A TWO YEAR RETROSPECTIVE REVIEW OF LAPAROSCOPIC VERSUS OPEN APPENDICECTOMY IN PERFORATED APPENDIX IN HOSPITAL IPOH (JUNE 2006-MAY 2008)

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DISSERTATION SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF MEDICINE

(GENERAL SURGERY)

UNIVERSITI SAINS MALAYSIA

UNIVERSITI SAINS MALAYSIA

AUGUST 2010

I. ACKNOWLEDGEMENT

My deepest and heartfelt gratitude to my supervisors Mr. Stephen Jacob (former Head of Department of Surgery and Senior Consultant of Surgery of General Hospital Raja Permaisuri Bainun Ipoh) and Mr. Yan Yang Wai (Head of Department of Surgery and Senior Consultant of Surgery of General Hospital Raja Permaisuri Bainun Ipoh) for sparing their valuable time and energy in helping me with my dissertation. I would also like to thank my in-campus supervisor Dr. Mohd. Nor Gohar Rahman for his invaluable assistance in helping complete this study.

I am also grateful to Dr.Syed Hatim and Dr. Kamarul Imran for their input on helping me analyse my data.

A heartfelt thanks also goes out to the director of Hospital Raja Permaisuri Bainun Ipoh, Dr. Zaidah bt. Hussain for giving me permission to conduct this study.

I would also like to thank my parents Mr. and Mrs. Krishnan for their continuing motivation and support. And last but not least I am grateful to my husband Dr. K Sivakumar for keeping me motivated and his invaluable support.

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V. ABBREVIATIONS

CO_2	Carbon dioxide
CT	Computed tomography
N_2O	Nitrogen Oxide
COTDS	Computerised Operating Theatre Documentation System
N.A.	Not available
n	Number of patients
NF – k B	Nuclear factor kappa beta
MAPK	Mitogen activated protein kinases
IL	Interlukin
IFN	Interferon
TNF	Tumour Necrosis Factor
CRP	C reactive protein

VI. ABSTRAK

Tajuk: Perbandingan Di antara Appendisektomi Laparoskopik Dan Appendisektomi Terbuka untuk appendiks yang pecah Di Hospital Ipoh dari bulan Jun 2006 ke bulan Mei 2008.

Appendisektomi adalah salah satu pembedahan yang paling kerap dijalankan di Jabatan pembedahan di serata dunia. (*McBurney C. et a,1894*). Pembedahan ini hampir tidak berubah langsung semenjak 100 tahun yang lalu kerana selamat dan efektif.

Appendisektomi Laparoskopik mula-mula dilakukan oleh Semm pada tahun 1983. *(Litynski, G.S. 1999).* Tetapi manfaat appendisektomi laparoskopik tidak seketara manfaat kolesistektomi (cholecystectomy) laparoskopik terutamanya dalam appendisektomi yang pecah.

Banyak kajian telah dilakukan yang gagal menunjukkan manfaat yang jelas appendisektomi laparoskopik dengan kaedah yang terbuka.

Kajian terbaru pula menunjukan laparoskopik appendisektomi semakin popular dan semakin banyak digunakan untuk merawat appendiks yang pecah. Ini disebabkan kemahiran laparoskopik yang semakin meningkat di kalangan pengamal perubatan.

Tujuan dissertasi ini adalah untuk membandingkan hasil kaedah appendisektomi laparoskopik dengan appendisektomi terbuka.

KEPUTUSAN: Seramai dua ratus lima pesakit yang telah mengalami appendiks yang pecah telah dimasukkan di dalam dissertasi ini. Umur median untuk kumpulan laparoskopik ialah 28 tahun dan kumpulan terbuka ialah 30 tahun. Purata jangka masa pembedahan ialah 69 minit untuk kumpulan laparoskopik dan 63 minit untuk kumpulan terbuka. Kedua-dua pemerhatian ini menunjukkan perbezaan statistik yang tidak signifikan. Begitu juga bagi purata masa tinggal di hospital pula ialah 3.5 hari untuk kumpulan laparoskopik dan 3.1 hari untuk kumpulan terbuka. Nilai 'p' untuk pemerhatian ini ialah 0.382. Perbezaan untuk pesakit mula makan dan untuk demam turun juga tidak menunjukan signifikan dari segi statistik. Enam pesakit mengalami jangkitan kuman di tempat pembedahan dalam kumpulan terbuka dan tiada dalam kumpulan laparoskopik (p = 1.000.) Lima pesakit dari kumpulan terbuka dan dua dari kumpulan laparoskopik telah diwadkan semula kurang seminggu dari tarikh pembedahan sebab mengalami perut kembung. Ini tidak signifikan dari segi statistik. Bagi ubat tahan sakit pula, purata (s.d.) penggunaan ialah 387.5mg (259.4mg) untuk kumpulan laparoskopik dan 274.5mg (204.3mg) untuk kumpulan terbuka. Nilai ini menunjukkan perbezaan yang signifikan dari segi statistic (p = 0.006.)

RUMUSAN: Tidak ada perbezaan yang ketara di antara kaedah laparoskopik atau terbuka untuk appendik yang pecah. Kedua-duanya merupakan kaedah yang sama efektif untuk merawat appendiks yang pecah.

VII. ABSTRACT

Topic: A Two Year Retrospective Review Of Laparoscopic Versus Open Appendicectomy In Perforated Appendix In Hospital Ipoh (June 2006-May 2008).

Appendicectomy is one of the most common general surgical procedures performed all over the world in the surgical department. Since its description by McBurney in 1894 the open approach has become the standard surgical intervention for appendicitis, remaining virtually unchanged for 100 years owing to its proven efficacy and safety.

Laparoscopic appendicectomy on the other hand was first performed by Semm in 1983 *(Litynski, G.S. 1999)*.But its popularity increased steadily throughout the 1990s. However, unlike cholecystectomy, the benefits of the laparoscopic approach have not been as apparent for appendicectomy, even more so in perforated appendicitis. Many early randomized trials failed to show any overall benefit for laparoscopy and others at best parity between the 2 procedures.

Current studies however indicate a shift in favour of laparoscopy, probably due to the increase in laparoscopic exposure at all levels of surgical training. The aim of this study is to compare certain parameters between Laparoscopic appendicectomy with open appendicectomy.

RESULTS: Two hundred and five patients with perforated appendicitis were reviewed. Fifty-six patients had laparoscopic appendicectomy and one hundred and forty nine patients had open appendicectomy. The median age in the laparoscopic group was 28 and the open group was 30. The difference in the median age groups was not statistically significant .The *p* value is 0.310. The mean (s.d) operating time for laparoscopic appendicectomy was 69 minutes (29 minutes).The mean operating time for the open group was 63 minutes (28 minutes). This study showed that there was no significant difference in the mean length of operating time between the two methods. The *p* value is 0.669. The mean (s.d.) length of hospital stay for the patients in the laparoscopic group was 3.5days (1.6 days). In the open group the mean length of hospital stay was 3.1 days (1.9 days). This was statistically not significant (p=0.382).There was also no statistical significance in the duration the patients took to tolerate orally and for the temperature to settle in both the groups. There were a total of six patients with the surgical site infection and seven who had readmission. Although all 6 patients with surgical site infection were from the open group and none in the laparoscopic group this was not statiscally significant. p = 1.000. Five patients in the laparoscopic group and two in the open group were readmitted within a week of their respective surgeries for ileus. This difference was also not statistically significant with a p value of 1.000.The mean (s.d.) amount of analgesia used in laparoscopic appendicectomy was 387.5mg (259.4mg) . The mean (s.d.) for the use of analgesia in the open group was 274.5mg (204.3mg) for the open group. This was statistically significant where p = 0.006.

CONCLUSION: There is no clinically significant difference between laparoscopic appendicectomy and open appendicectomy for perforated appendicitis.

1. INTRODUCTION

One of the most common general surgical procedures that is performed in the surgical department is appendicectomy. Since its description by McBurney the open approach has become the standard surgical intervention for appendicitis, remaining virtually unchanged for 100 years owing to its proven efficacy and safety. (*McBurney C. et al,1894)*

The optimal approach for appendicectomy is still under debate although laparoscopic appendicectomy has been performed since 1980 (*Lityinski,1999).*

The longer operating time, similar duration of hospital stay and increased incidence of intra-abdominal collection or postoperative ileus with laparoscopic appendicectomy outweighed any improvement in wound complication, recovery time or cosmesis. Current studies however present evidence of reduction in operating time, faster recovery, and lower wound complication rates, with the reversal in the risk of developing ileus in favour of laparoscopy . (*Golub R. et al, 1998*)

In Hospital Raja Permaisuri Bainun Ipoh, around 95 cases of perforated appendix are seen annually. There were one hundred and four patients with perforated appendicitis in 2006 and ninety-one patients with perforated appendicitis in 2007.

The usual method of choice has been open appendicectomy especially for perforated appendicitis. But since 2006 June laparoscopic appendicectomy has been done for acute as well as perforated appendicitis. In this study we compared the outcome of certain parameters between open and laparoscopic appendicectomy at our centre. The parameters that were compared were length of hospital stay, length of operative time, duration of ileus, duration of pyrexia and analgesia use. As for post-operative complications we only compared the number of readmissions and surgical site infections as these two parameters were the most constantly recorded.

This study will therefore show the outcome of laparoscopic and open appendicectomy in the treatment of perforated appendicitis. This in turn will enable the practitioners at this centre to choose the modality of treatment for perforated appendicitis.

2. LITERATURE REVIEW

2.1.(a) Historical review of Open Appendicectomy

Appendicitis and appendectomy has been described during the past two centuries. Jacopo Berengario da Carpi first described this structure in 1521. Gabriele Fallopio, appears to have been the first writer to compare the appendix to a worm in 1561. (*Williams G.R. 1983*.)

Numerous anatomists have added more or less insignificant ideas concerning the structure of the appendix and entered upon useless controversy concerning the name, function, position of the appendix vermiformis.

Appendicectomy was first successfully performed in 1735 by Claudius Amyand. (*Williams G.R. 1983*). Geillaume Dupuytren hypothesized that acute inflammation of the right side of the abdomen was due to disease of the caecum and not the appendix. In the early stages surgeons were wary of opening the abdomen for examination, so the initial presentation of appendicitis remained unknown. In 1812 John Parkinson gave a good description of fatal appendicitis. Because of this surgeons started draining localized abscesses. (*Williams G.R. 1983*).

The first diagnosis of appendicitis was made by Robert Lawson Tait in 1880 . (*Williams G.R. 1983*.) He also had surgically removed the appendix. Reginald Heber Fitz published a study on appendicitis in 1886 and named the procedure appendectomy. In 1889, Tait drained an inflamed appendix by splitting it open. He did not remove the appendix. The original operation that involved splitting of muscle was proposed by Charles McBurney in 1893. This operation was modified by Robert Fulton Weir in 1900 (*Williams G.R. 1983*). Currently there is a array of signs and symptoms, helping to diagnose appendicitis, and there are many methods for operation with little essential difference throughout.

2.1 (b) Review of history of laparoscopic appendicectomy

The framework and ideas for laparoscopic surgery were reported over a century ago. But, the introduction of laparoscopy in general surgery has been a relatively recent development.The development of laparoscopic surgery owes much of its history to the development of endoscopic technique. Albukasim (936-1013 A.D.), and the Frankfurt-born physician, Phillip Bozzini, in 1805 were among the first physicians to develop methods to examine body cavities. (*Lau WY et al, 1997).*

The history of laparoscopy illustrates the interaction between the many areas of medicine and technology; that is a cummulative effort of internists, gynecologists, and surgeons. At the beginning of our century, however, neither group was particularly open to the idea of scholarly exchange. *(Lityinski G. S., 1999).*

An early pioneer of laparoscopy, is Georg Kelling (1866–1945), a German physician from Dresden. He spent a great deal of time studying the capacity of the stomach, developing a semiflexible tube endoscope (straightened after the insertion), and attempting to alleviate gastrointestinal bleeding by means of high-pressure pneumoperitoneum (*lufttamponade*). He also performed the first laparoscopic intervention on 23 September 1901 using a Nitze cystoscope in a dog. *(Lau WY et al, 1997).*

His interest in the basic sciences such as anatomy and physiology of the gastrointestinal tract was reflected in his doctoral thesis. This experience, and his knowledge on air insufflation of the abdominal cavity, enabled him to be the first to develop the procedure which he named “celioscopy”. He developed various basic principles during these initial stages which are still valid today (*Lau WY et al, 1997).*

Celioscopy was created as an additional method to view the effects of *lufttamponde*, not as an endoscopic method itself. Kelling presented the technique in Hamburg as an endoscopic procedure. (*Lau WY et al, 1997).*

Further advances of technology (i.e., cold-light, Hopkins optical system, “video-endoscopy”) and the work of numerous scientists all over the world (e.g., Jacobaeus, Kalk, Ruddock, Palmer, Semm, Berci, Muhe, Troidl, Dubois, Perissat, Olsen, and Reddick) paved the way to the laparoscopic revolution of the late 1980s. (*Lityinsk G.S., 1999).*

Dr. H. C. Jacobaeus performed the first clinical laparoscopic surgery in Stockholm 94 years ago in 1910. His method was based on the animal experiments of Georg Kelling (1866-1945) as mentioned earlier. Jacobaeus published his first experiences in 1910 regarding laparoscopic surgery in the Munchner Medizinische Wochenschrift with the title “The possibility to perform cystoscopy in examinations of serous cavities." He used this technique for the diagnosis of unclear abdominal complaints and functional impairment. Jacobaeus also was the first person to point out the possibility of causing injury to organs, especially the gut, by inserting the trocar. In 1910 Jacobaeus recognized the vast diagnostic and curative possibilities of laparoscopic surgery, but also the difficulties and restrictions. He was also the first to realize that complete training sessions on animals and dead bodies were needed. He insisted that special laparoscopic instruments be developed to optimize and simplify the operation. (*Lityinski G.S. 1999).*

Semm developed thermocoagulation in the 1970s. He personalised the Roeder Loop, and further created extra and intra coporeal endoscopic knotting to attain endoscopic hemostasis (*Lau WY et al, 1997).*

His various technical inventions, especially the electronic insufflator, enabled more difficult surgeries to be performed using the laparoscopic technique. However, his methods were not easily adopted by the surgical society. There was an outcry when Semm carried out the first fully laparoscopic appendicectomy in 1980. Many prominent surgeons, were of the idea that Semm exaggerated the problem of laparoscopic surgery. These complications included adhesions, and that laparoscopic technique itself was regarded to be unsafe. Semm was able to force his ideas through despite skepticism and being misunderstood by medical scientists. He knew that endoscopic surgery had great potential, and popularised laparoscopic technique not only in his field of gynecology but among general surgeons as well. (*Lau WY et al, 1997).*

In 1985, Semm gave the initiative and paved the way for to McKernan and Save of Marietta, Georgia, to perform the first cholecystectomy laparoscopically in the United State when he presented a videotape of his laparoscopic appendectomy in Baltimore three years later (*Litynski, G. S.,1999)*

During the early 1980s, Semm's achievements with laparoscopic appendectomy reached the German medical circles. Erich Muhe, came up with the idea of laparoscopic removal of gallstones after hearing of Semm's technique and encouraged by the successes of the Erlangen endoscopists,. The details of an operative laparoscope, the "Galloscope," was done by Muhe in 1984 . On September

12, 1985, he performed the first cholecystectomy laparoscopically. Later, he improved on his technique and operated through a trocar sleeve.

Finally, he created an "open laparoscope" with a circular light. Muhe had conducted ninety seven endoscopic gallbladder removals by March 1987. Although he published information about his technique at the Congress of the German Surgical Society in April 1986 and at other surgical meetings in Germany his concept was disregarded.

The surgical community was still not ready for the era of "minimally invasive therapy." Erich Muhe was a surgeon ahead of his time. (*Litynski, G. S.1999).*

Laparoscopy was essentially used by gynecologists in the late 1980s (*Litynski, G. S.1999).* Phillipe Mouret of Lyon, a french private surgeon, shared his surgical practice with a gynecologist and therefore had the opportunity to use both laparoscopic equipment and also access to patients requiring laparoscopic intervention. Mouret carried out his first laparoscopic cholecystectomy by means of electronic laparoscopy in March of 1987. But he never published anything about this experience. The news on his technique reached Francois Dubois of Paris who had no prior laparoscopic experience. Dubois acted immediately. He performed his first animal experiments by borrowing instruments from gynecologists. He carried out his first laparoscopic cholecystectomy (LC) in Paris in April 1988 (*Litynski, G. S.1999).*. Jacques Perissat of Bordeaux, was inspired by Dubois. He presented this technique at a meeting in Louisville in April 1989 after introducing endoscopic cholecystectomy in his clinic. Very soon, news of the French work in laparoscopic cholecystectomy soon swept beyond the country's borders. Dubois and Perissat spoke about their work and were largely responsible for establishing what is today called the French technique. (*Litynski, G. S.1999).*

The swift acceptance of the technique of laparoscopic surgery by the general population is incomparable in the history of surgery. It has changed the field of general surgery more dramatically and more quickly than any other surgical milestone. (*Litynski, G. S.,1999).*

2.2 Embryology and Anatomy of Appendix

The appendix, ileum, and ascending colon are all derived from the midgut. The appendix first appears at the 8th week of gestation as an out pouching of the ceacum and gradually rotates to a more medial location as the gut rotates and the ceacum becomes fixed in the right lower quadrant *(Prystowsky JB et al, 2005).*

The appendiceal artery, a branch of the ileocolic artery, supplies the appendix. Histologic examination of the appendix indicates that goblet cells, which produce mucus, are scattered throughout the mucosa. The submucosa contains lymphoid follicles, leading to speculation that the appendix might have an important, as yet undefined, immune function early in development. The lymphatics drain into the anterior ileocolic lymph nodes. In adults, the appendix has no known function.

The length of the appendix varies from 2 to 20 cm, and the average length is 9 cm in adults. The base of the appendix is located at the convergence of the taeniae along the inferior aspect of the ceacum, and this anatomic relationship facilitates identification of the appendix at operation. The tip of the appendix may lie in a variety of locations. The most common location is retrocecal but within the peritoneal cavity. It is pelvic in 30% and retroperitoneal in 7% of the population. *(Prystowsky JB et al, 2005).*

The varying location of the tip of the appendix likely explains the myriad of symptoms that are attributable to the inflamed appendix. (*John Maa et al, Sabiston Textbook of Surgery, 18th ed).*

2.3 Pathophysiology of appendicitis

There are two main reason for acute appendicitis. One reason is obstruction or occlusion of the lumen. This may be due to fecolith, appendicolith, lymphoid hyperplasia, particles from vegetables or seeds, parasites, or a growth. In view of its small lumen in relation to its length, the appendix is prone for closed loop obstruction. When the appendiceal lumen is obstructed there is bacterial overgrowth. The continued secretion of mucus leads to distension of the lumen and increased wall pressure. Luminal distention causes visceral pain sensation which is experienced by the patient as periumbilical pain. Mucosal ischemia results from impaired lymphatic and venous drainage. These events will result in a localized inflammatory process that may progress to gangrene and perforation. Localized pain in the right lower quadrant is a result of inflammation of the adjacent peritoneum. *(Prystowsky JB et al, 2005).* Perforated appendicitis occurs in 20-24% of patients with appendicitis, *(Körner H et al, 1997)* with higher rates in small children about 30-45% *(Lau WY et al, 1987)* and the elderly, irrespective of gender. Factors that increase the rate of perforation are delayed presentation to medical care and extremes of age . *(Körner H et al, 1997)*

Another reason is the non-occlusive appendicitis. The mucosa of the gastrointestinal tract, including the appendix is susceptible to ischeamia. Impairment to vascular flow can be due to compression by mesenteric lymph nodes, vasculitis, local peritoneal infection like pelvic inflammatory disease, causing the appencieal artery to develop arteritis. This will promote intravascular thrombus formation and causing the whole vessel to be thrombosed, as the diameter of this vessel is small (0.1 cm).

Compression of the venules and capillaries by local enlarged lymph nodes can also cause thrombosis of these vessels and lead to outflow of blood obstruction. This will lead to ellipsoidal infarcts at the antimesenteric border. This in turn will lead to perforation at the infracted region. The perforated site will cause localized bacterial proliferation and further lead localized peritonitis. (*Swartz's Principle of Surgery, 8th edition).*

Perforation usually occurs after at least 48 hours from the onset of symptoms although there is considerable variability and is accompanied by an abscess cavity walled-off by the small intestine and omentum. Sometimes perforation of the appendix into the peritoneal cavity occurs and patients may present with peritonitis and septic shock and which in turn can be complicated by the subsequent formation of multiple intraperitoneal abscesses. *(Prystowsky JB et al, 2005.)*

2.4 Bacteriology

In the normal appendix the normal flora is similar to that of the colon, with a variety of facultative aerobic and anaerobic bacteria. Perforated appendicitis can be due to many types of bacteria. *Streptococcus viridians, Escherichia coli,* , *Bacteroides* and *Pseudomonas* are often isolated, and many other organisms may be cultured (Table 1). Peritoneal fluid sent for cultures are very often negative and are of limited use in patients with non perforated appendicitis. Cultures of peritoneal fluid are more likely to be positive, revealing colonic bacteria with predictable sensitivities in patients with perforated appendicitis. (*Gladman MA et al, 2004).*

Table 1 -- Bacteria Commonly Isolated in Perforated Appendicitis

ANAEROBIC	PATIENTS (%)
Bacteroides fragilis	80
Bacteroides thetaiotaomicron	61
Bilophila wadswirthia	55
Peptostreptococcus species	46
AEROBIC	
Escherichia coli	77
Streptococcus viridans	43
Group D streptococcus	27
Pseudomonas aeruginosa	18

Table taken from Sabiston Textbook of Surgery 18th edition pp-1334(Adapted from Bennion RS, Thompson JE: Appendicitis. In Fry DE (ed): Surgical Infections. Boston, Little, Brown, 1995, pp 241-250).

2.5 Symptoms

Classically, pain is initially diffusely centred in the lower epigastrium or umbilical area, is moderately severe, and is steady, sometimes with intermittent cramping superimposed. After a period of time varying from 1 to 12 hours, but usually within 4 to 6 hours, the pain localizes to the right lower quadrant. This classic pain sequence, although usual, is not invariable. In some patients, the pain of appendicitis begins in the right lower quadrant and remains there. Different anatomic locations of the appendix account for many of the variations in the principal locus of the somatic phase of the pain. For example, a long appendix with the inflamed tip in the left lower quadrant causes pain in that area; a retrocecal appendix principally may cause flank or back pain; a pelvic appendix, principally suprapubic pain; and a retroileal appendix may cause testicular pain, presumably from irritation of the spermatic artery and ureter.

Anorexia nearly always accompanies appendicitis. It is so constant that the diagnosis should be questioned if the patient is not anorectic. Although vomiting occurs in nearly 75% of patients, it is neither prominent nor prolonged and most patients vomit only once or twice. Vomiting is caused both by neural stimulation and the presence of ileus.

In patients with perforated appendicitis, there may be history of high grade fever.

2.6 Signs

The anatomic location of the appendix, as well as by whether the organ has already ruptured when the patient is first examined determines the physical findings. In uncomplicated appendicitis there is very little change in the vital signs. Temperature elevation is rarely more than 1°C (1.8°F) and the pulse rate is normal or slightly elevated. Changes of greater magnitude usually indicate that a complication has occurred or that another diagnosis should be considered. *(Shwartz's Principles of Surgery, 8th edition 2005)*

Patients with appendicitis are usually comfortable in the supine position. They prefer to lie with the thighs, particularly the right thigh, drawn up, because any motion increases pain. If asked to move, they do so slowly and with caution. *(Shwartz's Principles of Surgery, 8th edition 2005)*

Tenderness is often maximal at or near McBurney's point. Direct rebound tenderness is usually present. Additionally, referred or indirect rebound tenderness is present. This referred tenderness is felt maximally in the right lower quadrant, indicating localized peritoneal irritation. The severity of the inflammatory process is roughly indicated by the muscular resistance to palpation of the abdominal wall. Voluntary guarding is usually present early in the disease. As the disease process progresses, there is increasing peritoneal irritation and muscle spasm increases and becomes largely involuntary. This is true reflex rigidity due to contraction of muscles directly beneath the inflamed parietal peritoneum.

Anatomic variations in the position of the inflamed appendix lead to deviations in the usual physical findings. In patients with retro-ceacal appendicitis, the anterior abdominal findings are less obvious and tenderness may be most marked in the flank. When the inflamed appendix hangs into the pelvis, abdominal findings may be entirely absent, and the diagnosis may be missed unless the rectum is examined. As the examining finger exerts pressure on the peritoneum of the cul-de-sac of Douglas, pain is felt in the suprapubic area, as well as locally within the rectum. (*Sedlak et al, 2008).*Signs of localized muscle irritation may also be present.

The psoas sign is an indication that there is an irritative focus close to the psoas muscle. The test is performed by having patients lay on their left side as the examiner slowly extends the right thigh, thus stretching the iliopsoas muscle. The test is positive if extension produces pain. Similarly, a positive obturator sign of hypogastric pain on stretching the obturator internus indicates irritation in the pelvis. The test is performed by passive internal rotation of the flexed right thigh with the patient supine. Rovsing's sign which is pain felt in the right lower quadrant when palpatory pressure is exerted in the left lower quadrant also indicates the site of peritoneal irritation. Cutaneous hyperesthesia in the area supplied by the spinal nerves on the right at T10, T11, and T12 frequently accompanies acute appendicitis. In patients with obvious appendicitis, this sign is superfluous, but in some early cases, it may be the first positive sign. Hyperesthesia is elicited either by needle prick or by gently picking up the skin between the forefinger and thumb.

Dunphy's sign is positive when there is right lower quadrant pain in response to percussion of a remote quadrant of the abdomen, or to firm percussion of the patient's heel. This suggests peritoneal inflammation.The Markle sign,is positive when pain elicited in a certain area of the abdomen when the standing patient drops from standing on toes to the heels with a jarring landing.*(Markle et al,1985)* Per rectal examination may elicit temderness anteriorly if there is a pelvic abscess due to perforation. (*Sedlak et al, 2008).*

MANTRELS or Alvarado Scoring. The Alvarado scoring system in appendicitis, also called the **MANTRELS** scoring, makes use of clinical signs, symptoms and laboratory findings. Each of the alphabets represents a sign or symptom, and a score of 1 is award to each, where they exist, except T and S that are scored 2 each. The components are as follows:

M = Movement of pain to the right iliac fossa

A= Anorexia

N = Nausea and Vomiting

T = Tenderness in the right iliac fossa

R = Rebound tenderness

E= Elevated temperature

L = Leucocytosis greater than 10,000/mm2

S = Shift in white blood cell count to the right

A score of 8 – 10 is said to be highly predictive of appendicitis and is a call for immediate appendicectomy or operation for the removal of the appendix.

A score of 7 – 8 is indicative of appendicitis. 5 – 6 means there is the possibility of appendicitis, and 1 – 4 makes the diagnosis of appendicitis unlikely.

Any one scoring 5 – 8 needs regular clinical re-evaluation and re-assessment with a view to confirming the diagnosis and operate.

2.7 Laboratory Findings

White blood cell counts are variable. It is unusual for the white blood cell count to be greater than 18,000/mm^3 in uncomplicated appendicitis . White blood cell counts above this level raise the possibility of a perforated appendix with or without an abscess. Urinalysis can be useful to rule out the urinary tract as the source of infection. Although several white or red blood cells can be present from ureteral or bladder irritation as a result of an inflamed appendix, bacteriuria in a catheterized urine specimen is not generally seen with acute appendicitis. *(Shwartz's Principles of Surgery, 8th edition 2005)*

2.8 Imaging Studies

Plain films of the abdomen, although frequently obtained as part of the general evaluation of a patient with an acute abdomen, are rarely helpful in diagnosing acute appendicitis. In patients with acute appendicitis, there may be an abnormal bowel gas pattern, which is a nonspecific finding. The presence of a fecalith is rarely noted on plain films, but if present, is highly suggestive of the diagnosis.

Additional radiographic techniques include barium enema and radioactive-labeled leukocyte scans. If the appendix fills on barium enema, appendicitis is excluded. On the other hand, if the appendix does not fill, no determination can be made These are possible options when there is difficulty in diagnosing appendicitis. There has not been enough experience with radionuclide scans to assess their utility. (*Peter F. et al, 1984)*

Graded compression sonography has been suggested as an accurate way to establish the diagnosis of appendicitis. The technique is inexpensive, can be performed rapidly, does not require contrast, and can be used even in pregnant patients. Sonographically, the appendix is identified as a blind-ending, non peristaltic bowel loop originating from the cecum. With maximal compression, the diameter of the appendix is measured in the anteroposterior dimension. A scan is considered to be significant if the appendix is non compressible and is greater than 6 millimeter or greater in the anteroposterior direction.

The presence of an appendicolith establishes the diagnosis. The presence of thickening of the appendiceal wall and periappendiceal fluid is highly suggestive. *(Jeffrey RB et al,1994).*

The sonographic demonstration of a normal appendix, which is an easily compressible blind-ending tubular structure measuring 5 mm or less in diameter, excludes the diagnosis of acute appendicitis. The study is considered inconclusive if the appendix is not visualized and there is no pericecal fluid or mass. *(Jeffrey RB et al,1994).*

The sonographic diagnosis of acute appendicitis has a reported sensitivity of 55 to 96% and a specificity of 85 to 98% *(Jeffrey RB et al).* The use of sonography is similarly effective in children and pregnant women. But its application is limited in late pregnancy. *(Jeffrey RB et al,1994).*

Although sonography can easily identify abscesses in cases of perforation, the technique has limitations and results are user-dependent. A false-positive scan can occur in the presence of periappendicitis from surrounding inflammation, a dilated fallopian tube can be mistaken for an inflamed appendix, inspissated stool can mimic an appendicolith, and, in obese patients, the appendix may not be compressible because of overlying fat. False-negative sonograms can occur if appendicitis is confined to the appendiceal tip, the appendix is retrocecal in location, the appendix is markedly enlarged and mistaken for small bowel, or if the appendix is perforated and therefore compressible. *(Jeffrey RB et al,1994).*

Rettenbacher et al reported that graded compression sonography improved the diagnosis of appendicitis over clinical exam, specifically decreasing the percentage of negative explorations for appendectomies from 37% to 13%. Sonography also decreases the time before operation if a diagnosis of appendicitis is made. Sonography identified appendicitis in 10% of patients who were believed to have a low likelihood of the disease on physical examination. (*Rettenbacher Tet al, 2002).*

The positive and negative predictive values of ultrasonography have impressively been reported as 91 or 92%, respectively. However, in a recent prospective multicenter study, routine ultrasonography did not improve the diagnostic accuracy or rates of negative appendectomy or perforation when compared to clinical assessment.

High-resolution, helical, computer tomography also has been used to diagnose appendicitis. On computed tomography scan, the inflamed appendix appears dilated (greater than 5 cm) and the wall is thickened. There is usually evidence of inflammation, with "dirty fat," thickened mesoappendix, and even an obvious phlegmon. Fecoliths can be easily visualized, but their presence is not necessarily pathognomonic of appendicitis. An important suggestive abnormality is the arrow head sign. This is caused by thickening of the cecum, which funnels contrast toward the orifice of the inflamed appendix. Computed tomography (CT) scanning is also an excellent technique for identifying other inflammatory processes masquerading as appendicitis. (*Raman SS et al,2002*).

CT techniques includes focused and nonfocused CT scans and enhanced and nonenhanced helical CT scanning. The nonenhanced helical CT scan is important because one of the disadvantages of using CT scanning in the evaluation of right lower quadrant pain is dye allergy. Surprisingly, all these techniques have yielded essentially identical rates of diagnostic accuracy, i.e., 92 to 97% sensitivity, 85 to 94% specificity, 90 to 98% accuracy, and 75 to 95% positive and 95 to 99% negative predictive values. (*Raman SS et al,2002*). The use of rectal contrast did not improve the results of CT scanning.

The most useful clinical tools in assessing acute appendicitis are still a good history and physical examination, serial abdominal examinations, and a high index of suspicion. Migrating pain from the epigastric or periumbilical area to the right lower quadrant is the classical and most discriminating historical feature, which has high sensitivity and specificity. It has been suggested that the presence of right-lower quadrant tenderness is the most sensitive physical finding in early appendicitis. *(Rothrock SGet al, 1991).*

2.9 Treatment

Once a diagnosis of perforated appendicitis is made the patient should be treated aggressively. Patients may be dehydrated and in sepsis. *(Greenfields Surgery: Scientific Principles and practise, 4th edition).* Patients are kept nil by mouth as they are posted for surgery and hydration is commenced.

The incidence of the most serious infectious complication that is the postsurgical intra-abdominal abscess formation has reduced due to the use of peri-operative antibiotics. Generally 3 to 14 days of antibiotic therapy are recommended for patients with gangrenous or perforated appendicitis *(Greenfields Surgery: Scientific Principles and practise, 4th edition).* But the ultimate decision about the duration of treatment depends on the treating physician. By shortening the duration of treatment would shorten the length of hospital stays and lower the cost of treatment while reducing the risk of drug-related toxicities.

Antibiotic therapy should be continued postoperatively until patients are able to eat and afebrile (temperature less than 38°C) for 24 hours. *(Greenfields Surgery: Scientific Principles and practise, 4th edition).*

Shawn D et al,2008 conducted a prospective randomized trial that conclude that once daily dosing of both ceftriaxone and metronidazole is equal to standard triple antibiotic therapy for infection control in the treatment of perforated appendicitis in children. However, the 2-drug regimen is more cost-effective and easier for patients and caregivers. (*Shawn D et al,2008)*

2.10 Laparoscopic appendicectomy

There are two basic forms of access, the open method and the closed method. The open method is via the Hasson's technique. This technique was first described by Harrith Hasson in 1971. This access allows direct visualisation through the initial incision up to the peritoneum followed by trochar is insertion and insufflation with carbon dioxide.

This technique involves incising the fascial layer and holding its edges by two lateral stay sutures, these will be used to stabilize the cannula. This will seal the abdominal wall incision to the coned- shape sleeve. The telescope is introduced and insufflation commenced after visualising omentum and bowel are safely away from port insertion sites. *(Farquharson Textbook of operative General surgery,9th edition).*

Closed laparoscopic method utilises blind access, with either pre insufflation before laparoscope insertion with Veress needle. The Veress needle consists of a sharp needle with an internal, spring loaded trocar. The trocar is blunt ended with a lumen and side hole. Disposable and non disposable metal Veress needles are available commercial in different lengths i.e. long for obese patients, short for thin or pediatric patien. Before using veress needle every time it should be checked for its patancy and spring action.

Insufflation via the Veress needle creates a cushion of gas over the bowel for insertion of the first trocar. Insufflation then retracts the anterior abdominal wall exposing the operative field. If laparoscopy has to be performed, initially at the time of pneumoperitoneum by veress needle patient should be placed supine with 10 to 20 degrees head down.