid is the commonest cause.

EXTERNAL - Adhesions and kinking outside the wall.

## DISTAL OBSTRUCTION OF THE COLON

Acute appendicitis can result from an obstructing (colon) carcinoma, usually of the right colon, usually in the elderly cases.

## ABUSE OF PURGATIVES

Ingestion of purgatives especially castor oil by patients with 'stomach ache' and the violent peristaltic action' which results, favors, and often determines, perforation of the inflamed appendix. "Purgation means Perforation" is a wise rule.

## SEASONAL FACTORS

Particularly in children a possible association between respiratory tract infection and acute appendicitis exists. Involvement of lymphoid tissue in the tonsils and appendix may occur simultaneously. A blood borne infection may be present in these cases.

## BACTERIAL FACTORS

While appendicitis is clearly associated with bacterial proliferation within the appendix no single organism is responsible, a mixed growth of aerobic and anaerobic organisms is responsible. The most common organisms present are a mixture of E.coli (85%), entero cocci

(30%), non-haemolytic streptococci, anaerobic streptococci together with clostrdium welchi (30%) and bacteroides.

**VIRAL FACTORS**

An acute viral infection at the time of or just before appendicitis might lead to lymphoid hyperplasia and subsequent healing might produce scarring, kinking etc. leading to acute obstruction. Thus it is the effect of viral infection but not the direct cause.

Recently Cytomegalovirus appendicitis has been recognized in patients with HIV. Tucker and colleagues (1990) reported the 1st case, which had perforated appendix with peri-appendicular abscess due to E.coli. Intra-nuclear inclusions indicative of CMV infection were found throughout the mucosa and submucosa of appendix.

**TUBERCULOSIS OF THE APPENDIX** [51]

It has been seldom reported after introduction of antitubercular drugs. Borrow and Friedman (1952) had reviewed 265 cases, but majority were diagnosed at post-mortem examination of proved cases of tuberculosis. Two types have been described; ulcerative and hyperplastic types (Koster and Kosman, 1934). Tuberculosis of appendix may present as mass in right iliac fossa indistinguishable from ilio-caecal tuberculosis.

**OTHER RARE CAUSES**

- Appendicitis complicating regional ileitis (Crohns disease)

- Carcinoid tumor of the appendix

- Primary adenocarcinoma of appendix

- These are diagnosed only by histological examination

# PATHOLOGY [39, 48, 52]

The menace of acute appendicitis lies in the frequency with which the peritoneal cavity is infected from the focus.

- By perforation.

- By transmigration of bacteria through the appendicular wall

During the several hours between the onset of acute appendicitis and rupture, nature's walling of process is able to quarantine the inflammation in about 95% of cases and confine the spill to the peri-appendiceal area. The greater omentum attempts to seal off the spread of peritoneal invasion, while violent peristalses from ingested purgatives tend to spread it. Obviously if the inflamed appendix lies freely dangling, the threat of peritonitis is increased and should early perforation occur, rapidly diffusing peritonitis is inevitable. An inflammatory mass consisting of matted intestines and omentum with little or no pus is formed if walling off process is completed. In some patients however, a progressive suppurative process produces an expanding collection of pus contained by the walling off process—a peri-appendicular abscess.
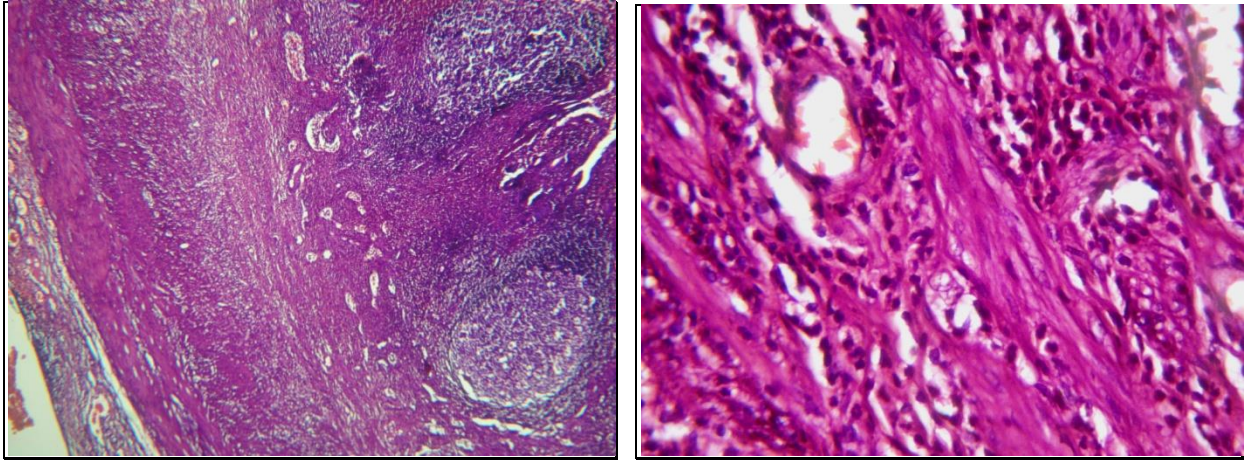
Figure 6 a & b – Microscopic appearance of acute appendicitis
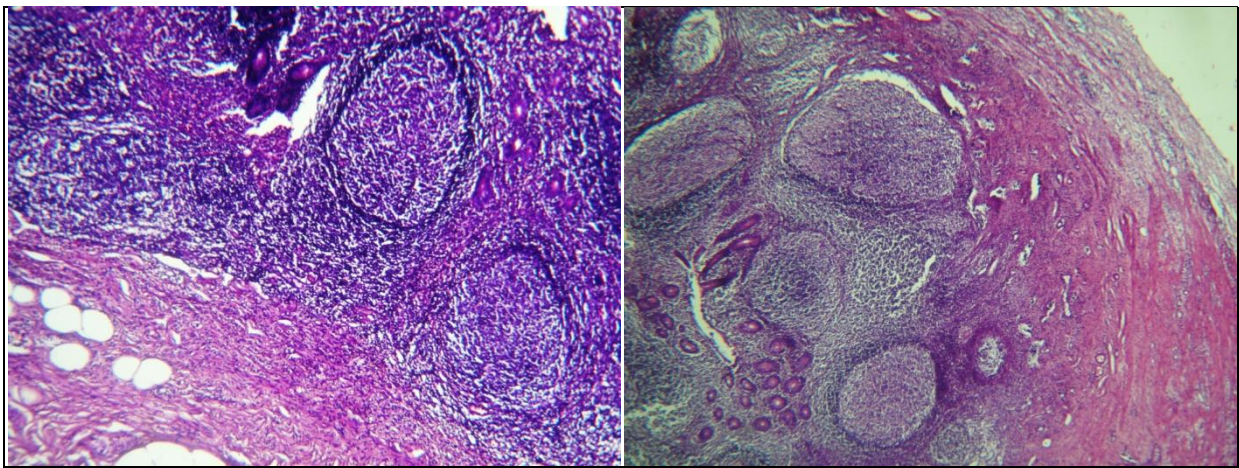


Figure 7 a & b - Microscopic appearance of recurrent appendicitis

Figure 6 shows the microscopic appearance of acute appendicitis. Transmural inflammatory cell infiltration, congested blood vessels and haemorrhages are seen in figure 6a and figure 6b shows neutrophils between muscle bundles. Figure 7 is the microscopic appearance in recurrent appendicitis. Follicular hyperplasia with sub-mucosal lymphocytic infiltration is seen in figure 7a and follicular hyperplasia with obliteration of lumen is seen in figure 7b.

Two types of appendicitis are known -

**NON OBSTRUCTIVE ACUTE APPENDICITIS**

The inflammation mostly due to bacterial invasion usually commences in the mucous membrane, less often in the lymph follicles and can terminate in one of the following ways.

- Resolution

- Ulceration

- Suppuration

- Fibrosis

- Gangrene

Once infection reaches the loose sub mucous tissues it progresses rapidly. The organ becomes turgid, dusky red and haemorrhages occur into the mucous membrane. The vascular supply of the distal part of the appendix is often in jeopardy because at this point the artery is intramural and liable to occlusion by inflammation or thrombosis. This may lead to gangrene of the tip. In some cases, the swelling of the lymphoid tissue in the appendix may lead to obstruction of the lumen proceeding to obstructive appendicitis.

Non-obstructive appendicitis may progress sufficiently slowly for protective barriers to form, and the resulting peritonitis is localized. In many instances the infection never progress beyond the mucous lining (i.e. catarrhal inflammation) but although the attack passes off, it is unlikely that a status quo ante is ever regained.

Because the tip suffers most, after resolution of the attack, fibrosis usually occurs there in and a shrunken tip is classically finding in recurrent appendicitis.

**OBSTRUCTIVE ACUTE APPENDICITIS**

When the appendix becomes obstructed the process of events begin with the accumulation of normal mucus secretion, proceeds to proliferation of the contained bacteria and the pressure atrophy of the mucosa, which allows bacterial access to the deeper tissue planes and continues with inflammation of the walls of the appendix with the thrombosis of the end artery leading inevitably to gangrene and then perforation of the necrotic appendix wall. Often within twelve to eighteen hours the appendix distal to the obstruction becomes gangrenous. Close examination of gangrenous appendices directly after their removal shows conclusively that they usually belong to the obstructive group (Willkie).[53]

Perforation occurs most often at the site of an impacted faecolith, before protective adhesions have had time to form. The escaping purulent and gaseous contents are under higher pressure and early wide spread peritonitis is liable to ensue. Subphrenic and pelvic abscesses are commonly later sequelae if the patient survives the initial peritonitis. An even more lethal form of peritonitis is produced by secondary rupture of intrabdominal abscess produced by perforated appendix. Ascending septic thrombophlebitis of the portal venous system –pylothrombophlebitis is a very grave but rare complication of gangrenous appendicitis. Septic clots from the involved mesenteric radicals embolise to the liver producing multiple pyogenic abscesses.

When acute inflammation subsides, adhesions form and kinking of the appendix may lead to obstructive appendicitis. Fibrosis of the wall from previous attacks of the appendicitis can contribute by narrowing the lumen and promoting faecolith impaction. Rarely appendicitis accompanies ilio-caecal Crohn's disease.

**AGENTS CAUSING OBSTRUCTIVE APPENDICITIS**

- Faecoliths

- Worms - Ascariasis, Enterobius vermicularis, taenia, etc.

- Swelling of the abundant lymphoid tissue

- Contraction of a sphincter-like mechanism at the base of appendix

- Fibrous contracture of the proximal end from previous attacks

- Kinking of the appendix by a band or a fold

- Distal obstruction of colon

- Foreign bodies - small fragments of bone, metal, seeds, pins, etc

- Barium contrast agent.

- Carcinoid tumor

When the obstruction is partial and not complicated by infection "mucocele of the appendix" is formed.

Less common pathological condition of appendix -

- Mucocele of appendix

- Diverticula of appendix

- Intussusception of the appendix

- Endometriosis of the appendix

- Primary Crohn's disease of the appendix

Histological criteria for the diagnosis of acute appendicitis are polymorphous leucocytic infiltration of the muscularis mucosa.

## PATHOLOGICAL TYPES

### CATARRHAL APPENDICITIS

Inflammation and symptoms are mild.

- Gross Appearance - The serosa looks infected, dull granular red membrane. The subserosal vessels are congested. Mucosa and submucosa are inflammed. Mucosal ulcers will be present. The lumen is not obstructed.

- Microscopy - Scant neutrophilic exudation throughout the mucosa, submucosa and muscularis. Scant perivascular neutrophilic emigration.

### ACUTE SUPPURATIVE APPENDICITIS

Inflammation is severe and purulent. The infection begins at the bottom of the crypts and spreads in the loose submucosa then mucularis, then along the penetrating vessels to the serous coat.

- Gross Appearance - Appendix is swollen and elongated, bright red color with dilated sub-peritoneal vessels and fibrous or purulent exudates on the surface. There may be yellow spots on the surface indicating the beginning of an abscess. The tip is usually swollen and the whole process is likely to be more marked in the distal than the proximal part. An obstructive element is usually present.

- Microscopy - All the coats are congested, oedematous and infiltrated with polymorphonuclear leucocytes, but the mucosal membrane may show little or no infiltration. Necrosis of the mucosa is common and masses of dead membrane may be cast off, thus forming ulcers, especially at the points where the lymph follicles approach the surface. Hemorrhage may occur in the inner coat suggesting acute haemorrhagic appendicitis.

Perforation may occur at any stage, but is usually associated with gangrene. The ulceration of mucosa may penetrate the mucosal and serosal coats causing perforation. A faecal concretion is often present at the site of the perforation and evidently plays a part in its production. It may escape into the abdominal cavity. If the perforation occurs into the open peritoneal cavity, it will result in generalized peritonitis.

## GANGRENOUS APPENDICITIS

It is merely a further stage of acute appendicitis. There is death and putrefaction of tissues of the appendix either local or general, due to interference with blood supply due to kinking or stricture of the appendix or thrombosis of the vessel that is traversing in the lumen of the appendix.

## RECURRENT APPENDICITIS

It is difficult for the pathologist to recognize chronic inflammation. Chronic appendicitis per se does not exist. The patients are usually examples of the recurrent form of the disease.

- Gross Appearance - The appendix is thickened and fibrosed and lumen may be narrowed or completely obliterated.

- Microscopy - Mononuclear cell infiltration of the wall, particularly in the submucosa and often associated with large lymphoid follicles. The mucosa and submucosa are infiltrated by large number of lymphocytes. Most of the appendices labeled as chronic appendicitis are really examples of healing after an acute attack.

**APPENDICITIS OBLITERANS**

It is a degenerative and atrophic process bearing no relation to inflammation.

## CLINICAL MANIFESTATION AND DIAGNOSIS

## AGE INCIDENCE

Rare before the age of 2 years, acute appendicitis becomes increasingly common during childhood and adolescence. The maximum incidence is between the age of 20 and 30 years. Thereafter there is a gradual decline but no age is exempt. In infancy the lumen of the appendix is large in relation to intestine and its lumen opens freely into the caecum. In old age the appendix undergoes involution.

## CLINICAL FEATURES[1, 38, 41]

## SYMPTOMS

## MIGRATORY ABDOMINAL PAIN

Usually the first symptom is pain around the umbilicus, in the epigastrium or it may be generalized, this is visceral pain and is therefore somewhat vague. It is due to distension of the appendix. The pain is constant. The site of localization of pain is in the midline because of the embryonic origin of appendix.

After a few hours the pain shifts to the point where the inflamed appendix irritates the parietal peritoneum, which is sensitive. This pain is somatic or peritoneal, accurately localized and constant. Coughing causes local pain in acute appendicitis but not in case of ureteric calculus.

If an obstructive element is present, colicky pain is experienced. In gangrenous

appendicitis, pain is experienced initially as the nerve endings are destroyed later. Once perforation occurs, and infection is not controlled by local or general factors, constant severe and generalized abdominal pain of diffuse peritonitis occurs.

**FEVER**

With corresponding increase in pulse rate 80-90 is usual. In severe cases temperature and pulse rate is even more.

**VOMITING, NAUSEA, ANOREXIA**

Upset of gastric function:

Vomiting generally occurs in the early stages of the attack, but usually a few hours after the initial pain due to protective pylorospasm. Many patients do not vomit, but instead have a sensation of nausea. Dyspepsia occurs in majority of the cases. Loss of appetite or repulsion for food may be regarded as a lesser degree of the same sensation and often of equal value in diagnosis. Any one in previously good health who suddenly loses appetite and complains of abdominal pain should be carefully watched for appendicitis.

The degree of nausea and the frequency of vomiting in the early stages appear to depend on two factors – first, the amount of distension of the inflamed appendix, and secondly the reflux nervous susceptibility of the patient. Vomiting is more prone to occur in children, or in patients whose digestive tract is easily deranged.

It may be taken as an important general rule that the severity and frequency of the vomiting at the onset of an attack of appendicitis indicate the degree of distension of the appendix and consequently the immediate risk to the patient that perforation may occur.

Persistent regurgitant vomiting occurs with diffuse peritonitis.

**BOWEL DISTURBANCE**

Constipation is common. Diarrhoea can occur in pre or post ileal positions of the appendix because of the irritation of the distal ileum. Pelvic abscess can irritate the distal gut leading to frequent bowel evacuation or tenesmus.

**URINARY DISTURBANCE**

Irritation of the ureters by the retrocaecal appendix may give rise to pain mimicking right ureteric colic. Increased frequency of micturation, haematuria or dysuria can occur due to the irritation by the inflamed pelvic appendix.

**SIGNS**

The physical signs of appendicitis are not specific but are merely those produced by local peritoneal irritation in the right iliac fossa, the most common cause of which is acute inflammation of appendix.

If the appendix is anteriorly placed, physical signs can be elicited over the anterior abdominal wall. There may be mild restriction of movement of the right lower abdomen with respiration.

**TENDERNESS**

As soon as the pain has shifted, there is localized tenderness either at Mc Burney's point or elsewhere, as determine by the site of the appendix. These determine the operative approach. Mc Burney (1889) stated that the seat of greatest pain determined by the pressure of one fingered examination, has been very exactly between an inch and a half to 2 inches from the anterior superior iliac spine in a straight line drawn from that process to umbilicus. Now it is generally accepted as a point of junction between lateral 1/3rd and medial 2/3rd of a line drawn from umbilicus to right anterior superior iliac spine. These points suppose to correspond to the base of the appendix.

Sir Cope remarks that tenderness over the Mc Burney's point is not always constant. [54] The pain seems to be actually located in the appendix itself and therefore depends on the position of the appendix and is obtainable when the viscus is not adhering to any surrounding part. Further the tenderness maybe due to irritation of the adjacent peritoneum. Gentle percussion can also elicit this point of maximum tenderness over the region. It may also lie in the flank.

**GUARDING AND RIGIDITY**

Guarding is an involuntary, protective process, preventing palpation. True guarding and voluntary false guarding should be differentiated. Guarding will usually be present over the right lower abdomen. Rigidity occurs when peritonitis sets in. Muscular rigidity occurs when the inflamed organ is in contact with the muscle.

## SPECIFIC SIGNS

**MC BURNEY'S SIGN**

It is elicited by demonstrating tenderness on deep palpation, over Mc Burney's point, which corresponds to the base of the appendix.

**ROVSING'S SIGN**

It is elicited by applying pressure over the left iliac fossa, which causes pain in the right lower abdomen. It was primarily thought to be due to shift of gas in the colon into the caecum, distending it, and the inflammatory phlegmon around. But Williams proved that this sign is positive in inflamed lesions of any organ in the right lower abdomen. Yashi (1958) showed that there is no increase in intraceacal pressure or the distal colon by cannulating the ceacum. This sign is probably due to the shift of the coils of ileum form the left iliac fossa to the right, where there is local peritonitis.

**BLUMBERG'S SIGN**

It is elicited by demonstration of rebound tenderness in the right iliac fossa.

**PSOAS TEST**

It is elicited by making the patient lie on his left side and extend his right thigh. Due to the irritation of psoas muscle in the inflammation of a retroceacal appendix, pain is felt.

**COPE'S OBTURATOR TEST**

On flexing and internally rotating the right thigh, if the inflammed appendix is in contact with the obturator muscle, pain is felt in the hypogastric region.

**HYPERAESTHESIA IN SHERRENS'S TRIANGLE**

Sherren's triangle is formed by the lines joining the umbilicus, right anterior superior iliac spine and pubic symphysis. Gently picking up a fold of skin and subcutaneous fat and drawing it away from the abdominal wall, or by stroking with a pin, elicits pain. Positivity of this sign is regarded by some clinicians as a good guide in the diagnosis of acute appendicitis before perforation. If, in such a patient, hyperesthesia disappears later, it indicates perforation of a gangrenous appendix.

**BALDWIN'S TEST**

The finger locates the tenderest spot in the flank, pressing lightly but just enough to cause a little pain. The patient is asked to lift his right leg few inches off the bed, keeping the knee stiff. If the patient promptly complains of pain, or drops off his leg with pain, the test is positive. It indicates retroceacal appendix.

**POINTING TEST**

A patient with acute appendicitis will point to the right lower abdomen on coughing, pointing to the site of inflammation. This is due to the irritation of parietal peritoneum.

**AUSCULTATION**

Bowel sounds are usually normal. Hyperperistaltic sounds are heard when there is an element of intestinal obstruction. Tinkling sounds are heard once paralytic ileus develops secondary to generalized peritonitis.

**PELVIC EXAMINATION**

Differential tenderness on the right side is significant in cases of pelvic position of appendix. In cases of pelvic abscess, a tender bulge can be felt, pointing into the rectum.

**VARIATIONS IN CLINICAL PRESENTATION DUE TO VARIOUS POSITIONS OF THE APPENDIX**

**RETROCAECAL APPENDIX - I**n this position, due to caecum intervening between the inflamed appendix and the abdominal wall, rigidity is not marked. Tenderness may be elicited over the right flank, as also is rigidity (Baldwin's test). Psoas test may be positive.

**SUBCAECAL APPENDIX - A**ppendix is curled up below the caecum and is in contact with the iliacus muscle. So, the extension of hip becomes painful due to iliacus spasm, and pain is felt in the hypogastrium.

**PELVIC APPENDIX -** When the appendix is almost entirely in the pelvis, the clinical signs may be absent over the anterior abdominal wall. Often, even the Mc Burney's sign may be negative. Pelvic examination detects differential tenderness on the right side. Obturator spasm

may be present rarely. Patient may have symptoms of strangury or dysuria or tenesmus, due to bladder or bowel irritation.

**SUBHEPATIC APPENDIX -** Due to its undescended position, the clinical signs are referred to the right upper abdomen. A mild degree of jaundice and very rarely haematemesis may occur due to its contact with the pylorus.

**RETROPERITONEAL APPENDIX -** A retrocaecal appendix is a totally retroperitoneal organ. In these cases, tenderness over the abdomen may be absent. Tenderness may be present over the loin. Haematuria is known to occur in 50% of these cases. Several complications like sub-diaphragmatic or retroperitoneal abscess may occur.

**POST-ILEAL OR RETROMESENTERIC APPENDIX –** Due to its position, inflammation of appendix is dangerous in these individuals. Acute inflammation does not produce the usual symptoms and signs. Irritation of the ileum results in frequent evacuation of the bowel initially. This is followed by paralytic ileus and the distended coils may mask the underlying appendicular mass or abscess.

Tenderness on the right iliac fossa is elicitable only on deep palpation. When the distended coils sink down into the pelvis, they may irritate the large bowel and may again cause diarrhoea.

## ACUTE APPENDICITIS IN INFANTS

In infants less than 36 months of age the incidence of perforation is over 80% and the mortality is considerably higher than the general mortality. Indeed when acute appendicitis occurs during the 1st year of life only 50% of the patients reach their 1st birthday. One of the reasons for the rapid onset of diffuse peritonitis is that the greater omentum is comparatively short and underdeveloped and is unable to give much assistance in localizing the infection. Even more important is the difficulty in arriving at an early diagnosis, and particularly in differentiating the condition from enteritis. Acute appendicitis may be associated with acute respiratory tract infection or exanthema.

## ACUTE APPENDICITIS IN CHILDREN

It is rare to find a child with appendicitis who has not vomited and they usually have complete aversion of food. In addition they do not sleep during the attack and very often bowel sounds are completely absent in the early stages.

## ACUTE APPENDICITIS IN THE AGED

Gangrene and perforation occur much more frequently. Elderly patients with lax abdominal walls may harbor a gangrenous appendix with little evidence of it and old people are prone to self medication with laxatives. In addition the picture may stimulate acute intestinal obstruction and if enemas are given, peritonitis may spread more widely. The immune system becomes weaker in old age. Acute appendicitis therefore in the older age groups carries a high mortality.

## ACUTE APPENDICITIS IN THE OBESE

Obesity can obscure and diminish all local signs of acute appendicitis. It is safer to operate on such cases through a generous vertical midline incision rather than miss a gangrenous appendix.

## ACUTE APPENDICITIS IN PREGNANCY

Appendicitis is the most common surgical emergency occurring during pregnancy. Diagnosis is often difficult. Physical findings may be obscured or altered by the cephalad displacement of the appendix as pregnancy progresses. Delay in treatment may result in death of the foetus or both foetus and mother. The incidence is 0.40 per 1000 pregnancy. It is common in 20-25 year age group but the age range extends from 14-34 years. More frequent in women having 2 or more pregnancies. It commonly occurs in the second trimester and less common in the 3rd trimester.

Around 80% present with symptoms of less than 24 hours. The duration of symptoms ranges from 6 hours to 6 days. Anorexia is present in almost all cases. Nausea and vomiting are common. Dysuria is infrequent. Pain and tenderness in the RIF is observed most commonly in the first 6 months of pregnancy. Diffuse abdominal pain is usual in the 3rd trimester. Abdominal pain and tenderness are situated more laterally and higher as the pregnancy advances. Rebound tenderness and muscle guarding are found less frequently, but when present, are valuable in diagnosis. Tocolytic agents prevent uterine contractions. When they are used prophylactically, produce good results.

The type and location of incision vary according to the stage of gestation. A muscle splitting incision centered over the point of maximum tenderness provides excellent exposure, and tilting the patient 90 degrees towards the left side may be of help. Simultaneously, caesarian section can be done if necessary and appropriate by obstetric view-point.

Maternal mortality has declined and is now 0.01%. Fetal loss has also decreased to <35%. Delay in operative intervention is the main cause of maternal and fetal death.

## APPENDICITIS IN PATIENTS WITH AIDS OR HIV INFECTION

The incidence of acute appendicitis in HIV-infected patients is reported to be 0.5% which is higher than the 0.1 to 0.2% incidence reported for the general population. The presentation of acute appendicitis in HIV-infected patients is similar to that in non-infected patients. The risk of appendiceal perforation appears to be increased in HIV-infected patients.

The differential diagnosis of right lower quadrant pain is expanded in HIV-infected patients compared with the general population. In addition to the conditions, opportunistic infections should be considered as a possible cause of right lower quadrant pain. Such opportunistic infections include cytomegalovirus (CMV) infection, Kaposi's sarcoma, tuberculosis, lymphoma, and other causes of infectious colitis. In the HIV-infected patient with classic signs and symptoms of appendicitis, immediate appendectomy is indicated. In those patients with diarrhea as a prominent symptom, colonoscopy may be warranted. In patients with equivocal findings, CT scan is usually helpful. The majority of pathologic findings identified in HIV-infected patients who undergo appendectomy for presumed appendicitis are typical.

## APPENDICITIS WITH HIRSCHSPRUNG'S DISEASE

In 1967, Martin described association between neonatal perforation of appendix and Hirschsprung's disease and quoted 3 such cases. In newborns, the common causes of large bowel obstruction are Hirschsprung's disease, imperforate anus, meconium plug, etc. This leads on to over-distension of the caecum and appendix. The appendix or caecum may perforate. The treatment comprises of rectifying the primary underlying disease, along with appendicectomy.

## APPENDICITIS AND ACTINOMYCOSIS

Actinomyces is an anaerobic micro-organism. The organism may be present in the lumen of appendix. After appendicectomy, it may gain a foothold in the devitalized stump and may lead to an external fistula, which discharges sulphur granules. The disease should be suspected if an external non-healing fistula occurs after appendicectomy. Patient may need a prolonged course of medical treatment with penicillin, for 3 weeks and constant follow-up for few months.

## ACUTE APPENDICITIS AND CROHN'S DISAESE

The appendix may be inflamed in Crohn's disease isolated to the appendix. It may also be found to be normal in the course of an emergency operation in a patient with Crohn's disease patient. There is unanimous agreement that appendicectomy is indicated when the appendix is inflamed, in the general population as well as in Crohn's disease patients. The recommendation not to perform appendicectomy when the appendix looks normal and the ceacum is inflammed, is well established.

**CHRONIC SCHISTOSOMAL APPENDICITIS**

Schistosomal infection of the appendix may be an incidental finding in the endemic area. But, it may cause recurrent or chronic appendicitis and this possibility must be remembered in those areas. Bowerman estimated that in West Africa, about 20% of cases of chronic appendicitis are due to schistosomiasis.

**APPENDICITIS DUE TO PARASITIC INFESTATION**

Parasites infesting the gut may enter the appendix and may occasionally cause luminal obstruction or local inflammatory reaction. Enterobius vermicularis is stated to be the commonest infesting organism. Stephenson, 1961, in a survey of 4000 consecutive appendices found infestation of Enterobius vermicularis in 2% of all appendices and 12% of those were associated with acute inflammation.

Nelson states that worms get attached to the mucosa, without causing appreciable damage, but they may cause haemorrhage from the wall, or provide opening for the invasion of the bacteria resulting in submucosal abscess.

**TUBERCULOSIS OF THE APPENDIX**

This presentation is seen as acute appendicitis or chronic appendicitis. It is always seen in conjunction with ileo-caecal TB. Diagnosis is only on histopathology.

**APPENDICULAR TUMORS AND APPENDICITIS**

- CARCINOID TUMOR - It is the most common and constitutes 90% of all primary tumors of appendix.  The tumor occurs usually in the tip rather than at the base of appendix, and obstruction of the lumen by this tumor is rare.  It may incidentally be found in an appendicectomy specimen.

- MUCINOUS CYSTADENOCARCINOMA - They present as a malignant mucocele of the appendix. Unless the mucocele has ruptured, appendicectomy will suffice.

- SARCOMAS – It is rare and very little is known about sarcomas of the appendix. Majority of the cases are lymphosarcomas.  Radical surgery is needed according to the case, with or without radiotherapy.

- Adenocarcinoma: Collin found adenocarcinoma in 41 out of 50,000 appendices examined histopathologically.  It rarely leads to appendicitis.  Right hemicolectomy is the treatment of choice.

# INVESTIGATIONS

The diagnosis of acute appendicitis is essentially clinical however a decision to operate based on clinical suspicion alone can lead to removal of normal appendix in 15-30% of cases. The premise that is better to remove a normal appendix than to delay diagnosis does not stand up to close scrutiny, particularly in the elderly. A number of clinical and laboratory based scoring systems have been changed to assist diagnosis.

## TOTAL WBC COUNT

A considerable overlap exists between the TLC and neutrophil count of healthy individuals and those with acute appendicitis. Interpretation of these counts together is more significant than either count alone.

It is clear that 80-85% patients with acute appendicitis will have a total WBC count of over 10,000/cu mm.[58, 59] Neutrophilia of >75% will occur in 78% patients.[60] When TLC and neutrophil count are taken together, less than 4% patients with acute appendicitis will have normal values. However, TLC is raised in 20-70% of patients with other causes of acute right iliac fossa pain. Leucocytosis increases with the duration of the disease process, but even a perforated appendix may present with a normal TLC. Of note is the observation of some that if TLC is repeated after a few hours, it tends to remain high in those with acute appendicitis but tends to fall in those without. Others have observed that TLC and neutrophil count are particularly sensitive in children.[61]

Thus although a raised WBC count is a highly sensitive test for acute appendicitis, it has low specificity and its value seems to be prompt in a patient with equivocal features of acute

appendicitis.

**ERYTHROCYTE SEDIMENTATION RATE (ESR)**

Peritonitis following perforation and appendicular abscess give rise to increased ESR and in other types of appendicitis ESR is normal (Albert Lesser Herald and Gold Burger, 1935) [62]

**URINE EXAMINATION**

Minimal albuminuria and some WBC in the urine are present in 20% of male patients with acute appendicitis. There may be presence of blood and pus cells in the urine routine examination due to approximation of inflamed appendix to the ureter.

Graham (1965) quantitatively analyzed mid stream urine specimens in 71 patients with a diagnosis of acute appendicitis. Microscopic pyuria was found in 9 patients (all females) and 1 had haematuria; 1 male patient had haematuria.

**C-REACTIVE PROTEIN**

CRP is an acute-phase reactant synthesized by the liver in response to bacterial infection. Serum levels begin to rise within 6-12 hours of acute tissue inflammation. A rapid assay is widely available. Measurement of CRP can increase the accuracy of diagnosis in acute appendicitis. An elevated C-reactive level (> 0.8 mg per dl) is common in appendicitis.

**PLAIN X-RAY ABDOMEN**[63]

A number of radiologic signs have been listed by Brookes and Keller (1965) as follows:

- Air-fluid levels localized to the caecum and to the terminal ileum, indicating inflammation in the right lower quadrant of the abdomen

- Increased soft tissue density of the right lower quadrant

- Blurring of the right flank stripe; the radioluscent line produced by the fat between the peritoneum and transverse abdominis muscle

- A faecolith in the right iliac fossa (which may be confused with a ureteric calculus, a gall stone, or a calcified mesenteric lymph node)

- Blurring of the psoas shadow on the right side

- A gas filled appendix.

- Free intraperitoneal gas with perforated appendix

- Deformity of the caecal gas shadow due to an adjacent inflammatory mass

Although there is no radiologic sign that is pathognomonic, there are certain signs that may point towards the diagnosis of acute appendicitis. None of these signs are specific to acute appendicitis and may be seen in patients with other pathology in the right iliac fossa and sometimes in normal subjects. Furthermore, irradiation hazards, especially in women of reproductive age group and in children, as well as the cost of overloading radiology departments make this investigation of low yield.

**ULTRASONOGRAPHY**

It is a noninvasive procedure and can be done in all set-ups and can be applied to all age groups and in pregnancy. Ultrasound is found to diagnose inflammatory appendix its specificity of 90-99% and sensitivity of 75-90%. With graded compression method markedly enhances diagnostic accuracy avoiding negative appendicectomy rate and delay in diagnosis beyond 6 hrs of admission. The inflamed appendix can be visualized sonographically and the factors like diameter >6mm, wall thickness>3mm, complex mass, irregular asymmetry, loss of contour, free fluid, local adynamic ileus, graded tenderness over Mc Burney's point are in favour of appendicitis.

Besides being highly specific in expert hands, USG has further advantage of excluding other diseases. Its disadvantage is the requirement of special equipment and expertise, also it is difficult to use in obese or distended abdomen.

**CONTRAST ENHANCED CT SCAN**

It is most useful in whom there is diagnostic uncertainty particularly older patients in whom acute diverticulitis, intestinal obstruction, or neoplasm are likely differential diagnosis. Selective use of CT scanning may be cost effective by reducing both the negative appendicectomy rate to 3.5-8.6% and length of hospital stay.

**RADIOACTIVE ISOTOPE IMAGING**

A patient's leucocytes may be incubated with radioactive isotope. After re-injection, these can be traced in an inflammed appendix. 99mTc-hexamethylpropyleneamine oxime (Tc-WBC) scans for diagnosing acute appendicitis in children have been used. It is not widely

available and also expensive.


**LAPAROSCOPY**

When the patient is a young female with acute pain in the right lower abdomen, diagnostic confusion arises. Laparoscopic examination may prove useful. This can be combined with culdoscopy.

Laparoscopy has the attraction of being the only investigation that can view the appendix directly. It can be diagnostic as well therapeutic. Negative laparotomy can be avoided in as many as 50% of the patients by using laparoscopy. The major disadvantage of laparoscopy is its invasiveness. It requires special equipment and expertise and also entails the general anaesthetic complications associated with an abdominal procedure.

## DIFFERENTIAL DIAGNOSIS

Diagnosis of acute appendicitis can be extremely difficult. There are a number of conditions which mimic acute appendicitis and also require surgical intervention. It is wise to consider and where possible, exclude these.

## ABDOMINAL CAUSES

- PERFORATED PEPTIC ULCER **-** As the duodenal contents pass along the paracolic gutter to the right iliac fossa, it may mimic acute appendicitis. Rigidity and tenderness in the RIF is present in both the conditions, but in perforated duodenal ulcer, the rigidity is usually more in the right hypochondrium.

- ACUTE CHOLECYSTITIS - Pain, vomiting, fever, constipation and local tenderness on the right side of the abdomen is present in both the conditions. The pain of cholecystitis is usually higher in location than that of acute appendicitis, and there may be a segmental referred pain in the right subscapular region. In very stout subjects with rigid abdominal muscles, it is often almost impossible to be sure whether appendix or gall bladder is involved.

- TORSION OMENTUM – It may simulate acute appendicitis as the part affected is usually to the right of the midline and pain and tenderness are present on the right of the umbilicus.

- CYCLICAL VOMITING – It is seen in infants, history of previous similar attacks is often available and abdominal rigidity is not present.

- ENTEROCOLITIS - History of diarrhoea and vomiting but no local tenderness and rigidity. Post-ileal appendicitis may completely mimic this condition.

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- TYPHLITIS – It is usually amoebic in etiology, maybe confusing clinically.  Tenderness is more diffuse over the RIF.  Stool microscopy may be helpful.

- NONSPECIFIC MESENTERIC ADENITIS - Pain is usually colicky and the patient maybe completely pain-free between attacks, which last for a few minutes. Cervical nodes may also be enlarged.

- TERMINAL ILEITIS - In its acute form terminal ileitis may be ndistinguishable from acute appendicitis, unless a doughy mass of inflammed ileum can be felt. An antecedent history of abdominal cramps, weight loss and diarrhea suggest regional ileitis rather than acute appendicitis. The ileitis may be nonspecific, due to Crohn's disease or Yersinia infection.

- MECKEL'S DIVERTICULITIS - It may be impossible to clinically distinguish this condition from acute appendicitis. The pain is similar but the signs may be central or left sided.

- ILEO-CAECAL TUBERCULOSIS - It may be easily mistaken for acute appendicitis. Commoner in children and cause slight tenderness, and may present as a mass in the RIF. Nausea and vomiting may occur, but epigastric pain is not in evidence and the typical symptom sequence is seldom present.

- INTESTINAL OBSTRUCTION - It may mimic acute appendicitis but distinction is to be made by noting that in obstruction the pain is more acute and not localized to RIF. Frequency and character of vomiting is different.  Temperature in obstruction is usually subnormal and never febrile as in acute appendicitis.

- CARCINOMA CAECUM - When obstructed or locally perforated may simulate acute appendicitis, in an elderly patient. A mass maybe palpable; barium enema or colonoscopy may be diagnostic.

## GYNAECOLOGICAL CAUSES

- SALPINGITIS - The commonest condition to pose diagnostic difficulty in a female patient. Typically, the pain is lower than that of acute appendicitis and is usually bilateral. A history of vaginal discharge, dysmenorrhoea, dysuria are all helpful differential points. USG can give confirmatory diagnosis.

- ECTOPIC GESTATION - In right sided unruptured tubal gestation, the signs are very similar to those of acute appendicitis, except that the pain commences on the right side and stays there. Usually there is history of missed menstrual period and urine pregnancy test may be positive. USG, preferably pelvic, should be carried out in all cases where ectopic gestation is a possibility.

- RUPTURED OVARIAN FOLLICLE (MITTELSCHMERTZ) - Pain typically occurs mid-cycle and usually subsides after a few hours. Systemic upset is very rare.

- TWISTED RIGHT OVARIAN CYST - When suspected, can be diagnosed by pelvic USG. When encountered at operation table, cystectomy or ovariotomy may be performed as deemed fit.

**UROLOGICAL CAUSES**

- RIGHT URETERIC COLIC - Pain commences in the loin and passes to the groin. Urinary symptoms are present. Pointing test is negative. Plain x-ray, urine microscopy, USG and IVP will help in diagnosis.

- RIGHT SIDED ACUTE PYELONEPHRITIS – It is accompanied and preceded by increased frequency of micturation. The leading features are fever, rigors, pyuria and tenderness confined to the loin.

**NEUROLOGICAL CAUSES**

- PREHERPETIC PAIN – Herpes zoster of the 9th, 10th and 11th thoracic nerves localize to the same area as that of acute appendicitis. It does not shift and is associated with marked hyperaesthesia. There is no intestinal upset or rigidity.

- TABES CRISIS – It is now rare. Severe abdominal pain and vomiting usher in the crisis. Other signs of tabes help the diagnosis.

- SPINAL CONDITIONS - Pott's spine, metastatic deposits, senile osteoporosis and myelomatosis may simulate appencicular pain. There is rigidity of the lumbar spine and intestinal symptoms are absent. X-ray spine may be diagnostic.

**MISCELLANEOUS CAUSES**

- Abdominal crisis of porphyria

- Diabetic abdomen

- Acute pancreatitis

- Torsion right testis or right epididymoorchitis

- Rectus sheath haematoma

- Bleeding into appendix or related structures, in blood dyscrasias, Henoch-Schonlein purpura

- Diabetic abdomen

- Basal pneumonia and pleurisy

## COMPLICATIONS [1, 37, 38]

## PERFORATION AND GANGRENE

When perforation or gangrene occurs within 12-24hrs after the commencement of the attack, explosive peritonitis is liable to occur. The abdomen becomes rigid, distended and silent on auscultation. In non-obstructive appendicitis particularly and in obstructive appendicitis when perforation or gangrene develop after a period of 24 hours the defense mechanisms can often contain the peritonitis, especially when the appendix lies in a relatively secluded portion of the peritoneal cavity as in retrocaecal appendix.

## THE APPENDICULAR MASS

A walled off perforated appendix will form an inflammatory mass. Usually there is a history of 4-5 days. 2% of the patients may have an appendicular mass on admission to the hospital. It presents with a surging temperature with an elevated pulse rate. There is a tender mass in the RIF that can often also be palpated per rectum. The abdomen is soft and bowel sounds are present. The mass is usually fixed to the posterior abdominal wall.

When the inflammatory process in a perforated appendix is gradual, it provokes a firoblastic reaction in the surrounding area and localizes the infection. This occurs when the resistance of the host is good or when the organisms are of low virulence. Then an inflammatory mass forms consisting of appendix, surrounded by a layer of omentum, neighbouring coils of intestine, together with the sero-fibrinous exudate. Some part of the mass is attached to the parietal peritoneum. The mass will undergo resolution under favourable circumstances. In a day or two, pus forms and accumulates in the centre of the mass and fibrin organizes around to form an abscess.

**THE APPENDICULAR ABSCESS**

It is true that is a certain number of masses will contain some pus or that they may occasionally become frank abscesses but both the terms are not synonymous. The features of an appendicular abscess include pyrexia, increased leucocyte count and signs of increasing toxicity. The mass and also the area of tenderness enlarge. The overlying abdominal wall may show redness, oedema and fixity of the mass to the overlying parieties. Patient may have tenesmus or strangury or dysuria if pelvic in position. The commonest site of abscess is in lateral part of right iliac fossa (extension of retrocaecal suppuration) next being pelvis.

If the abscess appears on the right flank, signs mimic a classical perinephric abscess. The pre-ileal abscess irritates ileum and leads to diarrhoea. Abscess spreads open into the peritoneal cavity causing diffuse peritonitis. The abscess may resolve or burst open with spontaneous resolution or may incite complications.

Fate of appendicular abscess may be -

- Spontaneous resolution - 50%

- Requiring drainage - 40%

- Misdiagnosis - 5%

- Generalized peritonitis - 5%

**ILEAL OBSTRUCTION**

Paralytic ileus is common during inflammatory stage. Sometimes adhesions around the distal ileum lead on to organic obstruction.

**MESENTERIC VEIN THROMBOSIS**

The thrombosis of the appendicular vein may progress to involve the mesenteric vein. This may result in haemorrhagic infarction and gangrene of the distal ileum, requiring resection.

**PYELOPHLEBITIS AND LIVER ABSCESS**

Infection of the appendix can spread retrograde to the liver, due to portal pyaemia. This complication can occur during an acute attack or in 3-6 weeks of an acute attack of acute appendicitis or even after 6 weeks of the attack.

**EXTERNAL OR INTERNAL FISTULA**

When the appendicular abscess ruptures through the skin, it results in an external fistula. When the appendix perforates into a viscus, it may form appendicovesical, appendicoileal, appendicojejunal or appendicosigmoid fistula. Symptoms in these cases are due to the discharge of contents form the appendix into the viscus, as well as, may be due to the herniation of bowel below the fistulous tract and obstruction of the same.

## TREATMENT

The treatment of acute appendicitis is immediate appendicectomy without delay. If the diagnosis is made at an early stage in the attack, and particularly in the absence of a localized mass, it is a rule that the appendix should be removed urgently.

J.B. Murphy quoted "The earlier the operation, the lower the mortality". The acute attack has been likened to a knock at the door saying 'let me out' (William Boyd). There is complete agreement that the treatment of early stage of acute appendicitis in the first 2 days of the attack before perforation occurs is designed to prevent peritoneal contamination. While there are no absolute rules, appendicectomy should be avoided in the presence of a mass or localized abscess or if history is more than 48 hrs long. The treatment after the 2nd day is clothed in controversy. Cases admitted with diffuse peritonitis are treated with early appendicectomy.

## PRE-OPERATIVE MANAGEMENT

A few hours and not more than 6 hrs is set aside for pre-operative workup.     Clinical examination, laboratory investigations and radiological examination are followed by the following measures.

- Nil orally
- Parenteral fluids for proper hydration and electrolyte balance of the patients
- Parenteral antibiotics
- Analgesics to relieve pain and reduce anxiety

- Enemas are contraindicated

- Monitoring the vital signs with particular attention being given to increase in the pulse rate and temperature

- Maintaining input and output chart

- Preparing the abdomen for laparotomy

# APPENDICECTOMY [64]

## INCISIONS FOR APPENDICECTOMY

Experience should enable the surgeon to determine with a fair degree of accuracy before operation, the position and pathological changes in the appendix and hence choose an appropriate incision.

- **GRID-IRON INCISION**

This was first described by McArthur in 1894, though it is popularly known as Mc Burney's incision. This muscle splitting muscle incision is commonly used for appendicectomy. The main advantage of this incision is that it does not damage any nerve and being muscle splitting it heals quickly. Inadvertently the sub costal nerve may be injured giving rise to inguinal hernias but this is very rare.

The incision is perpendicular to the right spino-umbilical line which extends from the right anterior superior iliac spine to the umbilicus through the Mc Burney's point. It measures about 3 to 4 inches in length, whose 1/3rd will be above the spino-umbilical line and 2/3rd below the same line. Though this is the classical position of Mc Burney's grid iron incision, yet the surgeon

should to try to feel the caecum first before planning the position of the incision, as sometime the caecum with appendix may lie higher up or even sub hepatic.

The skin, fascia of Camper and fascia of Scarpa are incised along the line of the incision. The fibers of the external oblique aponeurosis will be seen running along the line of the incision. They are simply split. If the incision made higher up or a little laterally, one will be able to see the fleshy fibers of the muscle. The two margins of the divided aponeurosis are retracted. The muscle fibers of the internal oblique will be seen running perpendicular to the line of the incision. These fibers and the muscle fibers of the transverse abdominis are more or less running in the same direction and should be split by inserting the tip of the artery forceps. The fingers are then introduced and the muscle fibers are retracted. The fingers are replaced by right angle retractors to expose the transversalis fascia and the peritoneum. This is picked up by two artery forceps as one layer and incised to enter the peritoneal cavity.

- **LANZ'S TRANSEVERSE INCISION**

This is a small transverse incision put 1 inch medial and above the anterior superior iliac spine and extending up to the lateral border of the rectus sheath. Thereafter, the muscles are split as in grid-iron incision. The method has a definite cosmetic value, but extending the incision if necessary, proves difficult.

- **RUTHERFORD-MORRISON INCISION**

This is an oblique muscle-cutting incision with its lower end at McBurney's point and extending obliquely upwards and laterally as necessary. All layers are divided in the same line. This incision is useful if the appendix is para or retrocaecal and fixed.

- **RIGHT LOWER PARAMEDIAN INCISION**

Its chief advantage lays in the strong scar which results the incision is made parallel to the mid line a distance of 2-3 cms from it. The anterior rectus sheath is divided in the line of incision. Forceps are placed on the medial cut margins, which are retracted to expose the medial edge of the rectus muscle. The rectus is then displaced laterally to expose the posterior sheath. The posterior sheath is incised together with the transversals fascia and peritoneum.

The main advantages are that it gives good access to the pelvic organs in the female and if necessary, it can be readily extended upwards, to deal with a perforated duodenal ulcer or other unexpected intra-abdominal pathology. The disadvantage being the organ is often comparatively inaccessible to this approach

- **BATTLES'S PARA RECTAL INCISION**

This incision is mostly made on the lower abdomen over the lateral part of the rectus muscle. The skin and subcutaneous tissue are incised along the line of the incision the anterior rectus sheaths is also divided in the same line. The rectus muscle is retracted medially to expose the posterior rectus sheath in the upper part of the incision and fascia transversalis in the lower major part of the incision, where the posterior rectus sheath is absent below the arcuate line. These nerves should be retracted to get into the abdomen. But it may so happen that sacrifice of one or two nerves may be necessary this will cause some weakness of that segment of the rectus muscle supplied by the nerve.

This incision was previously used for appendicectomy and for unilateral gynecological

operations. But its popularity is on the wane as neither has it given proper access to the organs concerned nor it can be extended due to the presence of intercostals nerve. Closure is carried out in the same manner as that of the paramedian incision.

## TECHNIQUE OF APPENDICECTOMY

The caecum may present as soon as the peritoneum has been opened, or it may have to be sought for by two fingers introduced into the peritoneal cavity and passed backwards round the lateral wall. It is easily distinguishable from small bowel by the presence of taenia coli. The caecum is grasped in a moist pack by the left hand and is gently withdrawn towards its lower end, when the appendix should follow it in to the wound. Delivery of the appendix is assisted if necessary by the right index finger, which is introduced deeply into the lower part of the wound below the caecum. If the appendix cannot be readily found the operator should trace one of the taenia coli of the caecum leading to its base. The appendix is then freed by a finger passed along it towards its tip, any firm adhesions being gently disrupted. If dense adhesions are present these should be separated or divided under the guidance of the eye, and with the assistance of narrow bladed retractors. Sometimes as the result of previous inflammation the appendix is sharply kinked and is bound down by adventitious bands to the right iliac fossa or to the brim of the pelvis. Such bands can be divided with safety and without risk of causing hemorrhage if the knife is kept to the lateral side of the appendix.
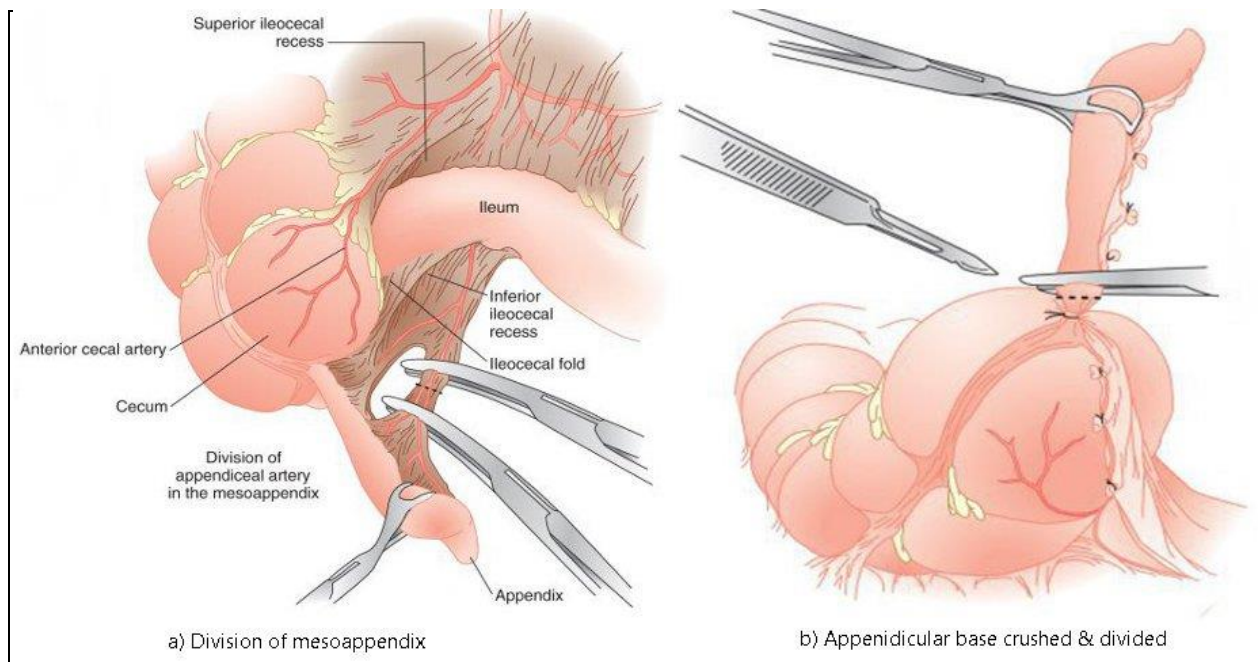
Figure 8a and 8b – Operative technique of appendicectomy
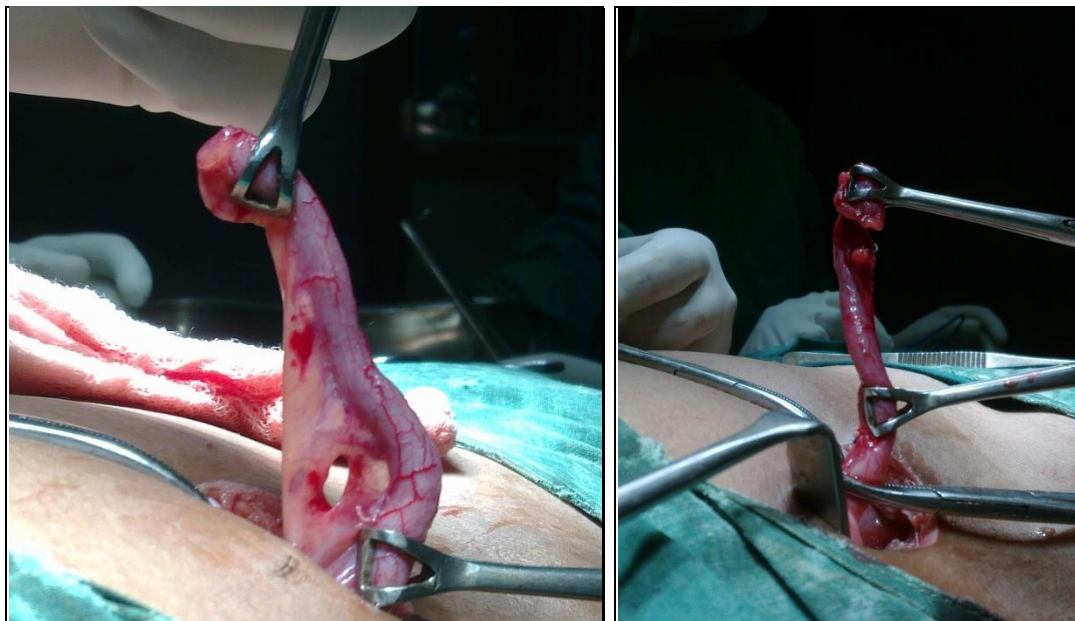


The part of the caecum to which the appendix is attached is retained outside the wound, while the remainder is returned to the peritoneal cavity. The appendix is raised up and is held taut by a pair of Babcock's forceps applied near its tip. The mesoappendix is clamped with one

or more pairs of artery forceps and the vascular arcade is divided between ligatures. The appendix is crushed about 3mm from the base of the appendix with a straight artery forceps and the forceps reapplied just distal to it (Figure 8a and 8b)

A purse string Lambert suture is placed in the caecal wall around the base of the appendix. A swab is placed underneath to absorb any escaping contents and the appendix is divided close to the forceps. The stump is invaginated with slender forceps while the purse string suture is tightened. The appendix together with the knife, swab and forceps which have been contaminated by contact with the mucosa are placed in a bowl and are removed from the field of operation.

Before the abdomen is closed the mesoappendix is re-examined for hemostasis. The parts within reach are inspected or palpated with particular attention being paid to the lower coils of the ileum and to the ileocaecal lymph glands. In the females the uterus, right ovary and tubes are palpated by two fingers passed downwards into the pelvis. The operation is completed by closure of the abdomen in layers.


**SPECIAL CIRCUMSTANCES**


- *The caecum cannot be found*

Caecum has not descended fully or malrotation of the intestine is present. An extension of the incision in an upward direction is indicated.


- *The appendix cannot be found*

Make certain that the caecum has been delivered and then trace one of the taenia coli

downwards; this must lead to the appendix. The appendix may be buried in the caecal wall or has become inverted or intussussepted.

- *The appendix lies buried retrocaecally*

The wound has to be enlarged. The caecum is retracted to the right. Once the reflection of the peritoneum on the lateral aspect of the caecum is visible, make a hockey-stick shaped incision on the parietal peritoneum. After blunt dissection in the retroperitoneal space, the caecum is made more mobile and can be retracted still further, bringing the previously hidden appendix into full view.

- *The appendix is clothed with adherent omentum*

Adherent omentum should not be disturbed; it should be divided between haemostats at a convenient distance from the appendix.

- *The base of the appendix is inflamed*

The base should not be crushed for fear of spreading infection by way of blood or lymph. It should be ligated close to the caecal wall, just tightly enough to occlude the lumen.

- *The base of the appendix is gangrenous*

Neither the appendix must be crushed nor should ligature be applied. Two stitches are placed through the caecal wall close to the gangrenous base of the appendix, which is amputated flush with caecal wall, after which these stitches are tied. Further closure is affected by means of a second layer of interrupted seromuscular suture.

- *The appendix has sloughed off*

The mesoappendix anchors the organ in the field of operation.  It may however be in 2 portions if a faecolith has perforated through the wall.  In such a case both portions must be removed and the faecolith retrieved usually from the pelvis.

- *The mesoappendix is gangrenous and cuts off*

If ligature does not hold, a stitch applied directly beneath a spurting vessel may stop bleeding.  If the artery has retracted, it must be sought behind the ileum.

- *The caecal wall is oedematous*

Invagination should not be attempted; the stump should be ligated and cut.

- *The appendix is lying against the mesentery and inflammation has implicated the latter*

It is highly important to observe the ileum in the immediate neighbourhood of the affected portion of mesentery.  If the intestine is devitalized, it is necessary and wise to resect the affected segment.

**RETROGRADE REMOVAL OF APPENDIX**

Frequently the base of the appendix is more accessible than the tip.  This is especially likely to occur when the appendix occupies the retrocaecal position when its inflamed distal end may be adherent to the posterior wall of the caecum or may even be buried within the serous port. In such cases the retrograde method of removal may often simplify the surgery. Two pairs

of artery forceps are insinuated through the mesoappendix are applied to the base of the appendix 5-6mm apart. The proximal forceps is removed and the appendix is ligated in the groove that has been crushed. It is then divided close to the distal forceps and the proximal stump is invaginated. The appendix with its cut end still occluded by the forceps is now freed by careful dissection and by successive clamping and clipping of its mesentery from base to tip it is removed.

## STUMPLESS APPENDICECTOMY [65]

Stumpless appendicectomy was performed in more than 400 cases between 1982 and 1986. Of these only 250 cases would be followed up, of these 205 patients underwent an elective procedure and the rest 45 an emergency appendicectomy.

In 220 cases a standard Mc Burney's incision was made, 20 patients had a Rutherford Morrison's incision, were as the rest 10 patients underwent a laparotomy.

After inspection and palpation of the caecum, the appendix was identified and delivered into the wound. The mesoappendix was ligated and a tiny vessel on the mesenteric side of the caecum was under-run. All vascular ligatures were made with 3-0 linen. An intestinal clamp was applied over the delivered and emptied caecum about 0.5cm proximal to the base of the appendix. A straight artery forceps was then applied over the base of the appendix, flush to the caecum and with a knife the appendix was cut flush to the artery forceps. Subsequent rent of the caecum was cleaned with wet sponge and sprit, carefully preventing any spillage and the contamination of the surrounding structures. The caecal rent was closed in two layers using 4-0 or 5-0 polyglactin-910 continuous interlocking sutures. The surrounding fat or omentum, when available was over swan on the suture line. After thorough cleaning, the caecum and the intestine were gently put back.

# LAPAROSCOPIC APPENDICECTOMY [66]

The most valuable aspect of laparoscopic in the management of suspected appendicitis is as a diagnostic tool, particularly in women of child-bearing age.

Essential equipments for Laparoscopic Appendicectomy

Instruments for visualisation

- Light source

- Telescope

- Video camera system

- Beam splitter

- Monitor

- Video recorder

- Video printer

Instruments for exposure and manipulation

- Insufflator

- Puncture instruments

- Grasping and dissecting instruments

- Occlusion and ligation instruments

- Electro surgical unit. Laser equipment is unnecessary

- Irrigation and suction instruments

- Wound closure instruments

- Laparotomy instruments

**PREPARATION OF THE PATIENT**

Under the circumstances it is mandatory that the patient be totally prepared mentally and physically for the procedure. The steps of the laparoscopic procedure are explained to the patient. It is at all times impressed that patients safety and the necessity of carrying out a complete and a through procedure may be terminated at any phase and converted into a open surgery it is made clear that open surgery if require would be done during the same anesthesia. Specific informed consent must be taken. A fully informed patients confidence acceptance and cooperation and vital for the smooth conduct of the procedure.

The preoperative evaluation of the patient is identical to that for open appendicectomy. As every case is done under general anesthesia the routine evaluation of the patient for fitness for anesthesia is carried out.

**TECHNIQUE OF LAPAROSCOPIC APPENDICECTOMY**

Laparoscopic appendectomy is performed under general anesthesia. Laparoscopic appendectomy usually requires the use of three ports. Four ports may occasionally be necessary to mobilize a retrocecal appendix. The surgeon usually stands to the patient's left. One assistant is required to operate the camera. One trocar is placed in the umbilicus (10 mm), and a second trocar is placed in the suprapubic position. Some surgeons place this second port in the left lower quadrant. The suprapubic trocar is either 10 or 12 mm, depending on whether or not a linear stapler will be used. The placement of the third trocar (5 mm) is variable and usually is either in the left lower quadrant, epigastrium, or right upper quadrant. Placement is based on location of the appendix and surgeon preference.

The most important single step in the safe an efficient conduct of any laparoscopic

procedure is the creation of an adequate generalized pneumoperitoneum. The pneumoperitoneum is created with help of a spring-loaded Veres needle. A stab incision is made in the infraumblical region and the Veres needle is inserted. Once it is established that the needle tip is in the free peritoneal cavity, it is connected to the electronic pneumo-insufflator and carbon dioxide insufflations is commenced at a flow rate of one liter per minute.

The appendix is identified by following the anterior taeniae to its base. Dissection at the base of the appendix enables the surgeon to create a window between the mesentery and the base of the appendix. The mesentery and base of the appendix are then secured and divided separately. The appendix is divided with a linear stapler after the mesoappendix is divided immediately adjacent to the appendix with clips, electrocautery, Harmonic Scalpel, or staples. The base of the appendix is not inverted. The appendix is removed from the abdominal cavity through a trocar site or within a retrieval bag. The base of the appendix and the mesoappendix should be evaluated for hemostasis. The right lower quadrant should be irrigated. Trocars are removed under direct vision.
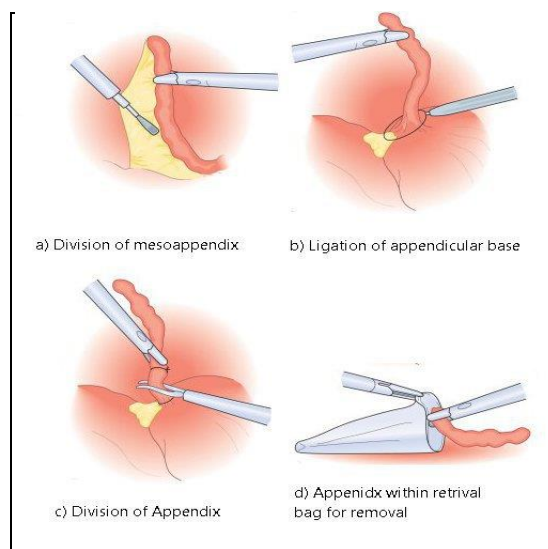


Figure 9 – Laparoscopic Appendicectomy

**POST-OPERATIVE MANAGEMENT**

- Oral feeds are withheld till the bowel sounds return and flatus is passed.

- I V fluids and electrolytes are given till oral feeds are allowed.

- Broad spectrum antibiotics are given to cover against mixed intestinal flora, till culture report of the peritoneal exudate is obtained.

- TPR chart is maintained.

- Analgesics and sedatives.

- Drain if placed in the peritoneal cavity, is removed by 24-48 hrs.

- Sutures removed by 7-10 days.

**APPENDICULAR ABSCESS**

Two types of appendicular abscess have been described

- RECENT ABSCESS - Immediate or early operation with or without appendicectomy is the treatment of choice for recent abscess and the mobile appencicular mass.

- ESTABLISHED ABSCESS - Abscess walled off from surrounding structures, or an abscess resolving with antibiotics

Conservative management is contra-indicated in children, pregnant women and the elderly. Drainage is to be done as soon as the patient is fit.

In infants, appendicectomy should always be done with drainage.  In adults, appendicectomy

should be done without breaking the walling off adhesions. If not done at the time of drainage, interval appendicectomy should be done 6-8 weeks later. Systemic antibiotic coverage should be given.

**TECHNIQUE OF DRAINAGE**

PRECAECAL, PRE-ILEAL AND POST ILEAL ABSCESS

- Relevant anaesthesia is administered

- Swelling located by palpation

- Incision made over the most prominent part

- Transperitoneal approach

- Index finger is inserted into the wound, abscess wall opened, pus drained

- If appendix readily comes to the finger, it is excised

- Drain placed and wound closed

- Drain is left undisturbed for 72 hrs

- After this time, it is rotated and shortened daily

- Removed by the end of 1 week, if there is no further discharge

RETROCAECAL ABSCESS

- Drained by retroperitoneal approach

- Transverse incision immediately medial to ASIS

- Lateral edge of peritoneum exposed and medially stripped with finger

- Mass can thus be reached

- After drainage, further course similar as in other abscess

PELVIC ABSCESS

- Felt on rectal examination

- If pointing through proctoscope, drained with artery forceps

- Rubber tube drain is kept in the cavity

- If pointing through vagina, posterior colpotomy done

**APPENDICULAR MASS**

If an appendix mass is present and the condition of the patient is satisfactory, the standard treatment is conservative Ochsner-Sherren regimen. This strategy is based on the premise that the inflammatory process is already localised and that inadvertent surgery is difficult and may be dangerous. It may be impossible to find the appendix and occasionally, a faecal fistula may form and for these reasons it is wise to observe a non-operative programme but to be prepared to operate should clinical deterioration occurs.

**OSCHNER AND SHERREN REGIMEN**

Clinical history of the patient with particular note made of the time of onset of symptoms and diagrammatic recording of physical signs.

- A chart with temperature, pulse and respiratory rate is maintained.

- Patient is kept nil orally, parenteral fluids and electrolyte supplementation given.

- Nasogastric aspiration is instituted to keep the stomach empty.

- Broad spectrum antibiotic is started

- Sedation is withheld

- If bowels do not act normally by 4th or 5th day, a glycerine suppository may be given

**CRITERIA FOR ABANDONING THE REGIMEN**

- Rising pulse rate in the early stages

- Persistent fever over 36 hrs

- Copious gastric aspirate, or persistent vomiting

- Persistent pain, Increasing or spreading abdominal tenderness

- Increase in the size of the abscess

- Fluctuation, oedema, redness of skin

- Unrelenting intestinal obstruction

**CONTRAINDICATIONS TO CONSERVATIVE MANAGEMENT**

- When diagnosis of acute appendicitis  is in doubt and other acute abdominal conditions requiring emergency surgical intervention cannot be ruled out

- The signs of inflammation are still confined to the appendix

- Age of patient <10 yrs or >65 yrs

- Pregnant women

Oschner and Sherren suggested that interval appendicectomy should be done after 3 months. But present consensus is that operation should be performed as soon as possible, after complete resolution of mass has been achieved.   Today, owing to use of antibiotics and other

supplementary medication, the general opinion is that appendix should be removed as soon as the patient can be prepared adequately.

## COMPLICATIONS OF APPENDICECTOMY

Post operative complications following appendecectomy are relatively uncommon and reflect the degree of peritonitis that was present at the time of operation and intercurrent diseases that may predispose to complications.

EARLY COMPLICATIONS

- Haemmorhage
- Diffuse peritonitis
- Pulmonary complications
- Neurogenic or adhesive ileus
- Retention of urine

INTERMEDIATE COMPLICATIONS

- Secondary or residual abscess
  - Pelvic
  - Paraceacal
  - Perinephric
  - Subdiaphragmatic
- Wound infection: the commonest, especially in a complicated appendicitis

- Pyelophlebitis

- Femoral or Iliac vein thrombosis

- Parotitis

- Persistent sinus or fistula

- Rupture of caecal wall

LATE COMPLICATIONS

- Incisional hernia

- Right sided indirect inguinal hernia

- Intestinal obstruction

## PROGNOSIS

Simple appendicectomy in uncomplicated acute appendicitis still carries a mortality rate approaching 0.2%. Regardless of the phase of the disease, the overall mortality of the primary appendicectomy is appreciably under 1%. The average hospital stay approximates 3 days for Simple appendicectomy. But complications of gangrene and perforation extend the average stay to 7 days.

Anaesthesia, age, infirmity and associated disease influence the outcome with respect to both morbidity and mortality.

Improved surgical techniques, antimicrobials, nasogastric intubation and decompression, pre and post operative fluid and electrolyte replacement, and the application of supportive aids in recovery and intensive care units have contributed appreciably to the reduction in morbidity and mortality from the complications inherent in delayed diagnosis.

# METHODOLOGY

# METHODOLOGY

**SOURCE OF DATA**

100 consecutive patients presenting to the Department of Surgery at R. L. Jalappa Hospital and Research centre with right iliac fossa pain during the time period of November 2009 to December 2010 were included in the study.

This is a randomized study comprising of 100 patients of suspected acute appendicitis over a period of one year (i.e. from November 2009 to December 2010). The patients on admission with suspected acute appendicitis are evaluated on the basis of the modified Alvarado Scoring System.

INCLUSION CRITERIA

- All patients with right iliac fossa pain

EXCLUSION CRITERIA

- Patients with clinically urologic or gynaecological symptoms

A proforma was designed for the study of these cases. The cases were subjected to a detailed clinical examination and essential investigations viz. total white cell count and ultrasonography of abdomen.

**MODIFIED ALVARADO SCORE**

Several diagnostic tools and scoring systems have been developed and been characterized as understandable, non invasive and cost effective. The Alvarado scoring system is one of them and is purely based on history, clinical examination and a few laboratory tests and is very easy to apply. The Alvarado score was first described in 1988 by Alfredo Alvarado as a practical score for the early diagnosis of acute appendicitis that can be instituted easily in the outpatient setting. The Alvarado score was modified by Kalan et al by excluding one laboratory finding – shift to left of neutrophil maturation i.e., score 1, as this is not routinely available and therefore, patients were scored out of 9 instead of 10 (Table -2).

Table 2 - **THE MODIFIED ALVARDO SCORING SYSTEM**

| PARAMETERS | MANIFESTATIONS | VALUE |
|---|---|---|
| SYMPTOMS | Migratory pain | 1 |
| | Anorexia | 1 |
| | Nausea/Vomiting | 1 |
| SIGNS | RIF* tenderness | 2 |
| | Rebound tenderness | 1 |
| LABORATORY VALUES | Elevated temperature | 1 |
| | Leukocytosis | 2 |
| TOTAL SCORE | | 9 |

**\***RIF – Right Iliac Fossa

Patients with score of 1 - 4 are not considered likely to have acute appendicitis. Those with score of 5 - 6 probably have and those with score of 7 - 9 are considered to have definitive diagnosis (Table – 3). The Alvarado score can increase or decrease on reassessment.

Table 3 - **MANAGEMENT PLAN**

| SCORE | MANAGEMENT PLAN |
|-------|-----------------|
| 1 to 4 | No admission<br><br>Oral antibiotics<br><br>To report back if symptoms aggravate |
| 5 to 6 | Admission<br><br>Parenteral antibiotics<br><br>Repeat Alvarado score at 12, 24 and 48 hours – if suggestive of acute appendicitis - Surgery |
| 7 to 9 | Definite diagnosis<br><br>Surgery |

Ultrasound abdomen of the patients was performed and the ultrasonological findings were correlated with the score.

**USG CRITERIA OF ACUTE APPENDICITIS**

- Visualization of appendix

- Diameter>6mm

- Wall thickness> 3mm

- Complex mass (echo poor, asymmetric)

- Irregular asymmetry

- Loss of contour

- Free fluid

- Local adynamic ileus

- Graded tenderness over Mc Burney's point

Patients with score of 7 and > 7 are subjected to surgery. Operative and histopathological diagnoses of appendicitis are confirmed.

The cases subjected to emergency surgery are adequately prepared by parenteral fluids, electrolyte supplementation, and administration of broad spectrum antibiotics intravenously (usually combination of Ceftriaxone 1g 12th hourly + Metronidazole 500 mg 8th hourly).

Surgery was done under spinal anesthesia. Grid iron incision was employed in majority of the cases. Post operatively patients are kept nil orally, till bowel sounds returned; parenteral fluid, electrolytes, antibiotics and analgesics were continued. Patients were monitored for any post operative complications and treated wherever needed. Post operatively sutures were removed on 7-9 days and the patients were discharged after histopathological confirmation.

# RESULTS

## RESULTS

A prospective study of 100 consecutive patients presenting with right iliac fossa pain was undertaken to evaluate the modified Alvarado score as a diagnostic indicator and its correlation to ultrasonography and histopathology.

**AGE AND SEX DISTRIBUTION**

### Table 4 - AGE and SEX DISTRIBUTION

| AGE GROUP | FEMALE | MALE |
|-----------|--------|------|
| 1 -10 | 4 | 1 |
| 11-20 | 9 | 18 |
| 21-30 | 17 | 20 |
| 31-40 | 6 | 11 |
| 41-50 | 2 | 6 |
| 51-60 | 1 | 3 |
| 61-70 | 0 | 1 |
| 71-80 | 0 | 1 |
| TOTAL | 39 | 61 |

## Graph 1 - **AGE & SEX DISTRIBUTION**

| Age group | FEMALE | MALE |
|-----------|--------|------|
| 1-10 | 4 | 1 |
| 11-20 | 9 | 18 |
| 21-30 | 17 | 20 |
| 31-40 | 6 | 11 |
| 41-50 | 2 | 6 |
| 51-60 | 1 | 3 |
| 61-70 | 0 | 1 |
| 71-80 | 0 | 1 |
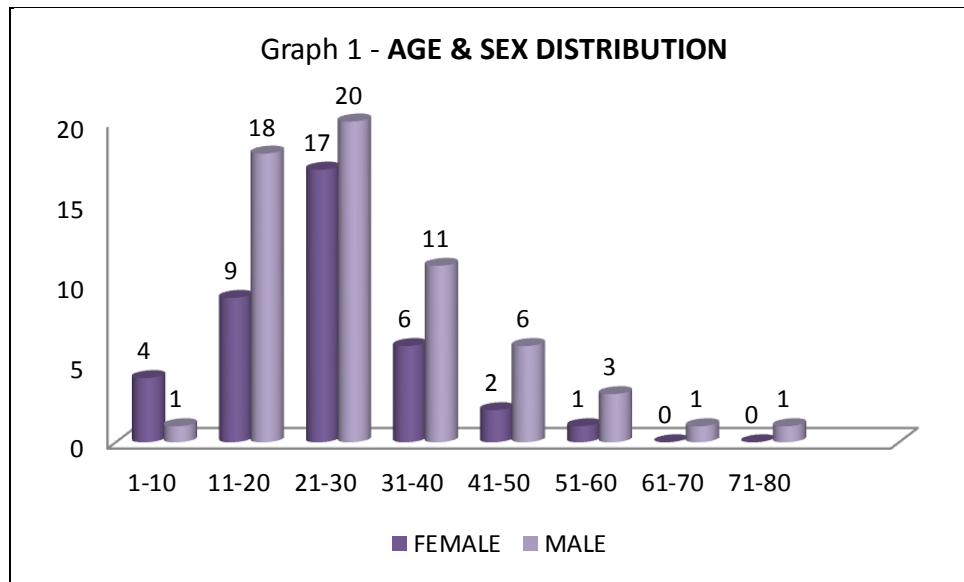
Acute appendicitis is more common in males than females. Boyd discussing acute appendicitis disease says it is more than twice as common in males as in females and attributes it to the fact that young males is more subject to strain and trauma and that their diet is usually richer in protein than that of the females.

In our series the male to female ratio was 61:39 i.e. 3:2

In Levis et al series of 1000 cases, the incidence of acute appendicitis was found to occur most commonly in the age group of 20-30 years in both males and females. The male to female ratio was 3:2.

In our series, the maximum incidence was found in the age group of 21 to 30 years followed by the 11 to 20 years age group.

## CLINICAL MANIFESTATIONS

Table 5 -**SYMPTOMS**

| SYMPTOMS | PERCENTAGE |
|---|---|
| Pain Abdomen | 100% |
| Anorexia | 73% |
| Nausea/Vomiting | 87% |
| Constipation | 16% |
| Diarrhea | 10% |
| Burning Micturation | 23% |

Pain was the commonest presenting symptom and had been observed in all the cases (100%) in the present series (Table 5). The classical shifting of pain from umbilical to right iliac fossa was present in 86% of cases. Other common symptoms observed were nausea and vomiting in 87% case, fever in 83% cases and anorexia 73%. Burning micturation was seen in 23% and bowel disturbance was seen in form of constipation (16%) and diarrhea (10%).

On clinical examination of the patient, tenderness at right Iliac fossa was present in all cases (Table 6). Rebound tenderness was present in 74%. Abdominal rigidity (15%) was due to perforated appendix or gangrenous appendicitis. Rovsing's sign was positive in 25%. Hyperaesthesia was present in 19% and 2% of cases had appendicular mass clinically.

Table 6 - **SIGNS**

| SIGNS | PERCENTAGE |
|---|---|
| RIF Tenderness | 100% |
| Rebound Tenderness | 74% |
| Guarding and Rigidity | 15% |
| Fever | 83% |
| Rovsing's sign | 25% |
| Hyperaesthesia at Sherren's triangle | 19% |
| Mass in RIF | 2% |

In the present study the total leucocyte count was increased in 77%, and it was within normal range in 23% of the cases (Table 7). In Pieper et al (1992) series, 66% had total count of 11,000 or more.[67]

Table 7 - **TOTAL LEUCOCYTE COUNT**

| TOTAL LEUCOCYTE COUNT | PERCENTAGE |
|---|---|
| <9000 | 24 |
| 9000-10000 | 04 |
| 10000-14000 | 37 |
| 14000-18000 | 29 |
| Above – 18000 | 06 |

Table 8 shows the incidence of the manifestations as per the modified Alvarado score with the most consistent feature being right iliac fossa tenderness (Graph 2).

Table 8 - **MANIFESTATIONS AS PER MODIFIED ALVARADO SCORE**

| MANIFESTATIONS | INCIDENCE |
|---|---|
| Migratory pain | 86% |
| Anorexia | 73% |
| Nausea/Vomiting | 87% |
| RIF Tenderness | 100% |
| Rebound Tenderness | 74% |
| Elevated Temperature | 83% |
| Leucocytosis | 76% |
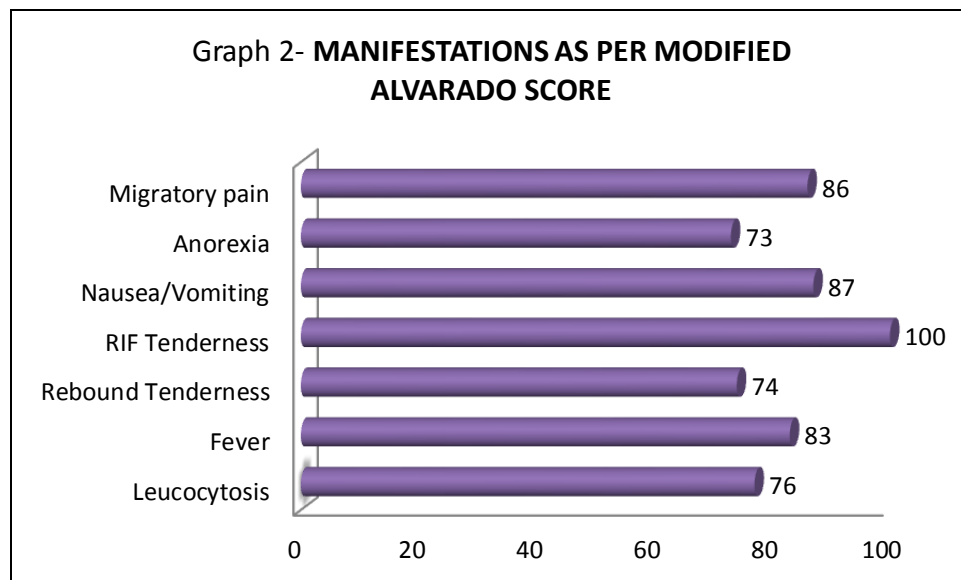
Graph 2- **MANIFESTATIONS AS PER MODIFIED ALVARADO SCORE**

| | |
|---|---|
| Migratory pain | 86 |
| Anorexia | 73 |
| Nausea/Vomiting | 87 |
| RIF Tenderness | 100 |
| Rebound Tenderness | 74 |
| Fever | 83 |
| Leucocytosis | 76 |

## ULTRASONOGRAPHY

All cases were subjected to ultrasonography and high frequency probe was used in some cases. Graded tenderness at the Mc Burney's point was the most common finding seen in 52 cases (Table 9). The appendix was visualized in 30 cases; 21 of who had acute appendicitis, 3 had appendicular mass and 6 had appendicular abscess. Two cases had mesenteric adenitis. The appendix was not visualized in both these cases. Two cases had right ureteric calculi while one other had a right VUJ calculus. Two cases had twisted right sided ovarian cysts. The ultrasound scan was found to be unremarkable in 10 cases.

Table 9 – **ULTRASONOGRAPHY FINDINGS**

| USG FINDINGS | NUMBER |
|---|---|
| Normal | 10 |
| Graded tenderness over Mc Burney's point | 52 |
| Acute Appendicitis | 21 |
| Appendicular mass | 3 |
| Appendicular Abscess | 6 |
| Mesenteric adenitis | 2 |
| Renal/Ureteric calculi | 4 |
| Ovarian Cysts | 2 |

## MODIFIED ALVARADO SCORE

The results of the modified Alvarado score were as shown in table 10 and 11.

Table 10 - **MODIFIED ALVARADO SCORES IN THE STUDY**

| MODIFIED ALVARADO SCORE | NUMBER OF CASES |
|:---:|:---:|
| 9 | 11 |
| 8 | 41 |
| 7 | 42 |
| 6 | 1 |
| 5 | 3 |
| 4 | 1 |
| 3 | 1 |

Table 11– **RANGE OF MODIFIED ALVARADO SCORE**

| MODIFIED ALVARADO SCORE - RANGE | No. of cases |
|:---:|:---:|
| >7 | 94 |
| 5 to 7 | 4 |
| <5 | 2 |

Of the 100 cases studied, 95 had a score of 7 and more. Out of the other 5 patients, 1 had a score of 6, 2 had a score of 5 and 1 each had a score of 4 and 3 respectively. The cases with a score of 5 or less were diagnosed by ultrasound with right ureteric calculus and were managed accordingly. One patient with a score of 5 had a right VUJ calculus.

Two cases with a score of 8 and 7 respectively were diagnosed as mesenteric lymphadenitis by ultrasonography and were managed conservatively. Both the cases responded to the treatment and improved within 24 hours.

One patient with a score of 6 was diagnosed as a right ovarian cyst. Another patient with a score of 7 was also diagnosed with a right ovarian cyst. Both these cases were then referred to the gynecologists for further intervention.

## MANAGEMENT

All the patients with a modified Alvarado score in excess of 7 were subjected to appendicectomy. A total of 94 patients underwent surgery. Cases diagnosed with mesenteric lymphadenitis by ultrasonography were managed conservatively despite having scores of 7 and 8 respectively. These cases were managed conservatively. Two patients diagnosed with a twisted ovarian cyst also underwent a laparotomy.

One patient who had a score of 5 was initially managed conservatively. A second assessment 24 hours later revealed clinical deterioration and an increase in the score from 5 to 8. The patient was then subjected to surgery which revealed acute appendicitis. This was confirmed by histopathological examination.

Table 12 – **INTRA-OPERATIVE FINDINGS**

| INTRA-OPERATIVE FINDINGS | NUMBER OF CASES |
|---|---|
| INFLAMED APPENDIX | 68 |
| APPENDICULAR MASS | 2 |
| GANGRENOUS APPENDIX | 1 |
| PERFORATED APPENDIX | 7 |
| APPENDICULAR ABCESS | 7 |
| NORMAL APPENDIX | 7 |
| TWISTED OVARIAN CYST | 2 |
| TOTAL | 94 |



Graph 3 - **INTRA-OPERATIVE FINDINGS**

Of the 94 patients who underwent surgery, 87 were explored through a grid-iron incision, 5 patients through a right para-median incision and the ovarian cyst patients through a lower midline vertical incision. The grid iron incision was extended whenever posed with difficulties and better exposure was needed.

At laparotomy 68 patients had an elongated, inflamed appendix. Appendicular mass was present in 2 patients, 1 had a gangrenous appendix, 7 had a perforated appendix with local peritonitis and 7 had an appendicular abscess. In 7 patients the appendix was found to be normal. Meckels diverticulum was not found in any of the patients. Both the cases with twisted ovarian cysts underwent ovariotomy.

The positions of the appendix at appendicectomy were as mentioned in Table 13 with retrocaecal being the most common accounting for 68.4% of the patients and 1 patient with a sub hepatic appendix was the least common position.

Table 13 - **INTRA-OPERATIVE POSITIONS OF THE APPENDIX**

| POSITION OF THE APPENDIX | NUMBER | PERCENTAGE |
|---|---|---|
| Retocaecal | 63 | 68.4% |
| Pelvic | 21 | 22.8% |
| Subcaecal | 5 | 5.4% |
| Preileal and post ileal | 2 | 2.1% |
| Others | 1 | 1%. |

The post operative complications seen in our study were wound infections and lower respiratory tract infections (Table 14). A few patients also had paralytic ileus post operatively.

103

Table **14 - POST OPERATIVE COMPLICATIONS**

| COMPLICATIONS | NUMBER |
|---|---|
| Wound Infection | 11 |
| LRTI | 4 |

**HISTOPATHOLOGY**

The specimen of the appendix was sent for histopathological examination in all the cases (Table 15, Graph 4). The histopathological examination confirmed the diagnosis of acute appendicitis in 69 cases. Necrotizing and gangrenous changes were seen in 6 and 8 cases respectively. The appendix was found to be normal in 7 cases.

Table 15 - **HISTOPATHOLOGY**

| HISTOPATHOLOGICAL FINDINGS | NUMBER |
|---|---|
| NORMAL | 7 |
| ACUTE APPENDICITIS | 69 |
| NECROTIZING APPENDICITIS | 6 |
| GANGRENOUS APPENDICITIS | 8 |

# Graph 4 -**HISTOPATHOLOGY**



Bar chart showing number of cases by histopathology category: NORMAL = 7, ACUTE APPENDICITIS = 69, NECROTIZING APPENDICITIS = 6, GANGRENOUS APPENDICITIS = 8.

Legend: ■ NUMBER OF CASES
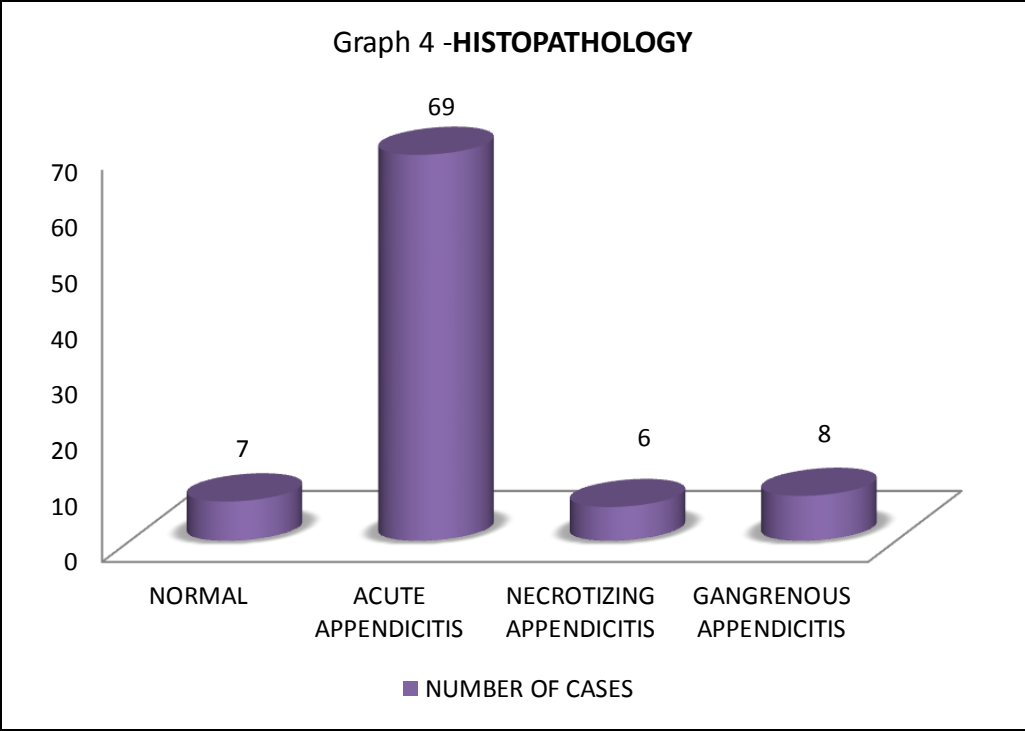
# STATISTICAL ANALYSIS

# STATISTICAL ANALYSIS

The statistical analysis was done to determine the sensitivity and specificity of the modified Alvarado score and ultrasonography. The positive and negative predictive values were also calculated. The histopathological examination was considered confirmatory of the diagnosis. Both the variables of the score and ultrasonography were compared with histopathology and the results were obtained.

Table 16 - **STATISTICAL ANALYSIS METHOD**

|          | DISEASE + | DISEASE - | TOTAL |
|----------|-----------|-----------|-------|
| TEST +   | TP        | FP        |       |
| TEST -   | FN        | TN        |       |
| TOTAL    |           |           |       |

**SENSITIVITY – TP/TP+FN**

**SPECIFICITY – TN/TN+FP**

**POSITIVE PREDICTIVE VALUE – TP/TP+FP**

**NEGATIVE PREDICTIVE VALUE – TN/TN+FN**

Table 17 - **STATISTICAL ANALYSIS – MODIFIED ALVARADO SCORE**

|  | HPR + | HPR - | TOTAL |
|---|---|---|---|
| MAS + | 84 | 10 | 94 |
| MAS - | 1 | 5 | 6 |
| TOTAL | 85 | 15 | 100 |

SENSITIVITY - 98.8%

SPECIFICITY - 33.3%

POSITIVE PREDICTIVE VALUE – 89.3%

NEGATIVE PREDICTIVE VALUE – 83.3%

Table 18 - **STATISTICAL ANALYSIS – ULTRASONOGRAPHY**

|  | HPR + | HPR - | TOTAL |
|---|---|---|---|
| USG + | 75 | 7 | 82 |
| USG - | 10 | 8 | 18 |
| TOTAL | 85 | 15 | 100 |

SENSITIVITY -88.2%

SPECIFICITY – 53.3%

POSITIVE PREDICTIVE VALUE – 91.4%

NEGATIVE PREDICTIVE VALUE – 44.4%

# DISCUSSION

## DISCUSSION

A prospective study of 100 consecutive patients presenting with right iliac fossa pain to the department of general surgery at R. L. Jalappa hospital and research centre, Tamaka, Kolar, was undertaken to evaluate the modified Alvarado score as a diagnostic indicator and its correlation to ultrasonography and histopathology.

Acute appendicitis remains a common abdominal emergency throughout the world. Despite the advances in the diagnostic field, the diagnosis of acute appendicitis remains an enigma for the attendant surgeon. None of the investigations like USG, CT, MRI can give a confirmatory diagnosis of acute appendicitis.

It has been proved that most of the aforementioned investigations are costly, time consuming, requiring more specialized and expert services, while some are not feasible and not available everywhere (Hoffmann; Rasmussen.1989).[68]

So a thorough clinical examination with basic investigations is one of the best diagnostic tools for acute appendicitis. With this background many eminent surgeons and physicians have been adopting different scoring systems in order to decrease negative appendicectomy rates (Fenyo.G. 1987; Arnbjornsson E. 1985; Teicher et al, 1983).[69]

We find the Alvarado score (Alvarado A. 1986) which was modified by Kalan et al 1994 very valuable for routine use in clinical practice. The modified Alvarado score is simple to use and easy to apply, since it relies only on history, clinical examination and a basic laboratory investigation.

The present study was undertaken to evaluate the usefulness of modified Alvarado scoring system in diagnosing acute appendicitis and reducing the number of negative

appendicectomy and to correlate it with ultrasonography and histopathology.

**AGE AND SEX DISTRIBUTION**

It is a well established fact that acute appendicitis is more common in males than females. It has been attributed to the fact that young males is more subject to strain and trauma and that their diet is usually richer in protein than that of the females. In our series the male to female ratio was 3:2. We had 61 male patients and 39 female patients in our study.

In our series, the maximum incidence of acute appendicitis was found in the age group of 21 to 30 years followed by the 11 to 20 years age group. This was comparable to the Levis et al series of 1000 cases and other similar studies (Table 19).

Table 19 – **SEX DISTRIBUTION IN VARIOUS STUDIES**

| NAME OF THE STUDY | M:F |
|---|---|
| Levis et al | 3: 2 |
| P. Ronan 'O' connel et al | 3: 2 |
| Addis DG et al | 1.3 : 1 |
| Blab E et al | 3: 2 |
| Present Study | 61:39 = 3:2 |

**CLINICAL MANIFESTATIONS**

Pain was the commonest presenting symptom and had been observed in all the cases (100%) in the present series (Table 5). The classical shifting of pain from umbilical to right iliac fossa was present in 86% of cases. Other common symptoms observed were nausea and vomiting in 87% case, fever in 83% cases and anorexia 73%. Burning micturation was seen in 23% and bowel disturbance was seen in form of constipation (16%) and diarrhea (10%).

Majority of the patients had aching type of pain and some had colicky pain. Vomiting occurred initially with one or two bouts with or without nausea. Vomiting appeared after the onset of pain. Fever was of low grade with corresponding rise in the pulse rate. Majority of the patients presented within 24 hours after the onset of pain, most of them presenting between 12-24 hours after onset of pain.

On clinical examination of the patient, tenderness at right iliac fossa was present in all cases (Table 6). Rebound tenderness was present in 74%. In these cases, there was presence of local peritoneal involvement or when inflamed appendix was more anteriorly placed. Abdominal rigidity (15%) was due to perforated appendix or gangrenous appendicitis. Rovsing's sign was positive in 25%. This sign is often positive whenever inflammation is present in right iliac fossa. Hyperaesthesia was present in 19% and 2% of cases had appendicular mass clinically.

In the present study the total leucocyte count was increased in 77%, and it was within normal range in 23% of the cases (Table 7). In Pieper et al (1992) series, 66% had total count of 11,000 or more.[67]

The value of white cell count in the diagnosis of acute appendicitis is disputed though

there is a definite relationship between the severity of the disease on the one hand and leucocytosis on the other hand (Kazarian et al 1970). The low leucocyte can also be attributed to the prior antibiotic therapy which some patients received either as over the counter basis or by their family physicians before presenting to our care.

## MODIFIED ALVARDO SCORE

Of the 100 cases studied, 95 had a score of 7 and more. Out of the other 5 patients, 1 had a score of 6, 2 had a score of 5 and 1 each had a score of 4 and 3 respectively (Table 9 and 10). The cases with a score of 5 or less were diagnosed by ultrasound with right ureteric calculus and were managed accordingly. One patient with a score of 5 had a right VUJ calculus.

All the patients with a modified Alvarado score in excess of 7 were subjected to appendicectomy. A total of 94 patients underwent surgery.

Two cases with a score of 8 and 7 respectively were diagnosed as mesenteric lymphadenitis by ultrasonography and were managed conservatively. These cases responded well to the antibiotic therapy and symptomatic improvement was seen in both the cases. These cases represent 2 of the 10 the false positives.

One patient with a score of 6 was diagnosed as a right ovarian cyst. Another patient with a score of 7 was also diagnosed with a right ovarian cyst. Both these cases were then referred to the gynecologists for further intervention. Both these patients diagnosed with a twisted ovarian cyst also underwent a laparotomy.

One patient who had a score of 5 was initially managed conservatively. A second assessment 24 hours later revealed clinical deterioration and an increase in the score from 5 to 8. The patient was then subjected to surgery which revealed acute appendicitis. This was confirmed by histopathological examination. This case represents the false negative.

A total of 94 patients had MAS of 7 or more. Histopathological examination confirmed the diagnosis in 84 of these patients. Among the remaining 10 patients, 2 patients had mesenteric lymphadenitis that was managed conservatively. One patient had a twisted ovarian cyst with MAS of 7. She underwent exploratory laparotomy and ovariotomy. Histopathological examination was normal in 7 patients. One patient who had a score of 5 was initially managed conservatively. A second assessment 24 hours later revealed clinical deterioration and an increase in the score from 5 to 8. The patient was then subjected to surgery which revealed acute appendicitis. This was confirmed by histopathological examination.

Statistical analysis revealed a sensitivity of 98.8% and a specificity of 33.3%. The high sensitivity suggests that the scoring system is very effective in diagnosing acute appendicitis when the scores are above 7. A specificity of 33.3% suggests that although the score may be helpful in diagnosing acute appendicitis it may not help to diagnose other conditions that may mimic acute appendicitis. These results were comparable to other studies done both in India and internationally.

Table 20 - Statistical Results of MAS in other studies

| STUDY | SENSITIVITY | SPECIFICITY |
|---|---|---|
| Nautiyal H et al[72] | 93 | 40 |
| Baidya et al[70] | 85 | 27 |
| Present study | 98.8 | 33 |

**ULTRASONOGRAPHY**

All cases were subjected to ultrasonography and high frequency probe was used in some cases. Graded tenderness at the Mc Burney's point was the most common finding seen in 52 cases (Table 9). The appendix was visualized in 30 cases; 21 of who had acute appendicitis, 3 had appendicular mass and 6 had appendicular abscess. Two cases had mesenteric adenitis. The appendix was not visualized in both these cases. Two cases had right ureteric calculi while one other had a right VUJ calculus. Two cases had twisted right sided ovarian cysts. The ultrasound scan was found to be unremarkable in 10 cases. These statistics were comparable to other Indian and international studies (Table 21).

Table 21– Visualization of normal appendix

| STUDY | PERCENTAGE |
|---|---|
| Bhattacharjee PK. et al[22] | 12.5 |
| Puylaert BCM et al[16] | 11 |
| Gallindo Gallego et al[20] | 12 |
| Present study | 10 |

In 82 patients, ultrasonography was suggestive of appendicitis. Histopathological examination confirmed the diagnosis in 75 of these patients and was normal in 7 patients. Among the remaining 18 patients, 3 patients had right ureteric calculi, 1 patient had a right VUJ calculus, 2 patients had mesenteric lymphadenitis and 2 patients had a twisted ovarian cyst. In 10 patients ultrasonography revealed a normal study.

The patients with urologic manifestations were referred to the urologist for further management. The 2 cases with mesenteric lymphadenitis were managed conservatively. The 2 cases diagnosed with ovarian cysts underwent exploratory laparotomy and ovariotomy. The 10 patients with a normal ultrasonography underwent surgery as their MAS warranted appendicectomy.

Histopathological examination was normal in 7 patients whose ultrasonography was suggestive of acute appendicitis.

Statistical analysis revealed a sensitivity of 88.8% and a specificity of 53.3%. The high sensitivity suggests that the scoring system is very effective in diagnosing acute appendicitis. Also a specificity of 53.3% suggests that ultrasonography is also useful in diagnosing other conditions which may clinically mimic acute appendicitis. These results were similar to those seen in other studies although the specificity in the present study was lower than that in other studies (Table 22).

Table 22 – Results of Ultrasonography in other studies

| STUDY | SENSITIVITY | SPECIFICITY |
|---|---|---|
| Nautiyal H et al[72] | 88 | 86 |
| Puylaert et al[16] | 100 | 89 |
| Gallindo Gallego et al[20] | 82 | 89 |
| Present study | 88.8 | 53.3 |

**OPERATIVE FINDINGS**

Of the 94 patients who underwent surgery, 87 were explored through a grid-iron incision, 5 patients through a right para-median incision and the ovarian cyst patients through a lower midline vertical incision. The grid iron incision was extended whenever posed with difficulties and better exposure was needed.

At laparotomy 68 patients had an elongated, inflamed appendix. Appendicular mass was present in 2 patients, 1 had a gangrenous appendix, 7 had a perforated appendix with local peritonitis and 7 had an appendicular abscess. In 7 patients the appendix was found to be normal. Meckel's diverticulum was not found in any of the patients. Both the cases with twisted ovarian cysts underwent ovariotomy.

Appendix was inflamed in68 of the 94 patients operated. Appendicular mass in two cases was dealt with careful dissection and appendicectomy. Omentectomy was done in one of these cases. In patients with a normal appendix at laparotomy, no other intra - abdominal pathology

was demonstrable. Appendicular perforations and abscesses were more common in perdiatric age group. This is important keeping in mind the shortness of omentum in children which can cause early perforation and peritonitis with its attendant morbidity and mortality.

**HISTOPATHOLOGY**

In the present series a total of 94 patients underwent surgery. Two of these patients underwent surgery for twisted ovarian cysts. Among the 92 patients who underwent surgery for acute appendicitis, histopathology confirmed the diagnosis in 85 cases, i.e. 92.4%. Histopathological examination was normal in 7 cases, i.e. 7.6%.

To prove accuracy of scoring, ultrasound sensitivity and specificity histopathological confirmation is needed.

Table 23 - **HISTOPATHOLOGY STATISTICS IN VARIOUS STUDIES**

| STUDY | PERCENTAGE |
|---|---|
| Bhatacharjeee et al | 82.7 |
| Sudhir Kumar Mohanty et al | 94.44 |
| George Mathews et al | 84.28 |
| Geryk B et al | 78.2 |
| Present Study | 92.4 |

**NEGATIVE APPENDICECTOMY RATE**

In the present series a total of 92 patients underwent appendicectomy. Histopathological examination was normal in 7 of these patients. A negative appendicectomy rate of 7.6% was observed. Hence we can conclude that the application of the modified Alvarado score has helped immensely in minimizing the rates of negative appendicectomy.

**COMPLICATIONS**

The higher rates of complications were predominantly seen at the extremes of ages. Pediatric and geriatric groups were more prone for appendicular perforation, abscess and mass formation. The incidence of post operative wound infections was higher in patients who had appendicular perforations or abscesses as compared to those patients who had acute appendicitis. Lower respiratory tract infections were more common in patients above the age of 50 years. Most of these patients had co-morbidities like COPD or diabetes mellitus.

In our present study, the usefulness of the scoring system was demonstrated beyond doubt by correctly diagnosing acute appendicitis and by reducing the number of negative laparotomies and their complications.

# CONCLUSION

# CONCLUSION

- The modified Alvarado scoring system is a good diagnostic indicator for acute appendicitis.

- It has a sensitivity of 98.8% in diagnosing acute appendicitis.

- It helps in reducing the number of negative appendicectomies.

- It can work effectively in routine practice as an adjunct to surgical decision-making in questionable acute appendicitis.

- It is effective in children and men but diagnostic laparoscopy is advised to minimize the unacceptably high false-positive rate in women.

- It is simple to use and easy to apply since it relies only on history, clinical examination and basic laboratory investigations.

- It is cost-effective and can be used in all set ups with basic laboratory facilities.

- Ultrasonography is also a sensitive investigation for diagnosing acute appendicitis. It also helps in diagnosing any other condition that may mimic acute appendicitis.

- It requires the presence of trained personnel and special equipment which is a disadvantage.

- It can be used as an adjunct in doubtful cases where diagnostic dilemma arises.

- When combined modified Alvarado score and ultrasonography can work very effectively in diagnosing acute appendicitis correctly and in reducing the number of negative appendicectomy.

# SUMMARY

# SUMMARY

A study of 100 cases who presented with pain in right iliac fossa was conducted at R L Jalappa hospital and research centre Tamaka, Kolar from November 2009 to December2010.

Acute appendicitis was more common in males than females and the highest incidence was seen in 2nd & 3rd decade of life.

The clinical manifestations included symptoms of pain in RIF, vomiting or nausea, anorexia, and signs of RIF tenderness, rebound tenderness, and rise in temperature. The patients were examined thoroughly. Total leucocyte count was done in all patients.
The patients were scored by the modified Alvarado scoring system.

All the patients underwent ultrasonography.

The patients were then managed as per the score. Patients with a score >7 were confirmed as acute appendicitis and underwent appendicectomy. A total of 94 patients underwent surgery.

Cases diagnosed with mesenteric lymphadenitis by ultrasonography were managed conservatively despite having scores of 7 & 8 respectively. Two patients diagnosed with a twisted ovarian cyst also underwent a laparotomy. One patient who had a score of 5 was initially managed conservatively. A second assessment 24 hours later revealed clinical deterioration & an increase in the score from 5 to 8. The patient was then subjected to surgery which revealed acute appendicitis. This was confirmed by histopathological examination.

The sensitivity of the modified Alvarado score was 98.8%. The negative appendicectomy rate was 7.6%.

Hence we can conclude that the application of the modified Alvarado score has helped immensely in minimizing the rates of negative appendicectomy.

Post operative complications of wound infection and LRTI were seen in 15 patients.

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# ANNEXURES

# CASE SHEET PROFORMA

NAME:                                          DATE OF ADMISSION:

AGE/SEX:                                       DATE OF SURGERY:

HOSPITAL NUMBER:                               DATE OF DISCHARGE:


PRESENTING COMPLAINTS

       PAIN ABDOMEN –

       FEVER –

       NAUSEA/VOMITING –

       ANOREXIA –

       OTHER COMPLAINTS –


HISTORY OF PRESENTING COMPLAINTS

       PAIN ABDOMEN – Duration

                  Onset and Progress

                  Site

                  Migration

                  Type of Pain

     FEVER – Duration

              Degree and Type

              Chills and Rigors


       VOMITING – Duration

Number of episodes

    OTHER COMPLAINTS

## PAST HISTORY

    H/O SIMILAR COMPLAINTS

    H/O DIABETES MELLITUS/ HYPERTENSION/ PULMONARY TB

    OTHER SIGNIFICANT HISTORY

## FAMILY HISTORY

## PERSONAL HISTORY

    DIET

    APPETITE

    BOWEL AND BLADDER

    SMOKING AND ALCOHOL CONSUMPTION

## GENERAL EXAMINATION

| | |
|---|---|
| PALLOR | GENERALISED LYMPHADENOPATHY |
| ICTERUS | EDEMA |
| CYANOSIS | CLUBBING |
| PULSE - | BLOOD PRESSURE -          mm of Hg |
| TEMPERATURE – | |

## ABDOMEN EXAMINATION

 INSPECTION

Shape

Umbilicus

Engorged Veins/ Visible pulsations/ Mass

Movement with Respiration

PALPATION

Mc Burney's Tenderness

Rebound Tenderness

Guarding/ Rigidity

Organomegaly

PERCUSSION


AUSCULTATION

Bowel Sounds

PER RECTAL EXAMINATION

RESPIRATORY SYSTEM

CARDIOVASCULAR SYSTEM

CENTRAL NERVOUS SYSTEM


**INVESTIGATIONS**

Haemoglobin

Total Leucocyte Count

Differential Count                     N                 L                 E                 M

ESR                                               PCV

RBS

Blood Urea                                    Serum Creatinine

Serum Na$^+$                                    Serum K$^+$

HIV                                    HBsAg

URINE EXAMINATION

Albumin        Sugar        WBC        Pus Cells


**ULTRASONOGRAPHY**

SIGNIFICANT FINDINGS


**IMPRESSION**


**MODIFIED ALVARADO SCORE**


**INTRAOPERATIVE FINDINGS**


**POST OPERATIVE RECOVERY**


**HISTOPATHOLOGY REPORT**

# KEY TO MASTER CHART

Inv      – Investigation
MAS    – Modified Alvarado Score
USG    – Ultrasonography
HPR    – Histopathological Report
M        – Male
F         – Female
AA      – Acute Appendicitis
AAb     – Appendicular Abscess
AP      – Appendicular Perforation
AM     – Appendicular Mass
PT      – Graded Probe Tenderness at Mc Burney's point
OC     – Ovarian Cyst
MA     – Mesenteric Adenitis
RC      – Renal/ Ureteric Calculi
N        – Normal
O        – Open Appendicectomy
L         – Laparoscopic Appendicectomy
L-O     – Laparoscopic converted to open surgery
GA     – Gangrenous Appendicitis
Nec     – Necrotising Appendicitis
LRTI   – Lower Respiratory Tract Infection
WI      – Wound Infection
R        - Recovered