"ONE YEAR RANDOMIZED CONTROLLED TRIAL COMPARING OPEN VERSUS LAPAROSCOPIC APPENDICECTOMY WITH RESPECT TO POST OPERATIVE PAIN"

By

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Under the Guidance of

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I hereby declare that this dissertation entitled **"ONE YEAR RANDOMIZED CONTROLLED TRIAL COMPARING OPEN VERSUS LAPAROSCOPIC APPENDICECTOMY WITH RESPECT TO POST OPERATIVE PAIN"** is a bonafide and genuine research work carried out by me under the guidance of **Dr. A. S. GOGATE** MS, Professor, Department of Surgery, Jawaharlal Nehru Medical College, Belgaum-590010.

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LIST OF ABBREVIATIONS USED

C	-	Centigrade.
Cm	-	Centimeter.
CT	-	Computed tomography.
Hg	-	Mercury
LA	-	Laparoscopic Appendicectomy.
Lt	-	Litre.
Min	-	Minute.
mL	-	Milliliter.
Mm	-	Millimeter.
OA	-	Open Appendicectomy.
SD	-	Standard Deviation
USG	-	Ultrasonography.
VAS	-	Visual Analog Scale.
W	-	Watt.
WBC	-	White blood cell count.

ABSTRACT

Background and objectives

Appendicitis is one of the most common condition requiring surgical intervention. Appendicectomy can be perfomed using either open or laparoscopic technique. Laparoscopic apendicectomy was first described in 1983. Though widely practiced LA has not gained universal approach. Controversy still continues about the advantage LA versus OA. The aim of this study is to compare OA and LA with respect to post operative pain and duration of hospital stay.

Methods

The present study was conducted in the Department of Surgery, KLES Dr. Prabhakar Kore Hospital and Medical Research Centre, Belgaum on patients presenting with appendicitis during the period of December 2007 to December 2008. 62 patients older than 16 years with diagnosis of appendicitis were randomized to either OA or LA group. Post operative pain and duration of hospital stay were analyzed.

Results

Sixty two patients were randomized with each group containing 31 patients. The average age of the patients in the study was 33.08 years old and ranged from 18 years to 60 years. The mean ages of patient undergoing OA and LA were 32.55 and 33.61 years respectively. Pain at various intervals of time post operatively (six-12-24-18-36 hours) measured using a visual analog scale was significantly less for patients treated laparoscopically ($p<0.0001$). The

hospital stay in LA was less compared to OA group (6.71 versus 7.74 days respectively).

Conclusions

Patients who underwent LA have a lesser post operative pain and shorter duration of hospital stay when compared with patients who underwent OA

Key word

Laparoscopic appendicectomy; Appendicectomy; Appendicitis.

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INTRODUCTION

Approximately seven percent of the population develop appendicitis in their life time[1] with peak incidence between the ages of 10 and 30 years[2] making appendicectomy the most frequently performed abdominal operation.[3]

Appendicectomy through McBurney's grid incision[4] remained the procedure of choice for nearly a century until 1983 when Semm Kurt[5] offered an alternative, laparoscopic appendicectomy (LA) since then LA as been compared to open appendicectomy (OA). But as McBurney's operation is well tolerated with less co-morbidity the benefits of LA have been difficult to establish.

The major benefits to patients undergoing LA are early hospital discharge, reduced postoperative pain, decreased wound infection, early return to full activity and a better cosmetic scar.[6,7] The unnecessary opening of the abdominal cavity and removal of normal appendix can be prevented by laparoscopy.[8] Laparoscopy also allows better assessment of other intra abdominal pathologies.

The limitations of LA are technical difficulty, non availability of equipment everywhere, longer duration of operation, higher expense and increased incidence of intra abdominal abscesses.[9] Due to the mentioned reasons LA has not yet gained wide spread acceptance.[10]

Laparoscopic appendicectomy is relatively a new technique and requires comparison to OA to determine its advantages. The objective of this study was to compare the out come of LA and OA in terms of post operative pain, duration of hospital stay.

OBJECTIVES

The objectives of the present study were;

Primary objective: To compare the post operative pain at various intervals of time that is six, twelve, eighteen, twenty four and thirty six hours post operatively.

Secondary objective: To compare the duration of hospital stay between OA and LA.

REVIEW OF LITERATURE

HISTORICAL BACKGROUND

That the appendix lay hidden in the right lower abdominal quadrant has been known for millennia, its function and role in disease however has remained obscure.

Egyptians 2000 years before the Christian era, noted the presence of the appendix during post-mortem preservation and referred to it as the "worm" of the bowel. The appendix, along with other viscera, was preserved during the ritual process of mummification.

The appendix vermiformis as an anatomical structure was first described in 1521 by Jacopo Berengario da Carpi, (CA 1470-1530) professor of anatomy at Bologna. In 1554 the French physician Jean Fernel (1497-1558) reported the first case of perforative appendicitis at autopsy.[11]

A classical post-mortem description is owed to Lorenz Heister (1683-1758) a professor of medicine and also a practicing surgeon at the Universities of Altdorf-Nürnberg and Helmstedt in Germany (1712). Heister was the first to study the pathology of appendicitis (1711).[12]

The 19th century pathological concept is based on the notion "perityphilitis", that is inflammation of the caecum (typhlon, blind). The caecum rather than the appendix was considered as the site of the disease. This is easily explained by advanced stages of inflammation which were observed in autopsies.

The condition now called ‘appendicitis’ became a surgical problem once it was obvious that the starting point of the disease was the appendix vermiformis. The first to clearly recognize this was Harvard University’s pathologist Reginald Heber Fitz (1843-1913) who communicated his finding at the first meeting of the Association of American Physicians in 1886.

In his paper, Fitz pointed out that the frequent abscesses in the right iliac fossa were not due to typhilitis, perityphilitis or epityphlitis but due to perforation of the vermiform appendix. Hence he gave the condition the name ‘appendicitis’ so as to avoid the possibility of misunderstanding and to localize the disease in its usual place of origin.[13]

Surgery for appendicitis

The first appendicectomy was performed at St. George’s Hospital, London, in 1736 by Claudius Amyand, a surgeon at St. George's Hospital in London and Sergeant Surgeon to Queen Ann, King George I, and King George II. The acutely inflamed appendix, perforated by a pin, and surrounding omentum was removed through a scrotal wound while dealing with a faecal fistula in a chronic scrotal hernia. The patient was 11 year old boy and patient recovered.[14]

The first surgical treatment for appendicitis or perityphlitis without abscess was made by Hancock in 1848. He incised the peritoneum and drained the right lower quadrant without removing the appendix.

The first published account of appendicectomy for appendicitis was by Krönlein in 1886. However, the patient died two days postoperatively.

Fergus, in Canada, performed the first elective appendicectomy in 1883.[15]

On May 4, 1901, Frederick Treves was knighted by King Edward VII, on whom he performed an appendicectomy in June 1902. The king desperately needed an appendix operation but strongly opposed going to hospital. 'I have a coronation on hand,' he protested. But Treves was adamant: 'It will be a funeral, if you don't have the operation.' Treves won, and the king lived. Treves found a large abscess, opened it, washed out the cavity and packed it with gauze. No attempt was made to find the appendix. The royal case history illustrates conservative, temporizing and primarily internal treatment of appendicitis with surgery as last resort when an abscess was clearly ascertained.[16]

Charles McBurney (1845-1913) was one of the surgeons pioneering the diagnostics and operative treatment of appendicitis. McBurney's classic report on early operative interference in cases of appendicitis was presented before the New York Surgical Society in 1889. In it he described the area of greatest abdominal pain in this disease process, now known as McBurney's point.

Five years later in 1894, he set forth in another paper the incision that he used in cases of appendicitis, now called McBurney's incision.[17]

However, McBurney later credited McArthur with first describing this incision.[17]

The US surgeon John Benjamin Murphy introduced and popularized early removal of the appendix in all cases of suspected appendicitis. In 1889 Murphy

established a pattern of early symptoms for appendicitis and strongly urged immediate removal of the appendix when this pattern appeared. Although Murphy's program first met with incredulity and derision from his colleagues, his more than 200 successful appendicectomies over the next several years provided ample evidence to make the operation common medical practice.[18]

Laparoscopy and appendicitis

Reducing the size of incisions has been a dream of surgeons for years. Hippocrates described a rectoscope in 400 BC.

Albukasim, an 11th century Arab doctor, developed a speculum illuminated by a set of light reflectors. These early systems had limited applications because the heat produced by candles and other artificial light sources was transmitted to the instruments and could result in burns.[21]

"I asked myself, how do organs react to the introduction of air? To find this out, I devised a method to use an endoscope on an unopened abdominal cavity (Koelioskopie) in the following way." George Kelling, of Dresden, coined the term "coelioskope" to describe the technique that used a cystoscope to examine the abdominal cavity of dogs.

Dr. Kelling reported these results at the German Biological and Medical Society Meeting in Hamburg, in September 1901.[20]

The first laparoscopy on a human was performed in 1911 by the Swedish doctor Hans Christian Jacobeus.

Von Ott inspected the abdominal cavity of a pregnant woman.[21]

In 1912, Nordentoff using the method identical to that of Kelling and Jacobaeus described viewing the female pelvis in a cadaver, which had been placed in deep Trendelenburg position.

In 1924, Zollikofer was the first to use carbon dioxide as the gas of choice for pneumoperitoneum.

In 1934, Ruddock used air for pneumoperitoneum and employed local anaesthesia. He designed a single puncture operating laparoscope and its accompanying instruments with which biopsies could be taken.

In 1938, Verres introduced a new type of pneumoperitoneum needle with a spring-loaded inner blunt probe surrounded by a sharp outer sleeve.[24]

In 1952, the endoscopic procedure was revolutionized by the introduction of "Gold Light Source" by Fourestier, Gladu Vulmiers of Germany a method of transmitting an intense light along a quartz rod. This removed danger of accidents due to electric faults and heat.

In the same year, the application of fibre optics to endoscopy by Hopkins and Kampany was described.

In 1972, the First International Congress on Gynaecological Laparoscopy took place in Las Vegas.

Up to the 1970s, laparoscopy was mainly used by gynaecologists and gastroenterologists for diagnostic purposes. Therapeutic laparoscopy was

introduced by gynaecologists in the early 1970s. Rapid technical advances in miniaturized surgical tools, fibre optics, and video systems enabled new developments in minimally invasive surgery. These methods greatly reduced post-operative complications so that laparoscopy and other types of minimally invasive surgery became widely used by surgeons around the world.[22]

In the young female the cause of lower abdominal pain is often of gynaecological origin. Gynaecologists perform diagnostic laparoscopy frequently.

On 13 September 1983 the gynaecologist Professor Kurt Semm performed the world's first laparoscopic appendicectomy at the University of Kiel in Germany.[23]

Increasing interest in laparoscopy among general surgeons developed only after the French gynaecologist Mouret performed in 1987 the first acknowledged laparoscopic cholecystectomy by means of four trocars.[24]

Götz et al[25] applied laparoscopic appendicectomy procedure in 1987. They pointed to the most important potential benefit, a lower incidence of long-term complications such as adhesive intestinal obstruction, which was reported to be high among patients with conventional appendicectomy and conventional abdominal surgery.[26]

Since then various studies have been conducted to compare LA and OA.

A prospective randomized trial conducted at Dublin, Ireland to compare OA and LA in patients with clinical diagnosis of acute appendicitis wherein 62

patients were randomized into OA (32) and LA (30) groups. The patients who underwent LA were discharged earlier (2.5 versus 3.8 days, $p<0.01$). Follow up showed less pain, shorter bed stay at home and faster return to work and sport after LA.[27]

137 patients with diagnosis of appendicitis were included in a RCT carried out in National University Hospital, Singapore . 52 underwent LA and 57 underwent OA. It was observed that the number of doses of pethidine required in the immediate post operative period did not differ between the two groups but the mean number of doses of oral analgesic was less in patients undergoing LA (2.8 versus 5, $p<0.05$). Patients who underwent LA returned to full home (17 versus 30 days, $p<0.01$) and social activities (19 versus 32 days, $p<0.05$) earlier than those who underwent OA.[28]

38 patients who underwent LA with 37 patients who underwent OA were compared during 12 month period in a study conducted in Texas. When compared with open, LA was associated with shorter duration of both parenteral and oral analgesia (two days versus 1.2 days and eight days versus 5.4 days, $p<0.05$). No statistical significant difference was noticed in terms of length of hospitalization, morbidity. [29]

In another study 81 patients who underwent LA were compared with 88 patients who underwent OA during nine months period. When compared with open, LA was associated with longer operative time (102.2 minutes versus 81.7 minutes, $p<0.01$), shorter duration of hospital stay (2.2 days versus 4.3 days,

p=0.007). However no difference was found in terms of return to activity or work.[30]

79 patients who underwent LA were compared with 72 patients who underwent OA in a prospective RCT conducted at University of Queensland, Australia. It was noticed that LA was associated with longer duration of operating time (63 minutes versus 40 minutes). The laparoscopic group required less narcotic analgesia and were able to tolerate solid diet at a median of 36 hrs compared to 48 hours for the open group. The median time of discharge was same in both the groups (three days) . Wound infection was two percent for LA group which was significantly less than 11% observed for open group.[31]

A prospective randomized trial in men with clinical diagnosis of acute appendicitis was conducted in South Australia. 64 patients were randomized into OA (31) and LA (33) groups. The mean postoperative hospital stay was significantly longer for OA (3.8±0.4 days) than for LA group (2.9 ± 0.3 days, p=0.045). The complication rate after OA did not differ with LA group.[32]

A metaanalysis of the randomized prospective studies was performed at New York Flushing hospital, USA. A total of 1,682 patients were analysed. The patients who underwent LA had less post operative pain, earlier resumption of solid foods, a shorter hospital stay and faster return to normal activities. LA was associated with increased incidence of intraabdominal abscess and longer operating time.[33]

A prospective randomized multicenter study of 500 patients was performed in Sweden. 244 patients underwent LA and 256 patients underwent

OA. Post operative pain (at 24 hours, seven days and 14 days) was less after LA compared to OA ($p<0.001$). Hospital stay and the complications did not differ between the groups. Operating time was significantly longer in laparoscopic group (60 versus 35 minutes, $p<0.01$).[34]

A prospective randomized unicenter study carried out at Poland included 200 patients. 96 patients underwent LA and 104 patients underwent OA over a period of 2 year. Post operative pain measured using a visual analog scale (at two and seven days) was less after LA compared to OA. The hospital stay in the both the groups did not differ significantly (5.03 days in OA and 4.71 days in LA). The time to return to work and social activities was significantly shorter in LA group. (15.85 days versus 19.65 days). [35]

A prospective randomized double blind study of 52 men presenting with signs and symptoms of acute appendicitis was carried out in 2001. Perceived post operative pain on day one and day seven were not statistically different between the two groups. The length of hospital stay averaged 21.5 hours in LA group and was not statistically different when compared to the open group.[36]

Comparison between OA and LA was done based on a large administrative database. 43,757 patients were included in the study. 7618 underwent LA and 36,139 OA. LA was associated with shorter median hospital stay (2.06 days versus 2.88 days for OA, $p<0.0001$), lower rate of infections ($p=0.02$). [37]

A randomized controlled trial of confirmed cases of appendicitis was done in Sweden. 163 patients were randomized into OA group and LA group. In

LA group the operating time was 55 minutes and in OA it was 60 minutes (p=0.416). The median hospital stay was two days in each group (p=0.192). No significant difference was seen between LA and OA in terms of time for full recovery. (Nine and 11 days respectively: p=0.225).[38]

A prospective randomized double blind study conducted at Los Angeles, California analysed 247 patients. Operating time was significantly longer in LA group (80 minutes versus 60 minutes, p=0.000). Post operatively both groups experienced similar severity of pain on post operative days one, two, three and two weeks. Narcotic medication usage to control post operative pain was also equivalent between two groups. No difference was noticed in resumption of diet, length of stay or activity scores.[39]

A study was conducted at Burdwan Medical College, Burdwan, West Bengal to compare LA with OA and ascertain the therapeutic benefit. 279 patients were analysed. 100 patients underwent LA and 179 patients underwent OA. The median length of hospital stay was significantly shorter after LA (three days after LA, five days after OA, p<0.0001) than OA. Operating time was shorter in patients undergoing OA (25 minutes versus 28 minutes for LA, p<0.050).[40]

A retrospective study was carried out at Queen Mary Hospital, Hong Kong to compare routine LA versus OA. 82 patients were included in the LA group and 119 patients were included in OA group. The median hospital stay for patients with LA and OA group were three days and four days respectively

(p=0.037). Post operative complication rates were comparable between the two groups (13.4% in LA group versus 15.8% in OA group).[41]

Another retrospective study was conducted at Baharain. 500 cases of LA were compared to 500 cases of OA over a period of one year. It was noticed that there was no difference the groups in terms of length of hospital stay and operative time.[42]

A prospective study comparing OA and LA was performed in Liaquat university hospital Hyderabad Pakistan. 100 patients were included in the study. Increased doses of analgesics, antibiotics and anti emetics were required in OA compared to LA. The mean post operative hospital stay in LA was 1.4 days whereas in OA was 3.5 days. [43]

A prospective study over a period of 21 months was conducted in India. 200 patients were included in the study. 114 underwent Open appendicectomy and 86 underwent laparoscopic appendicectomy. LA was better than OA with respect to early resumption of oral feeds, postoperative pain, lesser use of analgesics, postoperative hospital stay (3.13 days after LA, 4.36 days after OA, $p<0.0001$) and return to normal activities (LA group to OA group; 13.86 days to 19.44 days $p<0.0001$). [44]

Natural orifice transluminal endoscopic surgery is the newest technique emerging in the field of surgery. Various approaches for appendicectomy have been tried. Transgastric and trans vaginal routes have been tried.

Anatomy of vermiform appendix[45]

The vermiform appendix is a narrow, vermian (worm-shaped) tube which arises from the posteromedial caecal wall, two centimeter (cm) below the end of the ileum. It may occupy one of several positions.It may be retrocaecal, retrocolic (behind the caecum or lower ascending colon respectively), pelvic or descending (when it hangs dependently over the pelvic brim, in close relation to the right uterine tube and ovary in females). These are the commonest positions seen in clinical practice. Other positions are occasionally seen especially when there is a long appendix mesentery allowing greater mobility. These include subcaecal (below the caecum); preilial (anterior to the teminal ileum); postileal (behind the teminal ileum).

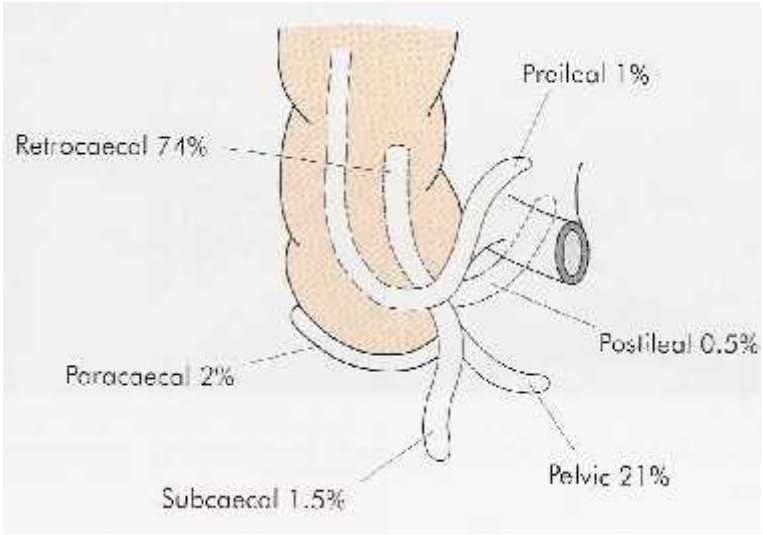


Figure 1: Various position of appendix

The three taeniae coli on the ascending colon and caecum converge on the base of the appendix, and merge into its longitudinal muscle. The anterior caecal

taenia is usually distinct and can be traced to the appendix, which affords a guide to its location in clinical practice.

The appendix varies from two to 20 cm in length. It is often relatively longer in children and may atrophy and shorten after mid-adult life. It is connected by a short mesoappendix to lie in lower part of the ileal mesentery. This fold is usually triangular, extending almost to the appendicular tip along the whole viscus.

The lumen of the appendix is small and opens into the caecum by an orifice lying below and slightly posterior to the ileocaecal opening. The orifice is sometimes guarded by a semilunar mucosal fold forming a valve. The lumen may be widely patent in early childhood and is often partially or wholly obliterated in the later decades of life. The appendix usually contains numerous patches of lymphoid tissue although these tend to decrease in size from early adulthood.

Vascular supply and lymphatic drainage

Appendicular artery

The main appendicular artery, a branch from the lower division of the ileocolic artery, runs behind the terminal ileum and enters the mesoappendix a short distance from the appendicular base. Here it gives off a recurrent branch, which anastomoses at the base of the appendix with a branch of the posterior caecal artery: the anastomosis is sometimes extensive. The main appendicular artery approaches the tip of the organ, at first near to, and then in the edge of, the mesoappendix. The terminal part of the artery lies on the wall of the appendix

and may be thrombosed in appendicitis, which results in distal gangrene or necrosis. Accessory arteries are common, and many individuals possess two or more arteries of supply.

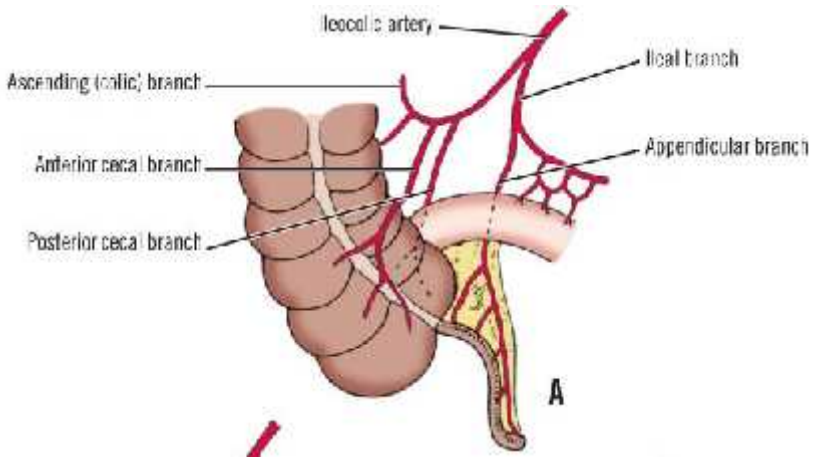


Figure 2: Blood supply of appendix

Appendicular veins

The appendix is drained via one or more appendicular veins into the posterior caecal or ileocolic vein and hence into the superior mesenteric vein.

Lymphatics

Lymphatic vessels in the appendix are numerous: there is abundant lymphoid tissue in its walls. From the body and apex of the appendix eight to 15 vessels ascend in the mesoappendix, and are occasionally interrupted by one or more nodes. They unite to form three or four larger vessels which run into the lymphatic vessels draining the ascending colon, and end in the inferior and superior nodes of the ileocolic chain.

Innervation

The appendix and overlying visceral peritoneum are innervated by sympathetic and parasympathetic nerves from the superior mesenteric plexus. Visceral afferent fibres carrying sensation of distension and pressure mediate the symptoms of pain felt during the initial stages of appendicular inflammation. In keeping with other structures derived from the midgut, these sensations are poorly localized initially, and referred to the central (periumbilical) region of the abdomen. It is not until parietal tissues adjacent to the appendix become involved in any inflammatory process that somatic nociceptors are stimulated, and there is an associated change in the nature and localization of pain.

Mesoappendix

The mesentery of the appendix is a triangular fold of peritoneum around the vermiform appendix. It is attached to the posterior surface of the lower end of the mesentery of the small intestine close to the ileocaecal junction. It usually reaches the tip of the appendix but some times fails to reach the distal third, in which case a vestigial low peritoneal ridge containing fat is present over the distal third. It encloses the blood vessels, nerves and lymph vessels of the vermiform appendix, and usually contains a lymph node.

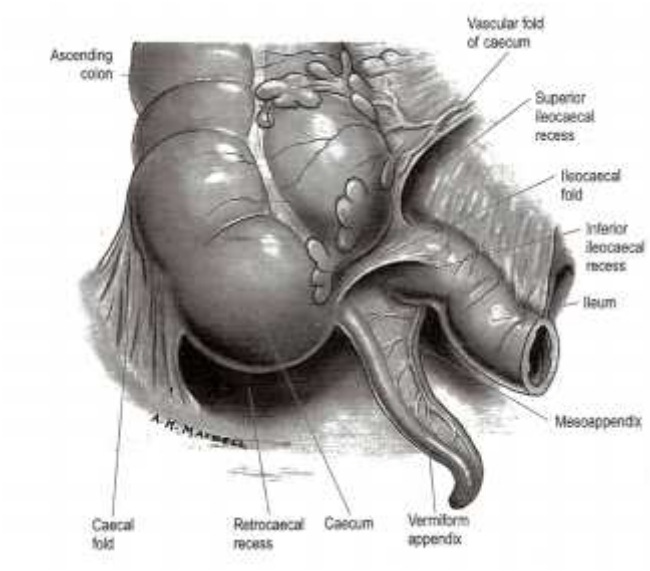


Figure 3: The peritoneal folds and recessess in caceal region.

Microstructure of the appendix

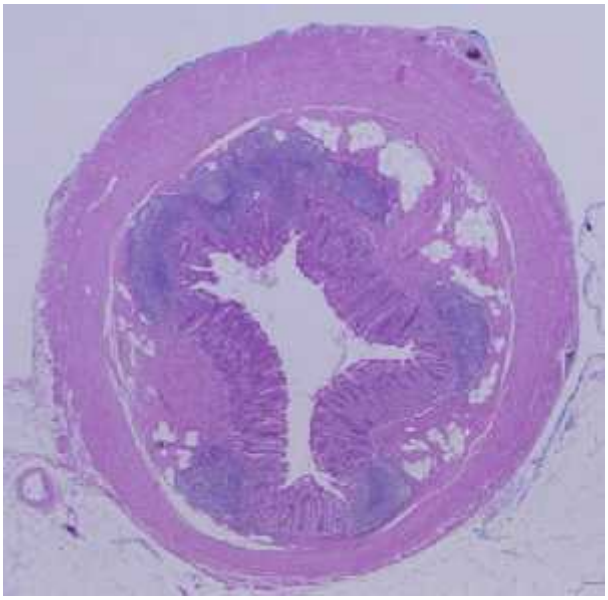


Figure 4: Normal histology of appendix

Serosa

The serosa forms a complete covering, except along the mesenteric attachment. The longitudinal muscular fibres form a complete layer of uniform thickness, except over a few small areas where both muscular layers are deficient, leaving the serosa and submucosa in contact.

Muscularis Externa

The muscularis externa has outer longitudinal and inner circular layers of smooth muscle. The longitudinal fibres form a continuous layer but, with the exception of the uniform outer muscle layer of most of the appendix, macroscopically these are aggregated as longitudinal bands or taeniae coli. At the base of the appendix, the longitudinal muscle thickens to form rudimentary taeniae that are continuous with those of the caecum and colon. Between the taeniae coli the longitudinal layer is much thinner, less than half the circular layer in thickness.

Sub-Mucosa

The submucosa typically contains many large lymphoid aggregates that extend from the mucosa and obscure the muscularis mucosae layer: consequently this becomes discontinuous. These aggregates also cause the mucosa to bulge into the lumen of the appendix, so that it narrows irregularly. They are absent at birth but accumulate over the first 10 years of life to become a prominent feature. The submucosal lymphoid tissue frequently exhibits germinal centres within its

follicles, indicative of B-cell activation, as it is in secondary lymphoid tissue elsewhere. In adults, the normal layered structure of the appendix is lost and the lymphoid follicles atrophy and are replaced by collagenous tissue. In the elderly, the appendix may be filled with fibrous scar tissue.

Mucosa

The mucosa is covered by a columnar epithelium and M cells are present in the epithelium that overlies the mucosal lymphoid tissue. Glands (crypts) are fewer in number and thus less densely packed. They penetrate deep into the lymphoid tissue of the mucosal lamina propria.

Embryology of the appendix[46]

At an early embryonic stage it has the same calibre as the caecum and is in line with it. It is formed by excessive growth of the right wall of the caecum which pushes the appendix to the inner side. Congenital absence of the appendix is extremely rare.

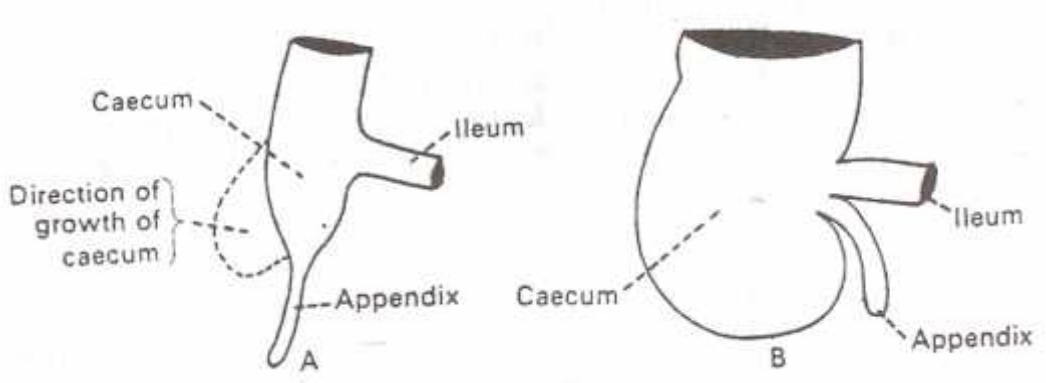


Figure 5: Development of the appendix

PATHOLOGY [47]

Morphology

At earliest stages, only a scanty neutrophlic exudate may be found throughout the mucosa, submucosa and muscularis propria. Subserosal vessels are congested and often there is a modest perivascular neutrophilic infiltrate. The inflammatory reaction transforms the normal glistening serosa into a dull, granular, red membrane; this transformation signifies early acute appendicitis for the surgeon. At a later stage, a prominent neutrophilic exudate generates a fibrinopurulent reaction over the serosa.

The histologic criteria for the diagnosis of acute appendicitis is neutrophilic infiltration of the muscularis propria. Usually, neutrophils and ulcerations are also present within the mucosa. Since drainage of an exudate into the appendix from alimentary tract infection may also induce a mucosal neutrophils infiltrate, evidence of muscular wall inflammation is requisite for the diagnosis.

Figure 6: Histology of inflamed appendix

Incidence

The lifetime rate of appendicectomy is 12% for men and 25% for women, with approximately seven percent of all people undergoing appendicectomy for acute appendicitis. Over a 10 year period from 1987 to 1997, the overall appendicectomy rate decreased parallel to a decrease in incidental appendicectomy. Appendicitis is most frequently seen in patients in their second through fourth decades of life, with a mean age of 31.3 years and a median age of 22 years. There is a slight male to female predominance (M:F 1.2 to 1.3:1).[48,49]

The incidence of appendicitis seems to have risen greatly in the first half of this century, particularly in Europe, America and Australia, with up to 16% of the population undergoing appendicectomy. In the past 30 years the incidence has fallen dramatically in these countries, such that the individual lifetime risk of appendicectomy is 8.6% and 6.7% among males and females respectively. The

number of operations annually in England and Wales declined from 113 000 in 1966 to 48 000 in 1990, while in Sweden there has been an annual decrease of 17% in the numbers of appendicectomies performed between 1987 and 1996.

Acute appendicitis is relatively rare in infants, and becomes increasingly common in childhood and early adult life, reaching a peak incidence in the teens and early 20s. After middle age the risk of developing appendicitis in the future is quite small. The incidence of appendicitis is equal among males and females before puberty. In teenagers and young adults the male-female ratio increases to 3:2 at age 25; thereafter the greater incidence in males declines.[50]

Aetiology

There is no unifying hypothesis regarding the aetiology of acute appendicitis. Decreased dietary fibre and increased consumption of refined carbohydrates may be important. As with colonic diverticulitis, the incidence of appendicitis is least in societies with a high dietary fibre intake. In developing countries that are adopting a more refined Western-type diet, the incidence continues to rise. This is in contrast to the dramatic decrease in the incidence of appendicitis in Western countries observed in the past 30 years. No reason has been established for these paradoxical changes; however, improved hygiene and a change in the pattern of childhood gastrointestinal infection related to increased use of antibiotics may be responsible.[50]

Intestinal parasites, particularly Oxyuris vermicularis (synonym: pinworm), can proliferate in the appendix and occlude the lumen.[50]

Pathogenesis

Obstruction of the lumen is the dominant causal factor in acute appendicitis. Faecoliths are the usual cause of appendiceal obstruction. Less common causes are hypertrophy of lymphoid tissue, inspissated barium from previous x-ray studies, tumors, vegetable and fruit seeds, and intestinal parasites. The frequency of obstruction rises with the severity of the inflammatory process. Faecoliths are found in 40% of cases of simple acute appendicitis, 65% of cases of gangrenous appendicitis without rupture, and nearly 90% of cases of gangrenous appendicitis with rupture.

There is a predictable sequence of events leading to eventual appendiceal rupture. The proximal obstruction of the appendiceal lumen produces a closed-loop obstruction, and continuing normal secretion by the appendiceal mucosa rapidly produces distension. The luminal capacity of the normal appendix is only 0. l millilitre (mL). Secretion of as little as 0.5 mL of fluid distal to an obstruction raises the intraluminal pressure to 60 cm H_2O. Distension of the appendix stimulates nerve endings of visceral afferent stretch fibers, producing vague, dull, diffuse pain in the mid-abdomen or lower epigastrium. Peristalsis is also stimulated by the rather sudden distention, so that some cramping may be superimposed on the visceral pain early in the course of appendicitis. Distension continues from continued mucosal secretion and from rapid multiplication of the resident bacteria of the appendix. Distension of this magnitude usually causes reflex nausea and vomiting, and the diffuse visceral pain becomes more severe. As pressure in the organ increases, venous pressure is exceeded. Capillaries and venules are occluded, but arteriolar inflow continues, resulting in engorgement

and vascular congestion. The inflammatory process soon involves the serosa of the appendix and in turn parietal peritoneum in the region, producing the characteristic shift in pain to the right lower quadrant.

The mucosa of the gastrointestinal tract, including the appendix, is susceptible to impairment of blood supply, thus its integrity is compromised early in the process, allowing bacterial invasion. As progressive distension encroaches upon first the venous return and subsequently the arteriolar inflow, the area with the poorest blood supply suffers most: ellipsoidal infarcts develop in the antimesenteric border. As distension, bacterial invasion, compromise of vascular supply, and infarction progress, perforation occurs, usually through one of the infarcted areas on the antimesenteric border. Perforation generally occurs just beyond the point of obstruction rather than at the tip because of the effect of diameter on intraluminal tension.

This sequence is not inevitable, however, and some episodes of acute appendicitis apparently subside spontaneously. Many patients who are found at operation to have acute appendicitis give a history of previous similar, but less severe, attacks of right lower quadrant pain. Pathologic examination of the appendix removed from these patients often reveals thickening and scarring, suggesting old, healed, acute inflammation.[51-53]

Bacteriology

Table 1: Common organisms seen in patients with acute appendicitis.[54]

Aerobic and Facultative	Anaerobic
Gram-negative bacilli	Gram-negative baciili
E. coli	Bacteroides fragilis
Pseudomonas aeruginosa	Bacteroides species
Klebsiella species	Fusobacterium species
Gram-positive cocci	Gram-positive cocci
Streptococcus anginosus	Peptostreptococcus species
Streptococcus species	Gram-positive bacilli
Enterococcus species	Clostridium species

Presentation

In 1905, Murphy clearly described the appropriate sequence of symptoms of pain followed by nausea and vomiting with fever and exaggerated local tenderness in the position occupied by the appendix.[55]

The classic presentation of acute appendicitis begins with crampy, intermittent abdominal pain, thought to be due to obstruction of the appendiceal lumen. The pain may be either periumbilical or diffuse and difficult to localize. This is typically followed with nausea; vomiting may or may not be present. If nausea and vomiting precede the pain, patients are likely to have another cause for their abdominal pain, such as gastroenteritis. Classically, the pain migrates to

the right lower quadrant as transmural inflammation of the appendix leads to inflammation of the peritoneal lining of the right lower abdomen. This usually occurs within 12-24 hours of the onset of symptoms. The character of the pain also changes from dull and colicky to sharp and constant. Movement or Valsalva maneuver often worsens this pain, so that the patient typically desires to lie still.

Patients may report low-grade fever up to 38.3°Centigrade (C). Patients who have appendicitis commonly report anorexia; appendicitis is unlikely in those with a normal appetite.

The classic presentation of acute appendicitis is not present in all patients. Patients may have none or only a few of the symptoms just described. For instance, they may not notice or recall the initial colicky pain. When the pain becomes constant, it may localize to other quadrants of the abdomen due to an alteration in appendiceal anatomy as in late pregnancy or malrotation. In patients with a retrocecal appendix, the pain may never localize until generalized peritonitis from perforated appendicitis occurs. Urinary or bowel frequency may be present due to appendiceal inflammation irritating the adjacent bladder or rectum. Because appendicitis is so common, a high index of suspicion for appendicitis is warranted in all patients with abdominal pain.[56]

Diagnosis

History and Physical Examination[56]

As always, the diagnosis begins with a thorough history and physical examination. The patient should be asked about the classic symptoms of

appendicitis, but the surgeon should not be dissuaded by the absence of many of the symptoms. Many patients with acute appendicitis do not have a classic history. Because the differential diagnosis of appendicitis is extensive, patients should be queried about certain symptoms that may suggest an alternative diagnosis. Surgeons must also remember that a previous appendicectomy does not definitively exclude the diagnosis of appendicitis, as "stump appendicitis" (appendicitis in the remaining appendiceal stump after appendicectomy), although rare, has been described.[57]

On inspection, patients look mildly ill and may have slightly elevated temperature and pulse. They often lie still to avoid the peritoneal irritation caused by movement. The surgeon should systematically examine the entire abdomen, starting in the left upper quadrant away from the patient's described pain. Maximal tenderness is typically in the right lower quadrant, at or near McBurney's point, located one-third of the way from the anterior superior iliac spine to the umbilicus. This tenderness is often associated with localized muscle rigidity and signs of peritoneal inflammation, including rebound, shake, or tap tenderness. Right lower quadrant tenderness is the most consistent of all signs of acute appendicitis;[58,59] its presence should always raise the specter of appendicitis, even in the absence of other signs and symptoms. Because of the various anatomic locations of the appendix, however, it is possible for the tenderness to be in the right flank or right upper quadrant, the suprapubic region, or the left lower quadrant. Patients with a retrocaecal or pelvic appendix may have no abdominal tenderness whatsoever. In such cases, rectal examination can be helpful to elicit right-sided pelvic tenderness.

Multiple signs can be detected on physical examination to contribute to the diagnosis of appendicitis.

1. Rovsing's sign, pain in the right lower quadrant on palpation of the left lower quadrant, is further evidence of localized peritoneal inflammation in the right lower quadrant.

2. Psoas sign, pain with flexion of the leg at the right hip, can be seen with a retrocecal appendix due to inflammation adjacent to the psoas muscle.

3. The obturator sign, pain with rotating the flexed right thigh internally, indicates inflammation adjacent to the obturator muscle in the pelvis.

Laboratory Studies[56]

Laboratory studies can be helpful in the diagnosis of appendicitis, but no single test is definitive. A white blood cell count (WBC) is perhaps the most useful laboratory test. Typically, the WBC is slightly elevated in nonperforated appendicitis, but may be quite elevated in the presence of perforation. The clinician must remember, however, that the WBC can be normal in patients with acute appendicitis, particularly in early cases. Serial WBC measurements improve the diagnostic accuracy, with a rising value over time commonly seen in patients with appendicitis.[60] Urinalysis is performed to diagnose other potential causes for abdominal pain, specifically urinary tract infection and ureteral stone. Significant hematuria with colicky abdominal pain suggests ureterolithiasis, and testing directed at this diagnosis is indicated. A urinary tract infection, on the other hand, is not uncommon in patients with appendicitis. Its presence does not

exclude the diagnosis of acute appendicitis, but it should be identified and treated. Although pyuria suggests urinary tract infection, it is not uncommon for the urinalysis in a patient with appendicitis to show a few white blood cells solely due to inflammation of the ureter by the adjacent appendix.

In certain patient populations, other laboratory tests are indicated. In women of childbearing age, the urine human chorionic gonadotropin should be checked to alert the clinician to the possibility of ectopic or concurrent pregnancy. Ectopic pregnancy is another cause of right lower quadrant pain that demands emergent diagnosis and treatment.

Table 2: Scoring system in case of acute appendicitis

Symptoms	**Score**
Migratory RIF pain	1
Anorexia	1
Nausea and vomiting	1

Signs	**Score**
Tenderness	2
Rebound tenderness	1
Elevated temperature	1

Laboratory	**Score**
Leucocytosis	2
Shift to left	1
TOTAL	10

Alvarado (Mantrels) score

A score of seven is strongly predictive of acute appendicitis.

Imaging Studies[56]

The potential imaging modalities for diagnosis of acute appendicitis include plain radiographs, Abdominal ultrasound (USG), and computed tomography (CT).

1. Prior to the wide-spread use of modern imaging techniques, plain abdominal films were often obtained in patients with abdominal pain. Some helpful x-ray findings following acute appendicitis are

    a. Localized air fluid levels in the right iliac fossa.
    b. Localized ileus with gas in caecum, ascending colon or terminal ileum. In retrocaecal appendicitis caecum is distended with gas.
    c. Localized soft tissue shadow in the right lower quadrant.
    d. Presence of faecolith.
    e. Gas in appendix.
    f. Obliterated psoas shadow
    g. Altered flank right strips (flat line).
    h. Free intra peritoneal gas in perforated appendix.
    i. Deformity of cecal gas shadow due to adjacent inflammatory mass (this is difficult to interpret because there may be disturbance of caecal gas from intraluminal fluid or faeces).

2. Abdominal ultrasonography (USG) is a popular imaging modality for acute appendicitis. Findings that suggest appendicitis include;

    a. Thickening of the appendiceal wall.
    b. Loss of wall compressibility.
    c. Increased echogenicity of the surrounding fat signifying inflammation
    d. Loculated pericecal fluid.

    The advantages of USG include its widespread availability, as well as the avoidance of ionizing radiation and the side effects of intravenous contrast such as renal toxicity and allergic reactions. In addition, USG (both abdominal and transvaginal) is particularly useful in assessing obstetric and gynecological causes of abdominal pain in women of childbearing age. Ultrasound is highly operator-dependent, however, and it is frequently unable to visualize the normal appendix.[61]

3. Computed tomography (CT) is yet another imaging modality for acute appendicitis. CT benefits from a high diagnostic accuracy for appendicitis[62] and visualization and diagnosis of many of the other causes of abdominal pain that can be confused with appendicitis. The radiographic findings of appendicitis on CT include a dilated (more than six mm), thick-walled appendix that does not fill with enteric contrast or air, as well as surrounding fat stranding to suggest inflammation In prospective studies, CT demonstrated a sensitivity of 0.94 and a specificity of 0.95.[62] CT thus has a high negative predictive value, making

it particularly useful in excluding appendicitis in patients for whom the diagnosis is in doubt. Appendicitis is highly unlikely if enteric contrast fills the lumen of the appendix and no surrounding inflammation is present. The clinician must remember, however, that a CT performed early in the course of appendicitis might not show the typical radiographic findings. In confusing cases, it is reasonable to repeat the CT after 24 hours of observation.[50]

Indications for appendicectomy

1. Acute appendicitis.
2. Recurrent or chronic appendicitis.
3. Carcinoma of appendix.
4. Carcinoid tumor of appendix.
5. Tuberculosis of appendix.

Treatment[50]

The treatment of acute appendicitis is appendicectomy. There is a perception that urgent operation is essential to prevent the increased morbidity and mortality of peritonitis. While there should be no unnecessary delay, all patients, particularly those most at risk of serious morbidity, benefit by a short period of intensive preoperative preparation. Intravenous fluids, sufficient to establish adequate urine output (catheterisation is needed only in the very ill), and appropriate antibiotics should be given. There is ample evidence that a single peroperative dose of antibiotics reduces the incidence of postoperative wound infection. When peritonitis is suspected, therapeutic intravenous antibiotics to

cover Gram-negative bacilli as well as anaerobic cocci should be given. Hyperpyrexia in children should be treated with salicylates in addition to antibiotics and intravenous fluids. With appropriate use of intravenous fluids and parentral antibiotics, a policy of deferring appendicectomy after midnight to first case of the following morning does not increase morbidity. However, when acute obstructive appendicitis is recognised, operation should not be deferred longer than it takes to optimise the patient's condition.

Appendicectomy[50]

Appendicectomy should be performed under general anaesthetic or spinal anaesthetic with the patient supine on the operating table. When a laparoscopic technique is to be used, the bladder must be empty. Prior to preparing the entire abdomen with an appropriate antiseptic solution, the right iliac fossa should be palpated for a mass. If a mass is felt, it may, on occasion, be preferable to adopt a conservative approach. Draping of the abdomen is in accordance with the planned operative technique, taking account of any requirement to extend the incision or convert a laparoscopic technique to open operation.

Conventional appendicectomy[50]

Incisions

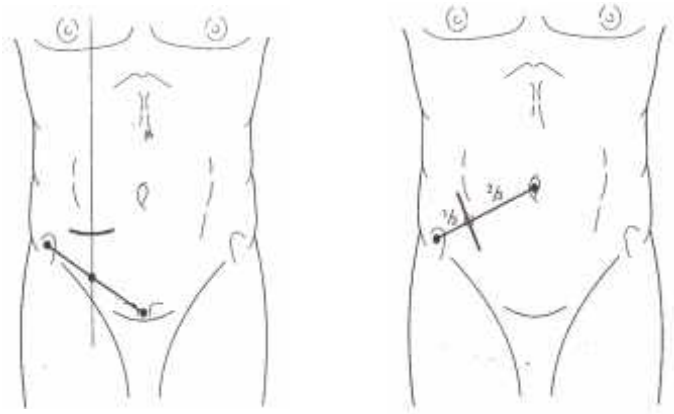


Figure 7: Gridiron incision for Appendicitis & Transverse or skin crease (Lanz) incision for appendicitis

When the preoperative diagnosis is considered reasonably certain, the incision that is widely used for appendicectomy is the so-called gridiron incision (gridiron:a frame of cross-beams to support a ship during repairs). The gridiron incision (described first by McArthur)[46] is made at right angles to a line joining the anterior superior iliac spine to the umbilicus, its centre being along the line at McBurney's point. In the subcutaneous tissues, an arterial twig from the superficial circumflex iliac artery usually requires ligation. The external oblique is incised in the line of its fibres along the length of the incision. The fibres of the internal oblique and transversus abdominis are split, and with suitable retraction the peritoneum is opened. If better access is required, it is possible to convert the gridiron to a Rutherford Morison incision by cutting the internal oblique, transversus muscles in the line of the incision.

A transverse skin crease (Lanz) incision has become more popular, as the exposure is better and extension, when needed, is easier. The incision, appropriate in length to the size and obesity of the patient, is made approximately two cm below the umbilicus centred on the midclavicular-midinguinal line. The external oblique aponeurosis, internal oblique and transversus muscles are split in the direction of the fibres, and the peritoneum opened. When necessary, the incision may be extended medially, with retraction or suitable division of the rectus abdominis muscle.

When the diagnosis is in doubt, particularly in the presence of intestinal obstruction, a lower midline abdominal incision is to be preferred over a right lower paramedian incision. The latter although widely practised in the past, is difficult to extend, more difficult to close and provides poorer access to the pelvis and peritoneal cavity.

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

Removal of the appendix[50]

A retractor is placed under the medial side of the wound and peritoneum and abdominal wall is elevated. Serous exudate is removed with a sucker. The caecum is identified by the presence of taeniae coli, and using a finger or a swab the caecum is withdrawn. A turgid appendix may be felt at the base of the caecum. Inflammatory adhesions must be gently broken with a finger, which is

then hooked around the appendix to deliver it into the wound. The appendix is conveniently controlled using a Babcock or Lane's forceps applied in such a way as to encircle the appendix and yet not damage it. The base of the mesoappendix is clamped in a haemostat, divided and ligated. When the mesoappendix is broad, the procedure must be repeated with a second or, rarely, a third haemostat. The appendix, now completely freed, is crushed near its junction with the caecum in a haemostat, which is removed and reapplied just distal to the crushed portion. An absorbable 2/0 ligature is tied around the crushed portion close to the caecum. The appendix is amputated between the haemostat and the ligature. A non absorbable suture purse-string or 'Z' suture may then be inserted into the caecum about 1.25 cm from the base. The stitch should pass through the muscle coat, picking up the taeniae coli. The stump of the appendix is invaginated while the purse-string or 'Z' suture is tied, thus burying the appendix stump.[63,64] Many surgeons believe invagination of the appendiceal stump is unnecessary.[65,66]

The distal ileum visualised to rule out meckel’s diverticulum. In female patients the ovary examined. The peritoneum closed with absorbable continous suture. The muscles approximated with intermittent simple absorbable chromic sutures. The external oblique aponeurosis closed with continous absorbable sutures. The skin closed with non absorbable subcuticular or mattress suture.

Methods to be adopted in Special circumstances[50]

When the caecal wall is oedematous, the purse-string suture is in danger of cutting out. If the oedema is of limited extent, this can be overcome by inserting the purse-string suture into more healthy caecal wall at a greater

distance from the base of the appendix. Occasions may arise when, because of the extensive oedema of the caecal wall, it is better not to attempt invagination.

When the base of the appendix is inflamed, it should not be crushed but ligated close to the caecal wall just tightly enough to occlude the lumen, after which the appendix is amputated and the stump invaginated.

Should the base of the appendix be gangrenous, neither crushing nor ligation must be attempted. Two stitches are placed through the caecal wall close to the base of the gangrenous appendix, which is amputated flush with the caecal wall, after which these stitches are tied. Further closure is effected by means of a second layer of interrupted seromuscular sutures.

Retrograde appendicectomy:[56]

When the appendix is retrocaecal and adherent, it is an advantage to divide the base between haemostats. The appendiceal vessels are then ligated, the stump ligated and invaginated and gentle traction on the caecum will enable the surgeon to deliver the body of the appendix, which is then removed from base to tip. Occasionally, this manoeuvre requires division of the lateral peritoneal attachments of the caecum.

Laparoscopy

The word laparoscopy is derived from a Greek word lapara, meaning “the soft part of the body between ribs and hip, flank, loin” and skopein, which means “to look at or survey”.

Laproscopic instruments

The core of laparoscopic equipments is the endovision, which comprises of

1. Telescope, endovision camera.
2. Light source and fibre optic cable.
3. Video monitor.

The other electronic devices needed are

- Co_2 insuffilator.
- Suction/irrigation machine.
- Energy source (cautery) or laser ultrasonic device.

Endovision camera

Endovision camera is the electronic eye by which the visualisation of surgical sites can be monitored and magnified on video screen to perform surgery. It is available either in single chip or three chip.

A single chip has a composite transmission in which the three colours-red, green, blue are compressed on a single chip with a resulatant resolution of >400. The three chip has a Red Green Blue transmission.

Figure 8: Camera

Video monitor

A colour video monitor with a resolution compatible with the camera unit is very important for the for good quality picture. The commonly used size is 14' diagonal length.

Telescope

Hopkins rod lens telescopes are reusable and consist of an eyepiece lens, a connection for the fibreoptic light cables and a screw adaptor for the other types of fibre optic light cables and a jack tube made of non corrosive material, which encloses the rod-lens system and a built in fibre optic light carrier.

Hopkins telescope come in various sizes- three millimeter (mm), five mm, 10mm. Telescopes are with the colour code which correspond with the angle of vision. The angled scopes can assess areas that are blind to 0^0, but they are difficult to handle.

- Green A- 0^0- straight forward.
- Red B--- 30^0—forward oblique.

Figure 9: Telescope

Light source.

The three type of light source available are;

- Xenon 175/300 Watt (W)
- Halogen 150W
- Metal halide 270W

Figure 10: Light source

Light cable

The light cables may be fibreoptic or liquid with a diameter between 3.5 mm and six mm and a length ranging from 180-350 cm. For general laparoscopy a five mm diameter cable with a length of 240 cm is enough.

Electronic CO2 insufflator

An electronic insuffilator is necessary to distend the peritoneal cavity with CO_2. Technical characteristics include its capacity to insuffilate upto nine-30 litres (Lt) per minute and maintain a constant intra-abdominal pressure without exceeding the safety limit of 12-15 mm of Mercury (Hg). Ideally a nine Lt/minute (min) instrument is sufficient for basic laparoscopy.

Figure 11: Insuffilator

Suction irrigation system

Its primary function is to deliver irrigation fluid and aspirate fluid and smoke, but it has proved to be ideal for dissection with simultaneous irrigation/suction.

- Energy sources
- Monopolar cautery
- Bipolar cautery
- Ultrasonic device
- Lasers,
- Argon beam coagulation.

Mechanical instruments

Veress needle

It may be disposable or reusable. It is a double barreled device with a spring loaded, blunt tipped inner stylet. It is 2.1mm in diameter (14Gauge) and 80mm long. It is used for creating pneumoperitoneum.

Figure 12: Veress needle

Trocars and cannulas

Trocars permit access to the intraperitoneal cavity. They can be introduced blindly after creating pneumoperitoneum with the veress needle. The main trocar can also be positioned under visual control by means of an "open" laparoscopy technique. First described by "Hasson", this technique consists of opening the cutaneous, fascial and peritonel layers under visual control. The trocar consists of a metal tube with a sharp conical or pyramidal tipped obturator. The outer surface of the cannula has a dull finish to minimize reflection of light in the abdomen. Gas escape is prevented by a flap gate or trumpet valve. All trocars have stop cocks through which carbon dioxide can be insufflated or smoke evacuated.

Trocar tips have either pyramidal tips or conical tips. Trocars come in various sizes three mm, five mm, 10 mm, 12 mm and 15 mm.

Figure 13: Tips of trocar

Figure 14: Hasson trocar

Endoscopic hand instruments

Instruments may be reusable or disposable. Instruments are used for dissecting, retracting, clamping and cutting, suturing.

1. Reducer – 10 mm and five mm.
2. Dissecting instruments – Maryland dissector.
3. Grasper- one atraumatic with rachet
4. Scissors-hooked or curved.
5. Hooks and spatulas
6. Clip applicator, size – medium/ large.
7. Aspiration needle.
8. Endoloop reducer.
9. 10 mm claw forceps for organ extraction.
10. Clamping instruments.

Figure 15: Maryland grasper

Figure 16: Scissors

Pneumoperitoneum

The creation of the pneumoperitoneum is the essential component for laparoscopic procedures.

The ideal gas for insufflation during laparoscopy must have the following characteristics:

1. Limited systemic absorption across the peritoneum.
2. Limited systemic effects when absorbed.
3. Rapid excretion if absorbed.
4. Incapable of supporting combustion.
5. High solubility in blood.

Pneumoperitoneum is created by two technique

1. Closed technique
2. Open or Hasson technique.

Closed technique

Patient is placed supine in 10 to 20 degree head down position. If there are no scars on the abdomen, a site is chosen at the superior or inferior border of the umbilical ring for the site of entry. There are several ways to immobilize the umbilicus and provide resistance to the needle. The inferior margin of the umbilicus can be immobilized by pinching the superior border of the umbilicus between the thumb and forefinger of the nondominant hand and rolling the superior margin of the umbilicus in a cephalad direction. Alternatively, in the

anesthetized patient, a small towel clip can be placed on either side of the upper margin of the umbilicus; this makes it easier to stabilize the umbilicus and lift it upward.

Next, a curvilinear incision is made in the midline of the superior or inferior margin of the umbilicus. With the dominant hand, the shaft of the veress needle is held like a dart and gently passed into the incision either at a 45^0 caudal angle to the abdominal wall (in the asthenic or minimally obese patient) or perpendicular to the abdominal wall in the markedly obese patient. There will be a sensation of initial resistance, followed by a give, at two points. The first point occurs as the needle meets and traverses the fascia and the second as it touches and traverses the peritoneum. As the needle enters the peritoneal cavity, a distinct click can often be heard as the blunt-tip portion of the Veress needle springs forward into the peritoneal cavity.

Figure 17: Insertion of veress needle.

There are five tests that should be performed in sequence to confirm proper placement of the needle.

1. ***Hiss Test:*** This is the sound of air flowing into the negative pressure of the peritoneum through the Veress needle as accentuated by elevation of

the abdominal wall, when the tip of the needle is correctly positioned. Unfortunately, the listener's ear has to be close to the top of the Veress needle to hear the "hiss", and theatre noise often precludes this.

2. ***Aspiration Test:*** A Syringe filled with saline connected to the Veress needle is used next. Fluid instilled into the peritoneal cavity will flow away from the tip of the needle and cannot be aspirated back into the syringe. If fluid is aspirated back, an incorrect needle tip placement is likely. In addition, is bowel content or blood is aspirated, the incorrect position of the needle tip is again obvious.

3. ***Negative Pressure Test:*** The insufflation tubing from the insufflator should next be connected to the Veress needle. Monitoring the peritoneal pressure prior to any insufflation at this point will reveal a slight negative pressure easily accentuated by abdominal wall elevation.

4. ***Early Insufflation Pressures:*** The next clue to correct positioning is monitoring of the insufflation pressure which should not exceed eight mm Hg at 11 Lt/min. The static pressure must not exceed three mm Hg. Pressures of more than 15 mm Hg with a low or no flow of gas indicate incorrect needle tip position.

5. ***Volume Test:*** In the average adult the volume required to distend the peritoneum adequately, and which creates a pressure of 8-10 mm Hg is about liters of gas. If the static pressure as measured by the insufflator reaches these pressures with less than one Lt of gas, suspicion should arise that the needle tip is incorrectly placed. If this is extraperitoneal

then it will often be accompanied by asymmetric anterior abdominal wall distension.

Technique of laparoscopic appendicectomy

Anaesthesia: Done under general anaesthesia.

The patient is placed in Trendleberg position with 15 to 20^0 tilt to the left. Patient is catheterized. The monitor is placed on the right side of the patient. The operator stands to the patient's left and faces a video monitor placed at the patient's right foot. Pneumoperitoneum is created using the open technique. 1.5 to 2 cm incision is made in infraumbilical region and deepened till the sheath is reached. With two right angled retractors in place the sheath is incised for 1.5 cm. The extraperitoneal fat is dissected, the peritoneum identified, held up with two hemostats and carefully incised for one cm. The Hasson trocar with its blunt obturator is gently eased into the abdomen. The cone is adjusted according to the patients built and fat. A purse string suture is placed around the Hasson's trocar to reduce an air leak and fixed to the cannula. Insufflation is started.

Laparoscope introduced and a diagnostic scopy is done trough the umbilical port.

The tip of the telescope is kept warm by dipping it in warm saline or anti-fog solution or with povidone, which acts as a surfactant.

The placement of operating ports may vary according to operator preference and previous abdominal scars.

The appendix is found in the conventional manner by identification of the caecal taeniae and is controlled using a laparoscopic tissue holding forceps. By elevating the appendix, the mesoappendix is displayed. A dissecting forceps is used to create a window in the mesoappendix to allow the appendicular vessels to be coagulated or ligated using a clip applicator. The appendix, free of its mesentery, can be ligated at its base. The appendix is placed in the endoloop made of 3'0 silk. The endoloop is tightened around the base of the appendix. Another loop is tightened distal to this so as to doubly secure the stump. A clip is applied to the distal end of the appendix. The appendix is cut between the clip and the ligature. The appendix is delivered through the 10mm trocar. The stump of the appendix is not buried. The distal end of the ileum visualised to rule out meckel's diverticulum.

Peritoneal cavity is re-examined and as much gas as possible is evacuated and 10 mm trocar withdrawn.

The 10mm port site closed in two layers. The sheath closed with absorbable suture. The skin closed with non absorbable suture. The 5mm ports closed in single layer. The appendix is sent for histopathology.

VISUAL ANALOG SCALE (VAS)

Consist of 10 centimeter line whose ends are labeled as extremes of pain. The distance from no pain end to the mark made by the patient is that patients pain intensity score. VAS has been developed in an effort to include domains of measurable pain experience other than the sensory intensity dimension. The patient is asked to rate the unpleasentness of their pain experience. Visual Analog

Scale can be vertical or horizontal line. To assist describing the intensity of pain words can be placed along the scale (example, mild, moderate, severe). Such description can help orient the patient to the degree of pain.

Advantages of VAS

a. Simple and fast
b. Independent of language.
c. Easily understood and reproduced.
d. Sensitive to pharmacological procedures, treatment effects.
e. Is a ratio scale which has a statistical significance.
f. Sensitive, reliable.

Disadvantages

a. Failure rate of seven percent.
b. Some patients may find it difficult to understand.
c. Visual Analog Scale may be biased by psyhophysical responses.
d. Requires certain amount of visual and motar co-ordination of the patient that may be blunted due to anaesthesia in the early post operative period.
e. Visual Analog Scale assumes pain is unidimensional , it describes intensity but not quality.
f. Mark on the scale may not actually correspond to the exact mental numeric value that patient gives to their pain.

METHODOLOGY

The present study was conducted in the Department of Surgery, KLES Dr. Prabhakar Kore Hospital and Medical Research Centre, Belgaum on patients presenting with appendicitis during the period of December 2007 to December 2008.

Study design

One year randomized controlled trial.

Study period

The present study was conducted during December 2007 to December 2008.

Method of collection of data

Source of Data

Patients presenting with appendicitis at Department of Surgery, KLES, Dr. Prabhakar Kore Hospital and Medical Research Centre, Belgaum.

Sample size

A sample size of 62 cases with feature of appendicitis divided into two groups was considered for the study.

Sampling procedure

The sample size was calculated considering the following formula

$$n = \frac{2(2\alpha+2\beta)^2 (S1+S2)^2}{(x1 - x2)^2}$$

Where, $\alpha = 0.05$; $\beta = 0.2$; $1-\beta=0.8$; power 80%

X1 = Mean VAS scores in OA (Previous studies).

X2 = Mean VAS scores in LA (Previous studies).

S1 = Standard deviation (SD) of OA (Previous studies).

S2 = S. D. of LA (Previous studies).

Selection criteria

Inclusion Criteria

The diagnosis of appendicitis was made on the following criteria.

- History of right lower quadrant pain or periumbilical pain migrating to the right lower quadrant with nausea and/or vomiting.
- Fever of more than 38°C.
- Right lower quadrant tenderness, guarding on physical examination.

Exclusion Criteria

- Contraindication to general anesthesia (severe cardiac and/or pulmonary disease).
- Appendicular mass/ Appendicular perforation.
- Pregnancy.
- Inability to give informed consent because of mental disability.

- Generalized peritonitis.
- Shock on admission.
- History of cirrhosis.
- Coagulation disorders.

Procedure

The study was conducted in Department of Surgery at KLES Dr. Prabhakar Kore Hospital and Medical Research Centre, Belgaum during one year duration. The study was approved by the Ethical and Research Committee of Jawaharlal Nehru Medical College, Belgaum.

After finding the suitability as per inclusion and exclusion criteria patients were selected for the study and briefed about the nature of the study, the interventions used and written informed consent was obtained (Annexure–I). Further, descriptive data of the participants like name, age, sex, detailed history, were obtained by interviewing the participants and clinical examination were recorded on predesigned and pretested proforma (Annexure-II). Necessary investigations like complete blood count, blood urea, serum creatinine, urine routine and microscopy and ultrasonography were performed. Further the patients were divided into two groups using a computerized randomization chart.

Open appendicectomy patients were considered as group A and laparoscopic appendicectomy patients were considered has group B. All patients were kept nil by mouth overnight prior to surgery and received antibiotic prophylaxis one hour before the surgery. (Ciprofloxacin and Metronidiazole intravenous)

Surgical procedure

Open appendicectomy

A McBurney's incision was put and the abdomen was opened in layers. The appendix was identified by following the taenia. The mesoappendix dissected. The base of the appendix was clamped, ligated and cut. The mucosa of appendicular stump was cauterised. The stump was buried. Abdomen was closed in layers.

Laparoscopic appendicectomy

Laparoscopic appendicectomy was performed with the operating surgeon on the left side of the table. Pneumoperitoneum was created using Hassan's open technique. A total of three or four ports were used for LA. It involved two 10 mm and either one or two five mm trocars. Ten mm ports were inserted in the infraumbalical and suprapubic region. Five mm trocar was inserted in the left iliac region. The second 5mm trocar was inserted at right lumbar if required. Peritoneal cavity was visualized and any adhesions if present were released. The appendix identified by following the taenia. The appendicular artery was dissected and divided between hemostatic clips. The appendix was secured at the base between two loop sutures/endoclips. The base was cut between them and the appendix was removed through the 10 mm umbilical port.

Once the patients were reversed from anaesthesia, they were shifted to recovery room for observation for an hour and then shifted to the post operative ward.

All patients were administered non steroidal anti inflammatory drugs (Diclofenac sodium injection for first twenty four hours following surgery and further analgesic were given based on patients perception of pain) and anti-emetics as required. Patients were allowed liquids once bowel sounds returned.

Post operative assessment

Following the surgery the post operative pain was assessed using a visual analog scale (VAS). Similar type of dressing was applied to both the groups so has to blind the Medical Staff who was incharge of collecting data. On the VAS the person is asked to identify how much pain they are having by choosing a number from zero (no pain) to 10 (the worst pain imaginable).

Post operative pain was assessed at various intervals of time that is at sixth, 12^{th}, 18^{th}, 24^{th} and 36^{th} hours after surgery. Duration of hospital stay was also assessed in terms of days. Duration of hospital stay is defined as the difference between the date of admission and date of discharge of the patient.

The operative time was noted from making skin incision to skin closure. Patients were discharged from the hospital once they were fully mobilized and able to tolerate a normal diet and pain relief was adequate.

Statistical Methods

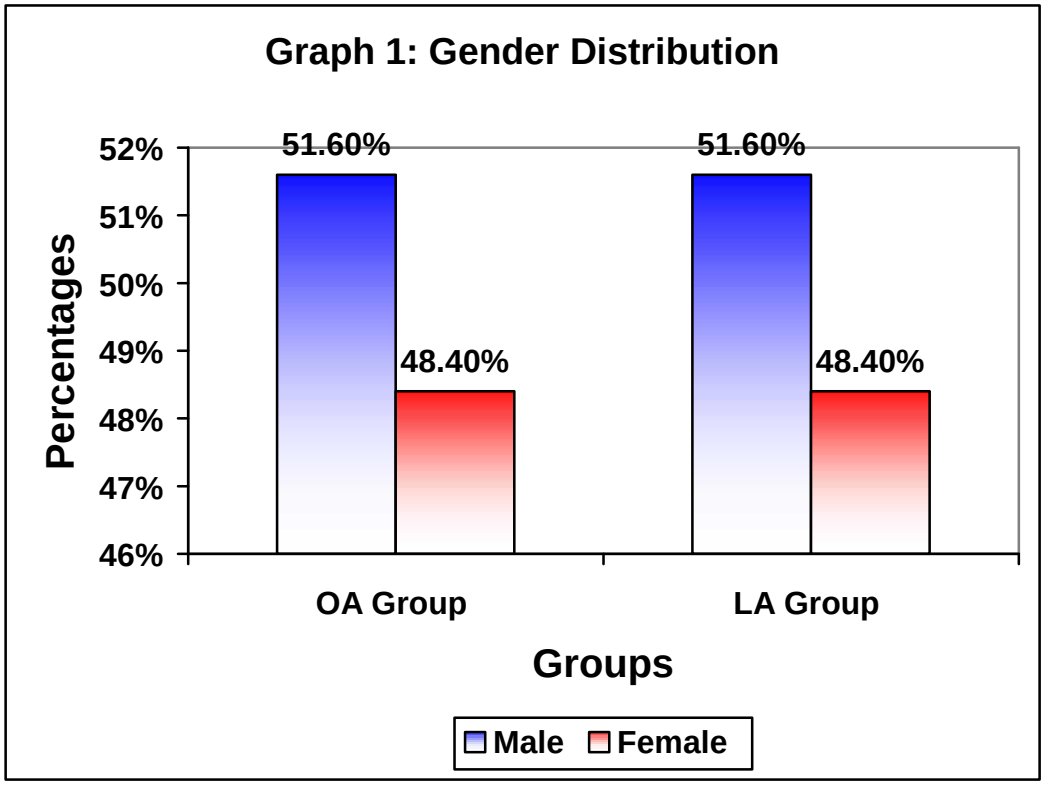
At the end of the study the data was tabulated and analysed using rates, ratios and percentages. Student unpaired ‘t’ test was used for comparison.

RESULTS

Thirty one patients were randomized to each group. The results were

Table 3: Gender distribution

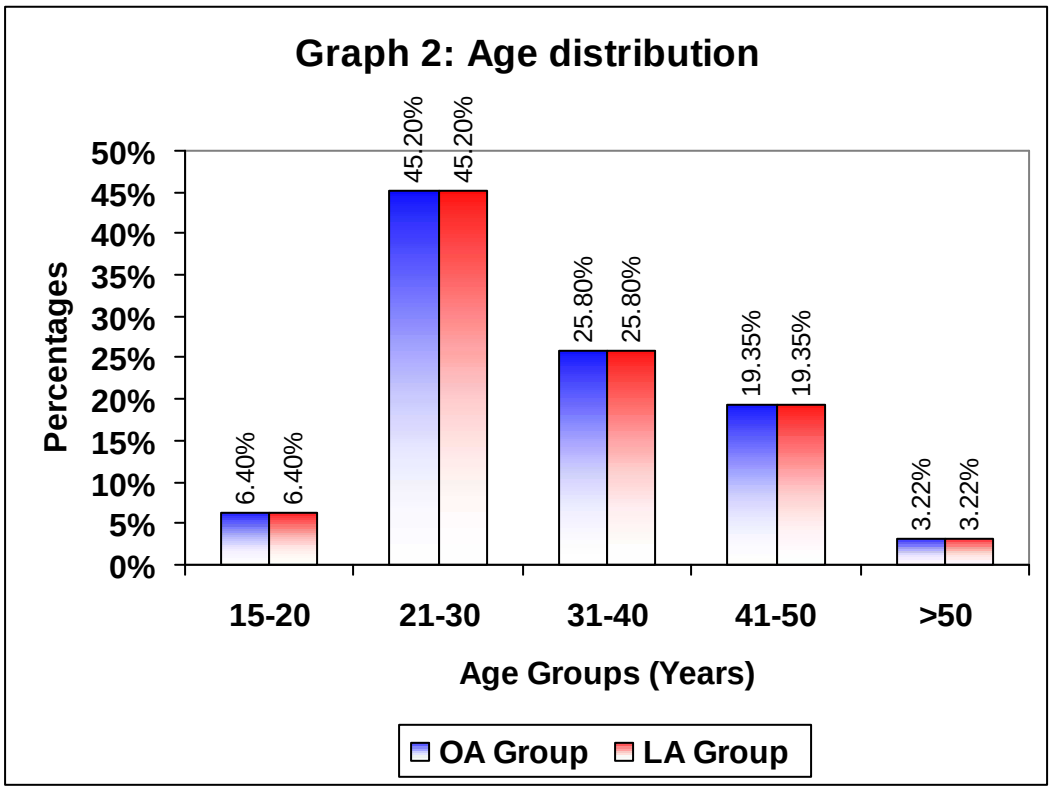
Gender	OA Group		LA Group	
	Number	**Percentage**	**Number**	**Percentage**
Male	16	51.6%	16	51.6%
Female	15	48.4%	15	48.4%
Total	31	100.0%	31	100.0%



In the present study 48.4% were females and 51.6% were males in each group.

Table 4: Age distribution

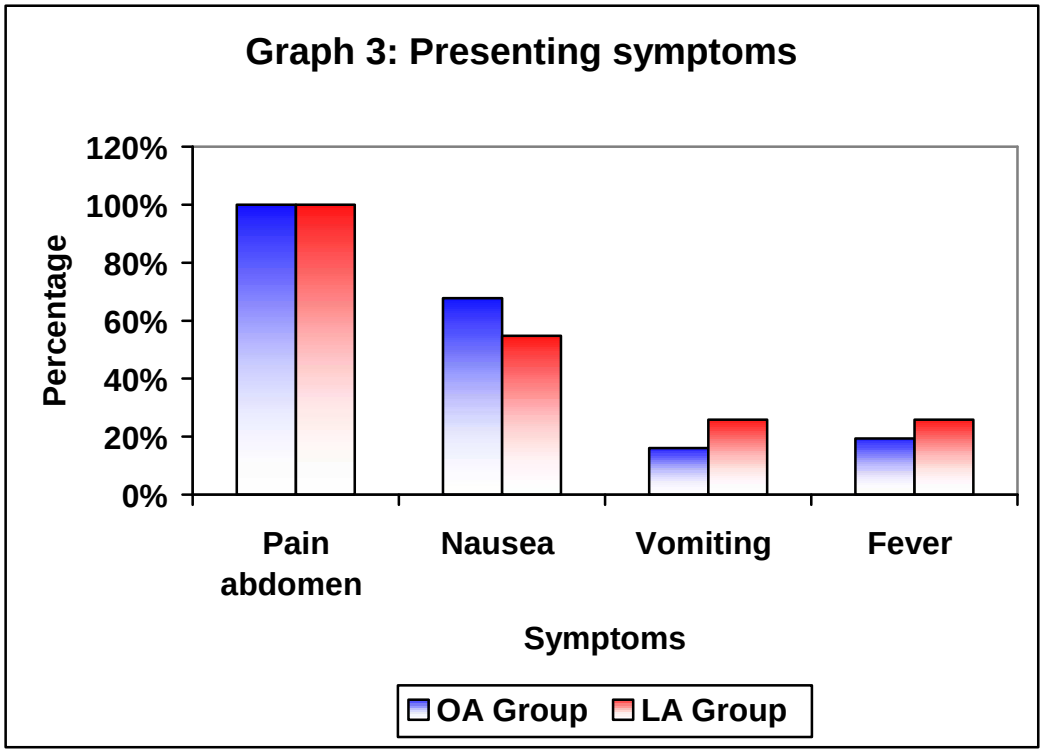
Age group (Years)	OA Group		LA Group	
	Number	Percentage	Number	Percentage
15-20	02	6.4%	02	6.4%
21 – 30	14	45.2%	14	45.2%
31 – 40	08	25.8%	08	25.8%
41 – 50	06	19.35%	06	19.35%
>50	01	3.22%	01	3.22%
Total	31	100.0%	31	100.0%



Patients were on average 33.08 years old and ranged from 18 years to 60 years. Patients who underwent LA were older (LA: 33.61 years, OA: 32.54 years). The mean ages of patient undergoing OA and LA were 32.55 and 33.61 years respectively. The difference was not to be found stastically significant (p=0.689).

Table 5: Presenting symptoms

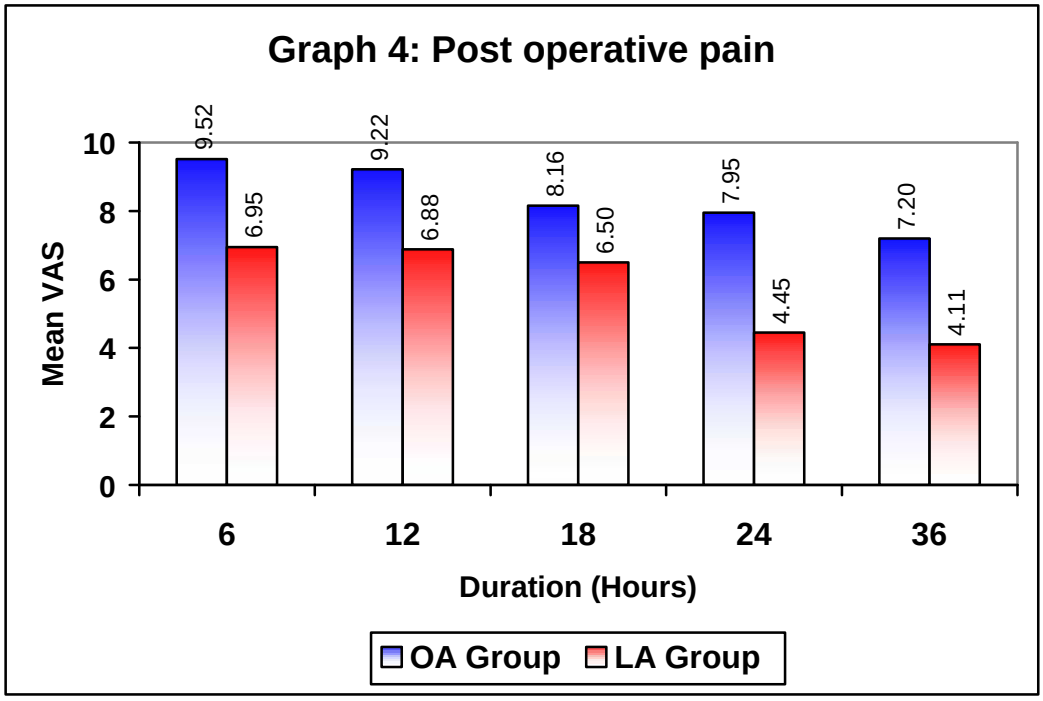
Symptoms	OA Group		LA Group	
	Number	Percentage	Number	Percentage
Pain abdomen	31	100%	31	100%
Nausea	21	67.74%	17	54.83%
Vomiting	05	16.10%	08	25.80%
Fever	06	19.35%	08	25.80%



All the patients in both the groups presented with pain in the right lower quadrant. Nausea was next common complaint present in 21 patients in OA group and 17 patients in LA group. Vomiting was present in five patients of OA group and eight patients in LA group. History of fever was present in six patients in OA group and eight patients in LA group.

Table 6: Post operative pain

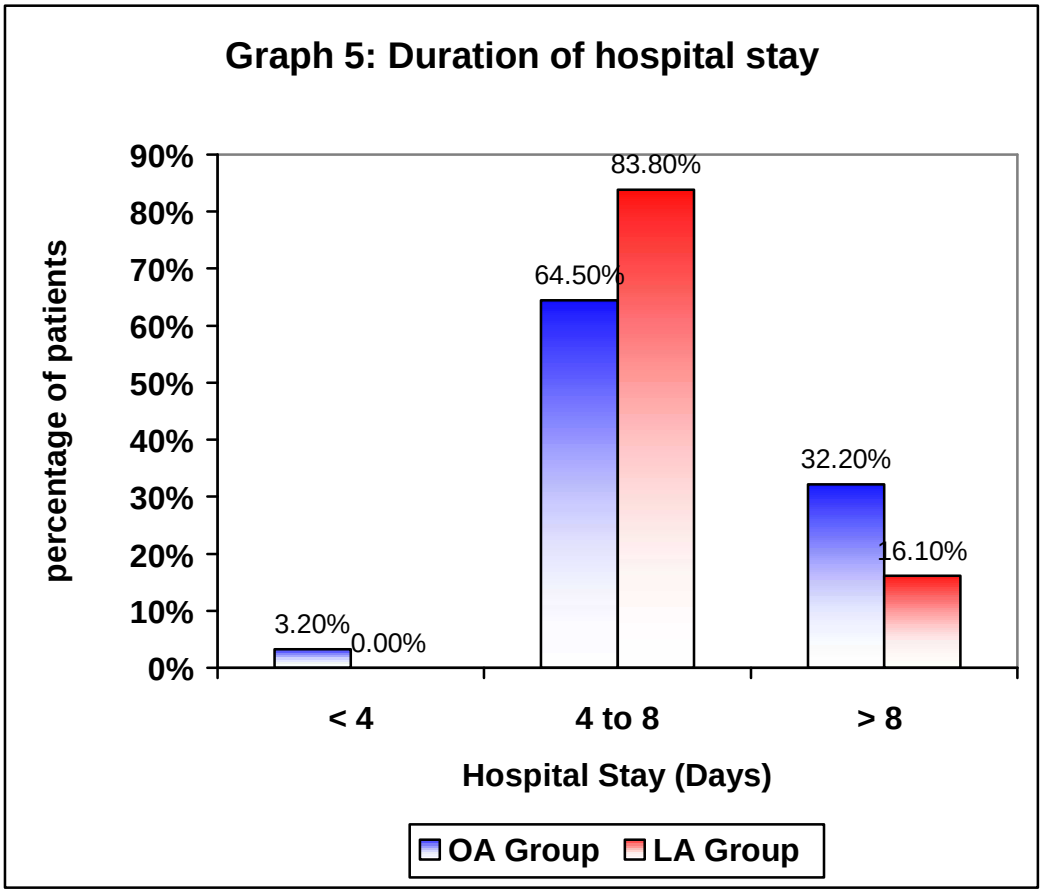
Duration (Hours)	OA Group		LA Group		p value
	Mean	S.D.	Mean	S.D.	
6	9.52	0.42	6.95	0.61	<0.0001
12	9.22	0.31	6.88	0.62	<0.0001
18	8.16	0.35	6.50	0.52	<0.0001
24	7.95	0.43	4.45	0.47	<0.0001
36	7.20	0.46	4.11	0.51	<0.0001



The mean pain scores for LA were less compared to OA in the first 36 hours post operatively. The difference was statistically significant at the various intervals of time post operatively ($p<0.0001$).

Table 7: Duration of hospital stay

Hospital stay	OA Group		LA Group	
	Number	Percentage	Number	Percentage
< 4	1	3.2%	0	00%
4 to 8	20	64.5%	26	83.8%
> 8	10	32.2%	05	16.1%

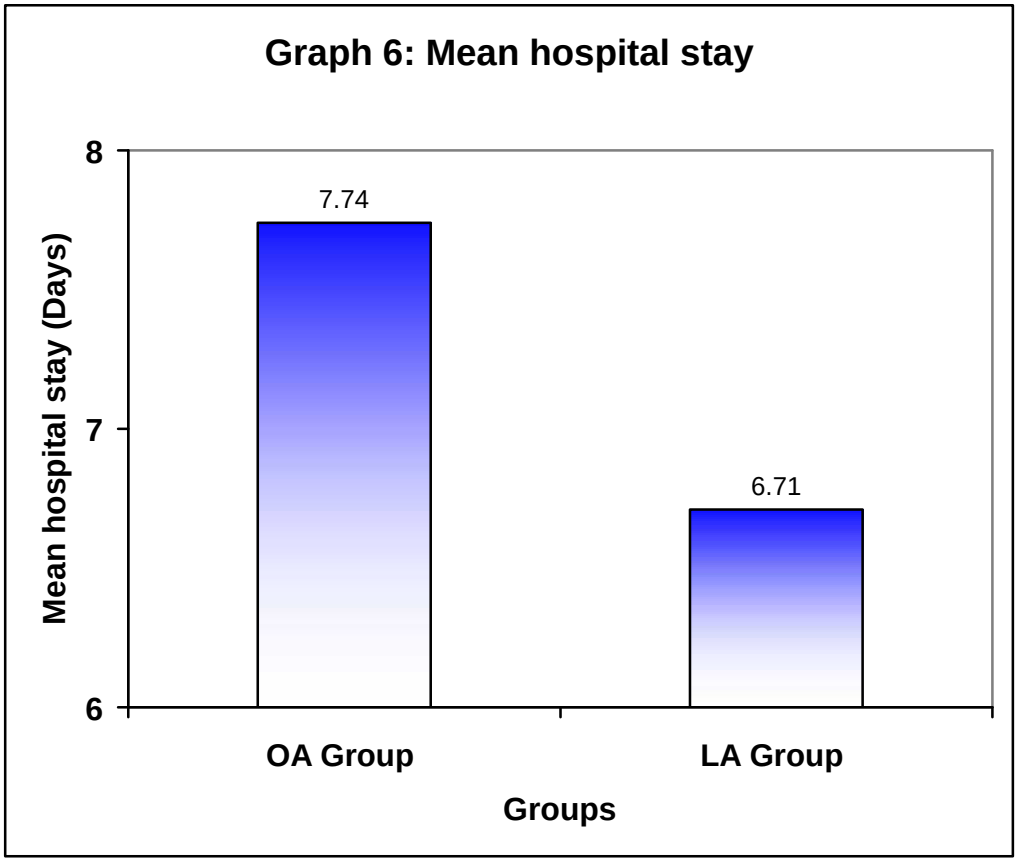


Hospitalization of less than four days was seen in one patient in OA group. 20 patients in OA group and 26 patients in LA were hospitalized between four to eight days.

Duration of hospital stay of more than eight days was seen in 10 patients undergoing OA and five patients undergoing LA.

Table 8: Mean hospital stay

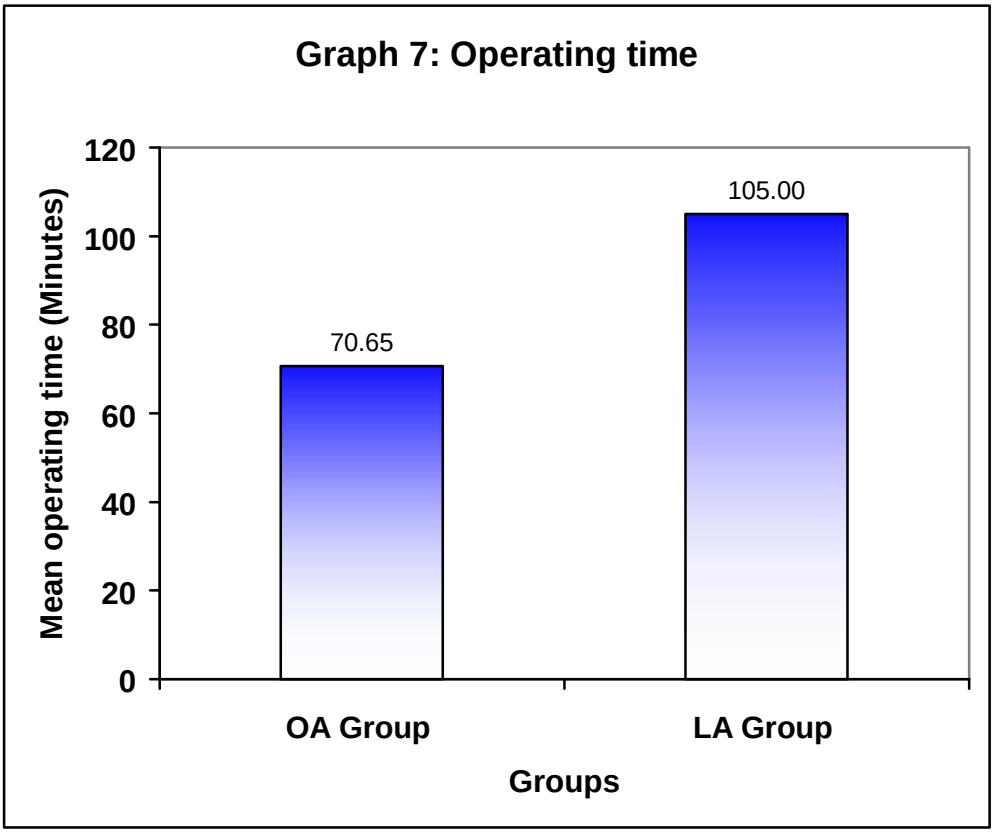
Procedure	Mean hospital stay		p value
	Mean	S.D.	
OA Group	7.74	2.41	0.0705
LA Group	6.71	1.99	



The mean postoperative stay in LA group was 6.71 days (range five to 12 days), whereas in OA group, it was 7.74 days (range three to 13 days). The difference was not statically significant (p=0.070).

Table 9: Operating time

Groups	Operating time (Minutes)		p value
	Mean	S.D.	
OA Group	70.65	15.10	< 0.0001
LA Group	105	13.90	



The mean operating time in OA group was 70.65 minutes and in the LA group was 105 minutes. The difference was found to be stastically significant (p<0.0001).

DISCUSSION

With the introduction of laparoscopy, the surgical approach to appendicectomy took a new turn and a large number of surgical procedures were attempted with this new technique.

In 1983, Kurt Semm a German gynaecologist described the first LA.[5] Laparoscopic appendicectomy like other laparoscopically adapted procedures, did not gain wide spread acceptance because the benefits of laparoscopic approach are not still clear. Unlike laparoscopic cholecystectomy (LC), LA is not regarded gold standard.

In this study both the groups had similar characteristics. The mean age for OA group was 32.51 years and for the LA was 33.61 years. The male to female ratio in both the groups were same.

The evaluation of pain for the patients who took part in the study was based on VAS. It was observed that the post operative pain measured at 6 hours, 12 hours, 18 hours, 24 hours, 36 hours was significantly lower after the laparoscopic procedure than the open procedure. These results are comparable with most of the results presented in the literature.[29,33,35,38,69] In none of the literature reviewed during this study found more pain after laparoscopic procedure.

However some of the studies did not show any difference between open and laparoscopic procedure.[36,39] Study by R. C. Ignacio et al (2004)[36] concluded that Perceived post operative pain on day one and day seven were not

statistically different between the two LA and OA. Patients studied by Namir Katkhouda et al (2005)[39] experienced similar severity of pain on post operative days one, two, three and two weeks.

It was also observed during the study that the patient who underwent LA had a better post operative recovery. The reduced trauma to the abdominal wall played a very significant factor in post surgical discomfort. The better mobility of the abdominal musculature and early ambulation, reduces the risk of early post operative complications.

The question whether laparoscopic appendicectomy decreases the length of hospitalization has been a great debate over the past decade.[28,29,31] The literature provides contradictory results. Most studies report a median hospital stay of two to five days irrespective of laparoscopic or open approach. Although some recent retrospective cohort studies or chart reviews found LA to be associated with significant shorter hospital stay.[32,67] Other retrospective investigations reported no significant differences.[37,68]

Similarly, some randomized controlled trials associated LA with decreased hospital stay.[27,30,32] However, other report no significant difference between LA and OA.[29,31,34,35,36] Even meta analyses report controversial findings. Sauerland[69] and associated summarized the results of 28 randomized trials and almost 3000 patients and reported significant decrease in length of hospital stay in patients undergoing LA. Similar results were found by Golub[33] and collegues, whereas another meta analysis failed to show a stastically significant difference in length of hospital stay between OA and LA. The current literature describes

that the difference may be affected by hospital factors or social habits rather than reflecting differences resulting from the operative technique.[37,68]

The present study revealed shorter hospital stay for patients undergoing LA.

Significant variation in operating time was noted in various controlled studies.[29,32,37] Some studies noted shorter operating time for patients undergoing OA while others revealed no difference. In present study more operating time was noted for LA.

This may be due to to the inclusion of additional steps for setup like adjusting different tubes, cables and video apparatus around patient, insufflation, trocar entry under direct vision and diagnostic laparoscopy. In teaching institution participating residents generally have less experience. Time spent teaching the residents (post graduates) naturally slows the progress of the operation. The other reason is because of the learning curve during the earlier phase of the study. Laparoscopic operating time should improve with increasing experience.

During the study it was noticed that the patient who underwent laparoscopic procedure developed bowel sounds earlier compared to open group post operatively. This allowed for the early resumption of diet in laparoscopic group.

There was no conversion from LA to OA in the present study. In the present study 31 patients underwent LA. In the literature the conversion rate varies from one percent to 22%.[35,38] The reasons for conversion are strong

infiltration and adhesion around cecum, bleeding from the appendicular artery and retrocecal location of the appendix.

Three patients who underwent LA complained of shoulder pain post operatively. Shoulder tip pain following laparoscopy is a known side effect. Several causes for shoulder pain following laparoscopic surgery have been suggested. They are the effect of CO2 gas,[70] peritoneal stretching, diaphragmatic irritation, diaphragmatic injury, and even shoulder abduction during surgery.[71]. The pain usually last for 2-3 days.

Added advantage of laparoscopic procedure is the ability to scan the abdomen (diagnostic scopy), if the diagnosis is in doubt. Laparoscopy gives a better evaluation of the peritoneal cavity than that obtained by standard grid iron incision. The procedure allows rapid and thorough inspection of the para colic gutters and the pelvic cavity that is not possible with open grid iron incision. It plays a significant role in young females where at times it is nearly impossible to differentiate between acute appendicitis and gynecological clinical condition like PID, twisted ovary and ectopic pregnancy.

In the present study the post operative complication and the cost analysis were not included. Our follow up was limited to, till the patient got discharged from the hospital.

CONCLUSION

In our study we find an advantage of LA over OA.

Laparoscopic appendicectomy was found to be associated with shorter hospital stay and decreased post operative pain. Therefore LA can be safely used for appendicitis unless laparoscopy is contraindicated.

SUMMARY

In the present study 62 patients admitted at KLES Dr. Prabhakar Kore Hospital and Medical Research Center, Belgaum with a diagnosis of appendicitis were randomized to undergo open and laparoscopic appendicectomy. 31 patients constituted each group. The results of the study were as follows:

- The commonest presenting complaint in both the groups was pain in the right lower quadrant followed by nausea, vomiting and fever.
- The mean ages of patient undergoing OA and LA were 32.55 and 33.61 years respectively (p=0.689).
- The duration of LA was significantly more than for OA (mean 105 versus 70.65 minutes respectively).
- There was no conversion from LA to OA.
- The Visual Analog Scale for pain in the post operative period was significantly less for LA patients compared to OA patients (p<0.0001).
- Patients undergoing LA developed bowel sounds earlier compared to open group post operatively. This resulted in early resumption of diet in LA group.
- In three patients who underwent LA complained of shoulder tip pain post operatively.
- The duration of hospital stay was longer for OA group than for LA group. (Mean 7.74 versus 6.74 days respectively).

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ANNEXURE I

CONSENT FORM

Mr./Mrs._____we are requesting you to enroll yourself in study conducted by DR S .PRAMOD, postgraduate student in M.S General Surgery under the guidance of DR A.S GOGATE at J.N Medical College, Belgaum.

You have been requested to participate. During the study you will be asked some questions and you are supposed to answer to the best of your knowledge.

Your participation in research is voluntary. Your decision whether or not to participate in the study will not affect your relationship with Jawaharlal Nehru Medical College, Belgaum. If you decide to participate you are free to withdraw at any time.

The purpose of research is to compare OA versus LA with relation to post operative pain and duration of hospital stay.

Procedure involved

If you agree in this research study we would ask you present, past and family history. After detailed clinical examination and routine investigation, when found fit for surgery you will be randomly assigned for the treatment with either open or laparoscopic method.

Risks and benefits

There are many risks involved in open and laparoscopic appendicectomy during anesthesia, operation and during post operative period. If any complication during the operation or during post operative period occurs then you will be treated with best of our knowledge. There is no compensation or payment for such medical treatment.

Alternatives

Even if you decline in participation, you will get the routine line of management.

Privacy and confidentiality

The only people to know that you are a research subject are members of the research team. No information about you or provided by you during the research will be disclosed to others without your written permission except:

1. In emergency to protect your rights and welfare.
2. If required by law.

Authorization to publish results

When the results of the research are published or discussed, in a conference, no information will be displayed that would disclose your identity. Any information that is obtained in connection with this study and that can be identified with you will remain confidential.

Financial incentives for participation

You will not be paid/offered any free gifts for participating in the research. You will not be reimbursed for expenses.

Consent form

I undersigned_____ have been explained in my vernacular language about the study and my participation in the study is voluntary. If I want, I can withdraw at any time. Also I have been explained about the risks involved in each of the procedure and been given enough time to clear my doubts and rights as study participant.

In case you have any questions related to the study, you can contact Dr. S. Pramod (Phone No 9900155256).

In case you have any questions about my rights as a study participant, you can contact Dr V. D. Patil (0831-2471350)

Signature or the Left Thumb print of Participant or legally authorized representative

Participants Name_____ Signature_____

Witness Name_____ Signature_____

Experimenter's Name_____ Signature_____

Date_____

Place_____

ANNEXURE II

PROFOMA

Group Patients name:

Address Age/sex.

I.P.Number D.O.A

D.O.D

Chief complaints

1.

2.

3.

General physical examination

Vital signs- Pulse Rate:

Blood Pressure:

Respiratory Rate:

Any other complaints

Local examination

Systemic examination

1. Respiratory examination.

2. Per abdomen examination.
3. Cardiovascular system.
4. Central nervous system.

Provisional diagnosis

Final diagnosis

Operative procedure

Anaesthesia

Evaluation of pain by visual analogue scale (VAS)

0 5 10

No pain worst pain.

0 to 3	-	Mild pain
3 to 7	-	Moderate pain
7 to 10	-	Severe pain

ANNEXURE III - PHOTOGRAPHS

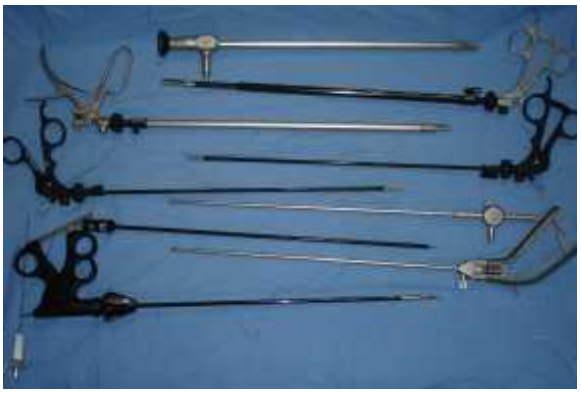

Photo 1: Laparoscopic hand instruments

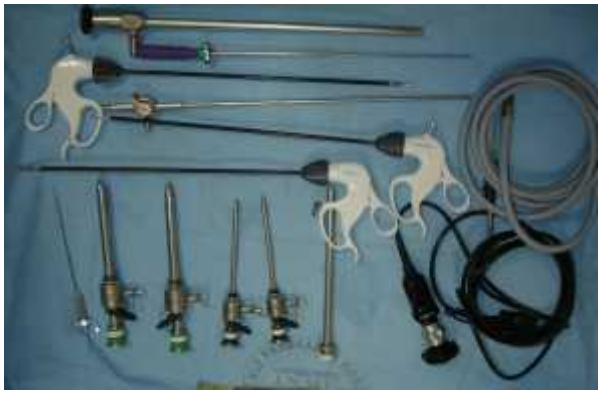

Photo 2: Laparoscopic instruments

Photo 3: Position of instruments

Photo 4: Instrument setup

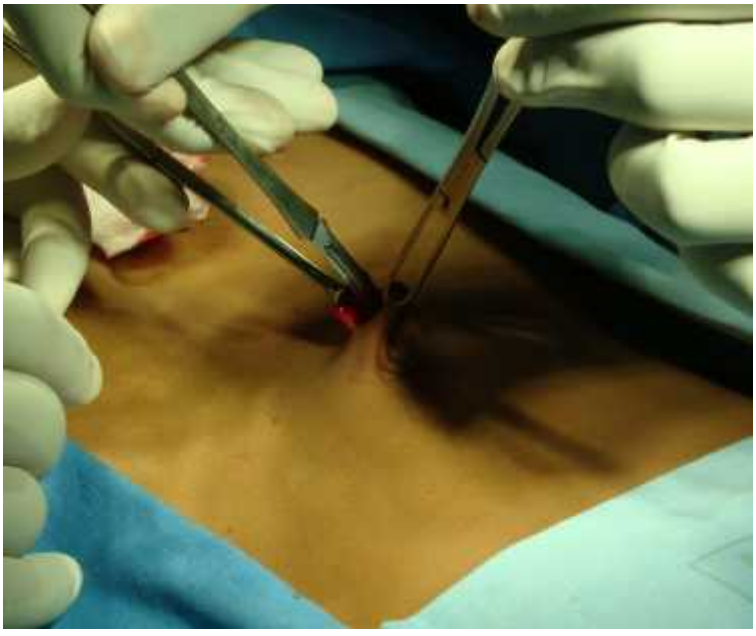

Photo 5: Open technique of trocar insertion

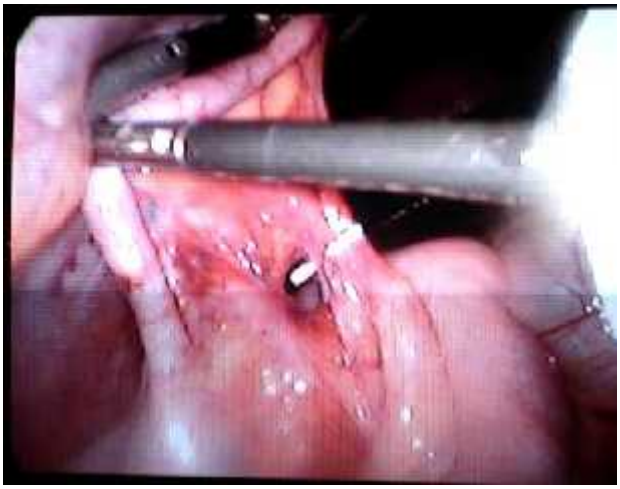

Photo 6: Mesoappendix clipped

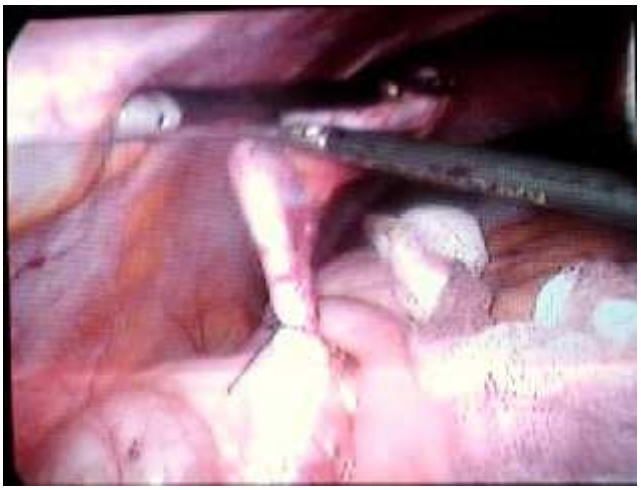

Photo 7: Base of appendix ligated

Photo 8: Patients marking score

ANNEXURE III - MASTER CHART

LAPAROSCOPIC APPENDICECTOMY

SI.No	I.P . No	Age (yrs)	Sex	D.O.A	D.O.D	HS	Post operative pain assessment						D.O.O
							6 hours	12 hours	18 hours	24 hours	36 hours	DoS	
1	254096	60	M	5/12/2007	12/12/2007	7	7	7	6.5	4	4	110	7/12/2007
2	257288	48	F	2/1/2008	14/1/2008	12	6.5	6	6	4	4	100	7/1/2008
3	258671	25	M	14/1/2008	22/1/2008	8	7	7	7	3	3	90	18/1/2008
4	259714	19	F	23/1/2008	29/1/2008	6	6	6	6	4.5	4.5	110	24/1/2008
5	260805	30	F	2/2/2008	8/2/2008	6	7.5	7.5	7.5	5	4.5	100	4/2/2008
6	260826	40	F	2/2/2008	13/2/2008	9	8	8	7.5	4.5	4	110	8/2/2008
7	262038	40	M	13/2/2008	18/2/2008	5	6.5	6.5	6.5	4.5	4	120	15/2/2008
8	262103	29	M	13/2/2008	18/2/2008	5	6	6	6	4.5	4	130	15/02/2008
9	262881	35	F	20/2/2008	25/2/2008	5	7.5	7.5	6.5	4.5	4	90	22/2/2008
10	262929	28	M	20/2/2008	25/2/2008	5	7	7	7	4	4	85	22/2/2008
11	263724	35	F	27/2/2008	4/3/2008	5	7	6.5	6	5	4.5	90	29/2/2008
12	264863	28	M	8/3/2008	18/3/2008	10	7	6.5	6	4.5	5	110	14/3/2008
13	265319	28	F	12/3/2008	18/3/2008	6	7.5	7.5	7	5	4.5	110	14/3/2008
14	267763	26	M	2/4/2008	10/4/2008	8	8	8	6.5	4.5	4	110	5/4/2008
15	267805	32	M	2/4/2008	13/4/2008	11	6.5	6.5	6	4.5	4	100	11/4/2008
16	270737	50	F	27/4/2008	2/5/2008	5	6	6	6	5.5	5	110	28/4/2008

SI.No	I.P . No	Age (yrs)	Sex	D.O.A	D.O.D	HS	Post operative pain assessment						D.O.O
							6 hours	12 hours	18 hours	24 hours	36 hours	DoS	
17	273681	35	M	21/5/2008	26/5/2008	5	7.5	7.5	7	4.5	4.5	85	23/5/2008
18	274568	48	F	28/5/2008	5/6/2008	8	7	7	6.5	4.5	4	100	2/6/2008
19	274993	50	M	31/5/2008	7/6/2008	7	6.5	6.5	6.5	5	4.5	110	2/6/2008
20	275828	25	M	7/6/2008	13/6/2008	6	6	5.5	6	4.5	4	100	9/6/2008
21	283917	21	M	7/8/2008	12/8/2008	5	6.5	6.5	6	4	3	110	8/8/2008
22	284109	50	F	9/8/2008	16/8/2008	7	7	6.5	6	5	4.5	120	10/8/2008
23	284306	25	M	11/8/2008	16/8/2008	5	7.5	7	6.5	4	3	130	12/8/2008
24	288972	20	F	17/9/2008	22/9/2008	5	6.5	6.5	6.5	4.5	4.5	135	19/9/2008
25	290059	23	M	24/9/2008	30/9/2008	6	7	7	7	4	3.5	90	26/9/2008
26	293271	22	F	21/10/2008	27/10/2008	6	7	7	6	4	4	120	24/10/2008
27	293440	30	F	22/10/2008	30/10/2008	8	8	7.5	7.5	4.5	4	90	27/10/2008
28	294980	35	M	5/11/2008	10/11/2008	5	7.5	7	6	4.5	4	80	7/11/2008
29	294982	35	F	5/11/2008	10/11/2008	5	7	7	7	4.5	4	100	7/11/2008
30	296838	23	F	19/11/2008	26/11/2008	7	6	7	7	4	4	110	21/11/2008
31	296834	47	M	19/11/2008	29/11/2008	10	7.5	7	6	5	5	100	21/11/2008

OPEN APPENDICECTOMY

SI.No	I.P . No	Age (yrs)	Sex	D.O.A	D.O.D	HS	Post operative pain assessment						D.O.O
							6 hours	12 hours	18 hours	24 hours	36 hours	DoS	
1	257358	38	F	3/1/2008	12/1/2008	9	9	9	8.5	8	7	60	5/1/2008
2	258102	33	F	9/1/2008	19/1/2008	10	9.5	9	8	8	7	60	14/1/2008
3	262749	28	M	19/2/2008	25/2/2008	6	9	9	8	7.5	6.5	60	21/2/2008
4	265487	34	M	13/3/2008	16/3/2008	3	9.5	8.5	8.5	8	7.5	75	13/3/2008
5	265281	32	F	12/3/2008	22/3/2008	10	10	9.5	8.5	7.5	7	90	14/3/2008
6	269035	38	F	13/4/2008	24/4/2008	11	9.5	9	8	8	7	75	14/4/2008
7	269415	25	F	16/4/2008	21/4/2008	5	10	9.5	9	9	8	75	18/4/2008
8	270096	24	M	22/4/2008	29/4/2008	7	9	9	8	8	7.5	60	22/4/2008
9	272149	37	F	9/5/2008	19/5/2008	10	10	9.5	8.5	8.5	8	75	10/5/2008
10	277863	25	F	23/6/2008	3/7/2008	10	9.5	9	8	8	8	60	27/6/2008
11	278908	24	F	1/7/2008	8/7/2008	7	10	9.5	8.5	8	7	60	1/7/2008
12	279266	18	F	2/7/2008	9/7/2008	7	10	9.5	8	7.5	7	75	4/7/2008
13	279958	45	M	9/7/2008	15/7/2008	6	9	9	8	8	7.5	90	11/7/2008
14	280392	44	M	12/7/2008	19/7/2008	7	9.5	9	7.5	7.5	6.5	75	12/7/2008
15	280769	30	M	15/7/2008	23/7/2008	8	9	9	8.5	8	7	75	17/7/2008
16	281646	45	F	21/7/2008	31/7/2008	10	10	9.5	8	9	7.5	90	25/7/2008

SI.No	I.P . No	Age (yrs)	Sex	D.O.A	D.O.D	HS	Post operative pain assessment						D.O.O
							6 hours	12 hours	18 hours	24 hours	36 hours	DoS	
17	282200	46	M	25/7/2008	2/8/2008	8	9.5	9.5	8	8	8	60	28/7/2008
18	282700	19	F	29/7/2008	5/8/2008	7	10	9.5	8	7.5	7	75	29/7/2008
19	282587	26	M	28/7/2008	1/8/2008	4	9.5	9.5	8.5	8	8	120	30/7/2008
20	282818	22	M	30/7/2008	2/8/2008	4	9	9	8.5	8	7.5	60	30/7/2008
21	284018	25	M	8/8/2008	13/8/2008	5	9	9	8	7	7	60	9/8/2008
22	287302	22	F	5/9/2008	13/9/2008	8	10	9.5	8.5	8.5	7	45	6/9/2008
23	287917	23	M	10/9/2008	18/9/2008	8	9	9	8	8	6.5	60	11/9/2008
24	288269	38	M	12/9/2008	22/9/2008	10	9.5	9.5	7.5	7.5	7	60	15/9/2008
25	290057	25	M	24/9/2008	30/9/2008	6	9	9	8	8	7	90	26/9/2008
26	291799	50	M	10/10/2008	18/10/2008	8	9.5	9.5	8.5	8.5	7.5	60	11/10/2008
27	294097	26	M	29/10/2008	6/11/2008	8	9	9	8	8	7	90	30/10/2008
28	294240	30	F	30/10/2008	4/11/2008	5	10	9	7.5	7.5	7	60	31/10/2008
29	294575	37	M	2/11/2008	10/11/2008	8	9.5	9	8	8	7	60	3/11/2008
30	295285	42	F	7/11/2008	20/11/2008	13	10	9.5	8	7.5	6.5	60	10/11/2008
31	296275	58	F	14/11/2008	26/11/2008	12	10	10	8.5	8	7.5	75	18/11/2008

ANNEXURE IV

KEY TO MASTER CHART

A	-	Age
D.O.A	-	Date of Admission
D.O.D	-	Date of Discharge
D.O.O	-	Date of Operation
DoS	-	Duration of Surgery
F	-	Female
HS	-	Hospital Stay
I.P	-	Inpatient
M	-	Male
No	-	Number
SI	-	Serial number