DELAYED VERSUS EARLY APPENDICECTOMY IN ADULT PATIENTS WITH ACUTE APPENDICITIS: A RETROSPECTIVE STUDY IN HOSPITAL SULTANAH NUR ZAHIRAH, TERENGGANU

By

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IV. LIST OF ABBREVIATIONS

ASIS	Anterior Superior Iliac Spine
CRP	C- Reactive Protein
CT	Computer tomography
CI	Confidence Interval
ENT	Ear Nose Throat
HIS	Hospital Information System
HPE	Histopathology Examination
HPF	High Power Field
HSNZ	Hospital Sultanah Nur Zahirah
KKM	Kementerian Kesihatan Malaysia
mcL	microliter
MO	Medical Officer
OMFS	Oral Maxillo Facial Surgery
PID	Pelvic inflammatory disease
RBC	Red Blood Cell
RLQ	Right lower quadrant
SD	Standard Deviation
SG	Specific Gravity
USM	Universiti Sains Malaysia
WBC	White Blood Cell

V. ABSTRAK

Pengenalan: Salah satu penyakit intraabdomen yang lazim adalah apendisitis akut dan memerlukan pembedahan kecemasan. Kelewatan apendisektomi dan dirawat secara perubatan tidak menunjukkan sebarang peningkatan morbidit.

Matlamat: Kajian ini membandingkan perkaitan dan kesan kelewatan appedisektomi pesakit dewasa.

Kaedah: Satu kajian retrospektif pesakit dewasa dengan apendisitis akut yang menjalani apendisektomi antara 1 Januari 2012 dan 31 Disember 2012 di Hospital Sultanah Nur Zahirah, Kuala Terengganu. Pesakit telah dibahagikan kepada dua kumpulan mengikut masa pembedahan selepas kemasukan ke wad. Kumpulan awal menjalani apendisektomi yang dilakukan dalam masa 24 jam. Data-data ini termasuk demografi, ciri pembedahan, persembahan klinikal, keputusan makmal, skor Alvarado, hasil histopatologi, hari mula makan, tempoh tinggal di hospital, jangka masa antibiotik intravena, tempoh masa pembedahan dan komplikasi selepas pembedahan telah dinilai dan dibandingkan.

Keputusan: Seramai 536 pesakit dalam kajian ini tetapi hanya 436 pesakit dimasukkan ke dalam kajian ini. Terdapat 290 pesakit dalam kumpulan awal dan 146 dalam kumpulan lewat. Tiada perbezaan yang ketara dalam persembahan klinikal kecuali dalam nyeri pantul dan kawalan dengan amat ketara masing – masing dalam kumpulan awal 31.7% (p=0.002) dan 19% (p=0.02). Keputusan makmal, leukositosis adalah sangat signifikan dalam

kumpulan awal 79% berbanding dengan 67.8% dalam kumpulan lewat tetapi tiada perbezaan yang signifikan dalam peralihan graf ke kiri. Skor Alvarado adalah jauh berbeza di antara kumpulan iaitu masing – masing berada 48.6% dan 37% dalam skor lebih dari 7. Tiada perbezaan ketara dalam keputusan histopatologi antara dua kumpulan. Terdapat perbezaan yang signifikan pada hari mula makan, tempoh tinggal di hospital, jangka masa antibiotik intravena dan tempoh masa pembedahan dengan min masing – masing 1.18 hari, 2.92 hari, 1.97 hari dan 47.65 minit dalam kumpulan lewat ($p<0.05$). Berbanding dengan min kumpulan awal masing – masing 1.07, 2.26, 1.30 dan 42.29. Tiada perbezaan yang signifikan dalam komplikasi selepas pembedahan.

Kesimpulan: Melakukan apendisektomi lewat selepas 24 jam dari kemasukan tidak meningkatkan kadar komplikasi dan perkembangan penyakit. Walau bagaimanapun, apendisektomi lewat meningkatkan hari bermula makan, tempoh tinggal di hospital, jangka masa antibiotik intravena dan tempoh masa pembedahan.

VI. ABSTRACT

Introduction: One of the commonest intraabdominal diseases is acute appendicitis and requiring emergency surgery. Delaying appendectomy and treated medically did not show any increasing morbidity.

Aim: This study compared the association and outcomes adult patients with acute appendicitis between delayed appendicectomy and early appendicectomy

Method: This is a retrospective study of adult patients with acute appendicitis who underwent appendicectomy between 1st January 2012 and 31st December 2012 in Hospital Sultanah Nur Zahirah, Kuala Terengganu. The patients were divided into two groups according to the time of surgery after admission. The early group underwent appendicectomy done within 24 hours of admission and delayed group appendicectomy after 24 hours. These data included demographic, operative characteristic, clinical presentation, laboratory results, Alvarado score, histopathology result, days of meal, length hospital stay, duration of intravenous antibiotic, duration of the operation and postoperative complications were evaluated and compared.

Results: A total of 536 patients in this study but only 436 patients were included in the study. There were 290 patients in the early group and 146 in the delayed group. There were no significant differences in clinical presentation except in rebound tenderness and guarding with highly significant in early group 31.7% (p=0.002) and 19% (p=0.02),

respectively. The laboratory result, leukocytosis was highly significant in the early group 79% compared to 67.8% in the delayed group but there was no significant difference in graph shift to the left. The Alvarado score was significantly different between groups which were 48.6% and 37%, respectively in score more than 7. There were no significant differences in histopathology results between two groups. There were significant differences in days started meal, length of hospital stay, duration of intravenous antibiotic and duration of the operation with mean 1.18 days, 2.92 days, 1.97 days and 47.65 minutes, respectively in delayed group ($p<0.05$). Compared to early group mean 1.07, 2.26, 1.30 and 42.29, respectively. There were no significant differences in postoperative complications.

Conclusion: Performing delayed appendicectomy after 24 hours from admission does not increase the complications rate and increase progression of the disease. However, delayed appendicectomy increases the days started meal, length of hospital stay, duration of intravenous antibiotic and duration of the operation.

1 INTRODUCTION

Acute appendicitis is one of the commonest intraabdominal disease and requiring emergency surgery. Emergency appendicectomy was the standard treatment for acute appendicitis and was reported since more than 100 years ago by McBurney and early appendicectomy had good outcome to the patients. Previously we thought, if appendicectomy was not done, the disease will progress from uncomplicated to complicated appendicitis such as suppurative, gangrenous and perforation. Any delay in operation for appendicitis also has been believed will increase postoperative morbidity and progress into complicated appendicitis. Aim for early appendicectomy is to prevent morbidity and progression of this disease. If appendicectomy delayed, it will increase morbidity and also mortality but there is lack of evidence for this assumption and how long one should wait for the operation is not well defined? Patients may present to the emergency department any time during the day or night, the question is, if patients presented during midnight can we delay appendectomy until the next morning?

Recently, emergency appendicectomy has been challenged by studies that suggested that surgery can be delayed in acute appendicitis or can be successfully treated conservatively. Delaying surgery and conservative management did not show any increased morbidity. Recently, antibiotic treatment without appendicectomy reported less morbidity. Systemic review and meta analysis of randomized control trials of antibiotic treatment has been compared to appendicectomy for treatment of uncomplicated acute appendicitis. The result has shown that there was no significant differences in treatment efficacy, length of

stay and risk developing complicated appendicitis (Varadhan *et al.*, 2012). In 2013 World Society of Emergency Surgery (WSES) guidelines recommended the appendicectomy remains the treatment of choice for acute appendicitis and conservative treatment may be used as alternative treatment for specific patients for whom surgery is contraindicated (Massimo Sartelli, 2013). The latest study by Shin *et al* (2014) stated that there was no significant differences between early and delayed appendectomy in 333 patients with acute appendicitis (Shin *et al.*, 2014). However, this study only compared appendicectomy within 8 hours and after 8 hours. Most of studies concluded, performing appendicectomy more than 24 hours from admission showed significantly increase the perforation rate, outcome and complication (Ditillo *et al.*, 2006 , Giraudo *et al.*, 2013, Von Titte *et al.*, 1996).

Hospital Sultanah Nur Zahirah, Kuala Terengganu is a tertiary referral center. In this hospital, there were many emergency operations including general surgery, neurosurgery, orthopedic, urology and obstetric, therefore patients with acute appendicitis often have to wait for their surgery because of a lower priority compared to neurosurgical, trauma and vascular emergencies. There were about 3 to 4 cases of acute appendicitis needing emergency appendicectomy per day and the waiting time for appendicectomy in this hospital is long. Some patients need to wait for appendicectomy until the next day and more than 24 hours. Problem also arises when patients are admitted late in the night when the dilemma of performing the surgery soon or delaying till the next morning will be safe for the patients. We also had problem if patient admitted in the middle of night, should we done operation immediately or can we wait until the next morning. If the study show association with higher morbidity, there will be evidence based reason not to delay the

surgery. It will also may reduce the cost of treatment as the length of stay is reduced when surgery is not delayed.

The present study was designed to determine the association and outcomes between the two groups in adult patients with acute appendicitis. We compared groups who underwent appendicectomy within 24 hours of admission and group who underwent appendicectomy after 24 hours of admission to the start of surgery. The comparison of both groups was regarding to profiling data, clinical presentation, laboratory results, histopathology results and outcomes in all adult patients who underwent an appendicectomy for acute appendicitis in a Hospital Sultanah Nur Zahirah, Kuala Terengganu. Clinical presentations include presenting migration pain, anorexia, nausea, vomiting, fever, loose stool, temperature, right lower quadrant tenderness, rebound tenderness and guarding. The Alvarado score was based on the modified Alvarado scoring system and divided to less than 6 and more than 7. Laboratory results consisted of total white blood cell and shift of neutrophils to the left side. For the early outcomes we look into the days started meal, length of hospital stay, duration of intravenous antibiotic, duration of the operation and postoperative complications as surgical site infection, pelvic abscess, adhesion colic and intestinal obstruction.

2 LITERATURE REVIEW

1.1 Anatomy

The vermiform appendix is a tubular structure attached to the base of the caecum (posteromedial border) at confluence of the taeniae coli. The appendix develops as outpouchings of the caudal limb of the midgut in the sixth week of human development. At the fifth months, the appendix elongates into vermiform shape (Brunicardi FC, 2009). The appendix, which rotates and descends to its final position in the right iliac fossa. The appendix approximately 8 to 10 cm long in adults with 5mm in diameter. The lumen is quite narrow and opens into the caecum by an orifice lying below and slightly posterior to the ileocaecal opening (Chummy SS, 2006). The lumen may be widely patent in early childhood but may be partially or totally obliterated after mid adult life. The three taenie coli on the ascending colon and caecum converge on the base of the appendix and merge into its longitudinal muscle. The anterior caecal taenia coli is usually distinct and can be traced to the appendix. It can be a guided to locate appendix during appendicectomy. The base of appendix corresponds to the McBurney's point. The McBurney points is a point at the junction of the lateral 1/3 and medial 2/3 of the line joining the umbilicus with the right anterior superior iliac spine (ASIS). The appendix can be found in any position relative to the caecum, 75% of appendix located at retrocaecal or retrocolic, 20% located at subcaecal and pelvic and 5% located at pre- ileal and post ileal (Chummy SS, 2006).

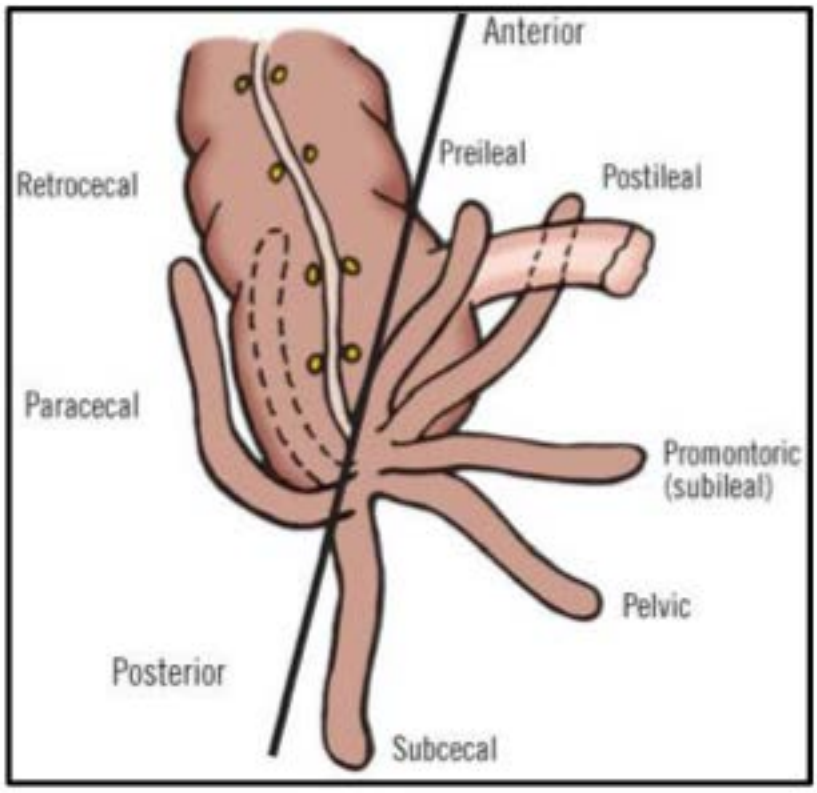

Figure 1: Position of appendix (adapted from Harrison and Benzinger, 2012)

Appendix was supplied by the appendicular artery, a branch of the lower division of the ileocolic artery and run behind the terminal ileum to reach the appendix through the mesoappendix. The terminal part of the main artery lies on the wall of the appendix and may be thrombosed in appendicitis resulting in gangrene or necrosis. Venous drainage was brought about by appendicular, ileocolic and superior mesenteric vein and to the portal vein. The lymphatic drainage is the ileocolic nodes. The nerve supply for appendix are symphatetic and parasympathetic fibres. The sympathetic fibres are derived from coelic and superior mesenteric ganglia (T10-T11) segment and parasympathetic fibres are derived

from vagus nerves. Both this nerves form a plexus around the artery supplying the appendix (Chummy SS, 2006).

The histology structures of appendix resembles that of large intestine. The layers consist of mucosa, submucosa, lamina propria, muscularis and serosa. The serosa forms a complete covering except along the mesenteric attachment. In muscularis layer, the longitudinal muscle thickens to form rudimentary taenia at the base of the appendix, that are continuous with the caecum and colon. The circular muscle fibers form a thicker layer separated by connective tissue (Chan L et al, 2011). The submucosa contains many large lymphoid. The mucosa is covered by a columnar epithelium that overlies the mucosa lymphoid tissue. Crypts are present but fewer and in the base of crypts lie the special cells (Kultschitzsky cells) which give rise to carcinoid tumors and they can cause appendicitis.

1.2 Appendicitis

Uncomplicated appendicitis is defined as an inflamed appendix in an absence of gangrene, perforation or abscess around the appendix. Perforated, gangrenous appendicitis or presence of periappendicular abscess is a complicated appendicitis (Brunicardi FC, 2009). The etiology of acute appendicitis is still unknown and it’s probably multifactorial such as dietary, genetic, infectious and immunological factors.

1.3 Pathophysiology

As noted previously, acute appendicitis is the most common cause for emergency surgery among adults in the worldwide. The principal cause of appendicitis is obstruction of the appendiceal lumen by faecolith, lymphoid hyperplasia, foreign bodies, parasites, primary or secondary metastatic tumors. It occurs due to intraluminal appendiceal obstruction, most commonly from faecolith, this can lead the appendix to become distended or swollen (Dixon and Stanes, 2009; O. Engin *et al.*, 2012). Faecolith formed by entrapment of a bit of vegetable fiber in the lumen of the appendix, its stimulating secretion and deposition of calcium rich mucus. The mucus becomes inspissated around the fiber and if faecolith with 1 cm in diameter, it may obstruct the lumen and cause appendicitis. In early uncomplicated appendicitis, these inflammatory changes confined to the tip of the appendix due to reduced blood supply from the terminal capillary branches of the appendiceal artery. In suppurative appendicitis, intraluminal pressure increases more than capillary perfusion pressure, causing venous outflow obstruction and ultimately arterial compromise. The lack of appropriate venous and lymphatic drainage allow bacteria to grow within the appendix, leading to potential mucosal ischemia (Chan L *et al.*, 2011).

1.4 Pathology

On gross pathology, uncomplicated appendicitis is characterized by a dull appearance of the normally glistening serosa surface and dilatation of the serosa vessels causing an injected appearance. In uncomplicated appendicitis histologically showed intramural edema

and infiltration by inflammatory cells. On gross pathology, showed external appendix distended and hyperemic, mesoappendix also edematous. In suppurative appendicitis, showed intramural infection without necrosis. The gangrenous appencitis, histologically showed increasing intramural inflammatory changes and transmural necrosis with serosal exudate. Grossly, its characterized by a friable serosa surface with purple, green or black discoloration. In perforated appendicitis, it showed indurated inflammatory mass (phlegmon) develops at surrounding such as mesoappendix, omentum and small bowel (Chan L *et al.*, 2011). The result of appendicectomy after clinically suspected appendicitis has histopathological shown a correct diagnosis in 78% for acute appendicitis and 12% in perforated appendicitis (Tingstedt B and R., 2005).

Figure 2: Gross specimen of acute appendicitis. Note grossly inflamed appendix with slough over the body of appendix (from author's collection).

Figure 3: Gross specimen of gangrenous appendicitis. Note bluish- black discoloration with marked edema of the mesoappendix and area of fat necrosis (adapted from Chan L *et al.*, 2011).

Figure 4: Gross specimen of perforated appendicitis. Note perforation at the base of appendix (from author's collection).

1.5 Epidemiology

The overall incidence of appendicitis in the United States, 1.1 per 1,000 population per year and most commonly occurs in the 10-19 year old age range and rarely occurs in children under the age of two (Addiss DG *et al.*, 1990). Its rare in infant and old age due to in infants the lumen of the appendix is fairly large and in old age the appendix often undergoes involution. Appendicitis is more common among males than females 1.4:1 and in United States, the whites people have a 1.5 times greater likelihood of developing appendicitis when compared to non-whites peoples. A study by the Centers for Disease Control and Prevention (CDC) found the incidence of appendicitis in the United States to be 11.3% higher in summer than in winter months (Addiss DG *et al.*, 1990). There was very limited data in Malaysia, Lee et al (1993) study 529 patients in a year at University Hospital showed 39.7% Malay, 40.2% Chinese, 17.6% Indian and 2.5% others races. Male to female ratio was 1.7:1 and appendicitis commonly occur at the age of15-25 year old. In Hospital Sultanah Bahiyah, Alor Setar, the mean age was 27.21 years with 45.64% male and 54.36% female (Kumar and Yin, 2014).

1.6 Clinical presentation

Acute appendicitis can be diagnosed clinically due to most of patients presented with typical history and physical examination. Abdominal pain is the primary presenting complaint and in early appendicitis, patients will complain of periumbilical colicky pain

and anorexia. This symptoms occurs during the first 24 hours of developed acute appendicitis (Dixon and Stanes, 2009). In early appendicitis, the inflammation is limited to the visceral peritoneum and its not localizes the pain at right lower quadrant. Pain usually associated with nausea and vomiting. When inflammation progress and involve the parietal peritoneum, patients usually felt pain localizes to the right lower quadrant. Typically, the patients describes a periumbilical colicky pain during first 24 hours followed by vomiting and migrates to the right iliac fossa. This classical presentation is only seen in approximately 50% of patients (Humes and Simpson, 2006). The three signs and symptoms that are most predictive of acute appendicitis are pain in the right lower quadrant, abdominal rigidity and migration of pain from the periumbilical to the right lower quadrant. This three signs and symptoms have sensitivity about 63-81% (Paulson EK, 2003). Persistent vomiting with bowel symptom like loose stool is a feature of development of diffuse peritonitis following perforation appendix. The appendix have a variety anatomical position and this will result the clinical presentation. This clinical presentation is influenced by the surrounding structures that involved in the inflammatory process. A high index of suspicion is required to make the diagnosis in case patients extremes age, woman of reproductive age and infants due to they may present with atypical clinical presentation. Pelvic inflammatory disease (PID), ruptured ovarian follicle and ectopic pregnancy are the most common misdiagnosed with appendicitis in woman. To exclude this disease, menstrual history and per vagina discharge should be asked during clerking.

Patients with early appendicitis usually have a low grade fever and mild tachycardia, it occurs due to systemic inflammatory response. Abdominal examination will

usually demonstrate right lower quadrant tenderness. Pain most severe at the McBurney's point, which lies two- thirds of a way along a line drawn from umbilicus to the anterior superior iliac spine. Rebound tenderness, guarding and rigidity are the signs of peritoneal irritation. Further examination suggested to diagnose acute appendicitis are Rovsing sign, Psoas sign or Obturator sign. Rovsing sign occurs when patients felt pain in the right lower quadrant on palpation of the left lower quadrant. Psoas sign is a pain at the waist with extension of the right hip and leg, it is related to an inflamed pelvic appendix. Obturator sign can be elicited by passively flexing the right hip and knee and internally rotating the leg at the hip joint. Patients felt pain in the right side of the abdomen due to irritation of the obturator muscle (Wagner *et al.*, 1996). Per rectum examination is a part of abdomen examination, but the value of rectal examination in diagnosis of appendicitis is controversial. Right side tenderness on per rectum examination may indicate a pelvic appendix (Wagner *et al.*, 1996). Dixon *et al* (1991) study of 1,204 patients admitted with complaint of right lower quadrant pain showed right sided pain on rectal examination was more common in patients with acute appendicitis but this give little information (Dixon *et al.*, 1991). Per rectum examination might not be considered as a predictor of pelvic appendix because of its low accuracy (48%) and pre rectum examination should be used to rule out specific condition as pelvic abscess and extra luminal mass. The clinical diagnostic accuracy is better in male patients than in female and in female the clinical accuracy is low especially in active reproductive age group patients (Junior Sundresh N, 2014).

1.7 Laboratory investigation

Special investigation to confirm acute appendicitis is not recommended if the diagnosis is predominantly clinical (Howell *et al.*, 2010). The simple laboratory test can give additional evidence to support the diagnosis of acute appendicitis and to exclude important differential diagnosis (Humes and Simpson, 2006). Some investigations such as urine analysis, urine pregnancy test, full blood count and C reactive protein (CRP) can be used to exclude other pathologies or to provide additional evidence to support a clinical diagnosis of appendicitis. Ten percent of patients with acute abdomen in emergency department have urinary tract disease and urine analysis can exclude urinary tract disease such as urinary tract infection or urinary stone. Results of urine microscopy showed erythrocyte counts more than 30 cells leukocyte counts more than 20 cells per high power field suggest a urinary tract disorders.

Some authors stressed a polymorphic leukocytosis as an important feature for diagnosis acute appendicitis. Leukocyte count and C – reactive protein (CRP) is the commonly used in the diagnosis of acute appendicitis. The sensitivity of an elevated leukocyte count range from 52% to 96% and left shift neutrophil count from 39% to 96%. In acute appendicitis, full blood count showed an increase white blood cell with a 'left shift' (Dixon and Stanes, 2009). A white blood cell of 3.9-10.9 x 10^9/L was accepted as normal and greater than 11 x 10^9/L as elevated and neutrophil count more than 73% (normal range 48-73%) were considered abnormal. Guraya *et al* (2005) showed a mean

white blood cell count of 18.1 ± 1.9 x 10^9/L for patients with complicated appendicitis which is markedly higher than a mean white blood cell count of 14.5 ± 7.3 x 10^9/L encountered in acute appendicitis and 94% patients showed neutrophilia had histologically proven appendicitis (Guraya *et al.*, 2005) . Andersson *et al* (2004) reported that the WBC and neutrophils count had higher power in discriminating for complicated appendicitis than for uncomplicated appendicitis. The diagnosis of acute appendicitis can be excluded if CRP, WBC and neutrophil count are normal. Anderson *et al* (2004) reported patients with suspicious acute appendicitis and has two or more inflammatory viables (granulocyte count, proportion of polymorphonuclear blood cells, white blood count and CRP) were elevated, combined with clinical descriptors of peritoneal irritation and migration of pain, more likely has acute appendicitis (Andersson, 2004). High leucocyte count is a very early marker of uncomplicated appendicitis but CRP level usually increases markedly in complicated appendicitis (JM Gronroos and Gronroos, 1999). Inflammatory variables should be used to support a clinical diagnosis of acute appendicitis and to exclude other pathologies. Not all patients with acute appendicitis had leukocytosis, some patients had total white cell count may be normal (Ngodngamthaweesuk N *et al.*, 2003; Junior Sundresh N, 2014).

In all woman of reproductive age with acute abdomen, serum beta human chorionic gonadotropin level should be checked to rule out ectopic pregnancy. Other blood test including amylase, lipase, liver function test and coagulation profile may be required to

confirm or exclude other diagnosis (Humes and Simpson, 2012). Routine urinalysis can differentiated between uncomplicated and complicated appendicitis. Urine ketone bodies, nitrate, SG, pH, RBC counts and WBC counts had significant factors in patients with acute appendicitis and in perforated appendix this value had a higher percentage, especially in urine RBC counts (>2.0/HPF) and urine WBC counts (>4.0/HPF) (Chen *et al.*, 2013).

1.8 Imaging

In Malaysia, imaging is not recommended as routine investigation to diagnosis acute appendicitis where the clinical assessment is suggestive the acute appendicitis. If clinically diagnosed acute appendicitis, no need to precede further investigation. Patients with acute appendicitis is still being managed without imaging with acceptable rates of negative appendicectomies and perforations (Sabiha PK *et al.*, 2000). The expected diagnostic accuracy is about 95% and its not improved by imaging. When the clinical assessment is equivocal, imaging can be used to clarify the diagnosis (Wijesuriya, 2007). Plain radiography is a first imaging can be used but it has a low sensitivity and specificity for diagnosis of acute appendicitis. Plain radiograph are not recommended but can be considered in excluding other differential diagnosis such as perforation viscus, intestinal obstruction and ureteric calculus.

Ultrasound is used to exclude gynaecologic or obstetric pathology and may lead to an alternative diagnosis for acute abdomen. The accuracy of ultrasound to diagnosed of

appendicitis is superior to clinical and it can reduce the rate of negative appendicectomies (Mohammad Akbar Ali Mardan *et al.*, 2007; Junior Sundresh N, 2014). Although ultrasound is accurate in diagnosing acute appendicitis but it does not prevent adverse outcomes or reduced length of hospital stay (Charles D Douglas *et al.*, 2000). In ultrasound, features that suggestive of acute appendicitis are visualization of non compressive appendix, the appendix measures more than 6mm in diameter, thickened of wall, present of periappendiceal fluids and demonstration of an appendicolith (Pinto F *et al.*, 2013). Ultrasonographic study has 80 to 97% sensitivity and 85 to 91% specificity in diagnosis of appendicitis (Dirk Pickuth *et al.*, 2000; Himeno S, 2003; Tauro LF *et al.*, 2009).

Computed tomography (CT) scanning has 94% sensitivity, 95 % specificity in diagnosis of acute appendicitis(Dirk Pickuth *et al.*, 2000). In North America, computerized tomography is more widely used to diagnose acute appendicitis. The evidence of acute inflammation of appendix are swollen appendix, thickened wall, periappendiceal fat stranding, thickened mesoappendix, periappendiceal fluids and faecolith. In equalvocal presentation or if there is the suspicious of a mass, most studies suggest computer tomography (CT) scan abdomen or ultrasound abdomen can be used to help in establishing the diagnosis of acute appendicitis and reduce the rate of negative appendicectomies (Dirk Pickuth *et al.*, 2000; Paulson EK, 2003) . There was no statistically significant difference in the rate of perforations between the group of patients who had no imaging and those had ultrasound before surgery but there was statistically significant in group had computerized tomography because due to delayed for operation (Sabiha PK *et al.*, 2000).

The computer tomography (CT) scan is an invaluable aid in the diagnosis of acute appendicitis and the effectiveness of CT scan is enhanced when combined with clinical (Lucas, 2001). The CT scan is more accurate than clinical or Alvarado score and the performance of CT scan even in patients with clinically evident appendicitis or had high Alvarado scores should considered in order to reduce negative appendicectomy rates (Kim *et al.*, 2008). CT scan is more accurate than ultrasound in patients suspected acute appendicitis and routine use of focused CT in equivocal cases can improve in diagnostic rate and fewer negative appendicectomies (Dirk Pickuth *et al.*, 2000). Despite its superior sensitivity, there are problems with CT scan such as iatrogenic ionizing radiation, the intravenous contrast had risk of allergic reaction and the scanners are expensive and unavailable in some hospital, particularly in developing countries. Because of the side effects and time consuming, ultrasound is recommended as first imaging followed by CT scan if ultrasound cannot detect any pathology (Andrea S. Doria *et al.*, 2006; Reich *et al.*, 2011)

1.9 Scoring systems

Early diagnosis and early appendicectomy is the key for successful management of acute appendicitis. Some of the cases like very young patient, elderly and childbearing woman, are very difficult and may delay in diagnosed acute appendicitis. This can lead to an increase in mortality and morbidity. Ultrasound, computerized tomography and diagnostic laparoscopy have been used to confirm accurate diagnosis. The routine used of computerized tomography has potentially harmful ionizing radiation, in ultrasound its

operator dependent and in laparoscopic diagnosis is an invasive procedure and associated with morbidity. In Malaysia, not all hospital had these facilities. So we still need to diagnose acute appendicitis based on the history, physical examination and basic laboratory test reflecting the inflammatory response. Clinical scoring system is used to improve in diagnosis of acute appendicitis. Scoring system is a cheaper, faster and non invasive in diagnosing acute appendicitis. Scoring systems have been used to aid the diagnosis of acute appendicitis but not been widely used and not made it into routine clinical practice in all settings. This scoring system is based on symptoms, signs and laboratory findings. A large number of scoring systems have been used. The most widely used in adult is the Alvarado score and in children is the pediatric appendicitis score or Samuel score.

The Alvarado score is the most well known and best compared with others scoring system (Ohmann C, 1999). The Alvarado score was developed by Alfredo Alvarado in 1986, this studies of 305 patients admitted to Nazareth Hospital in Philadelphia from 1975 to 1976. Studies have shown that Alvarado score has diagnostic accuracy of around 88% (Alvarado, 1986). This score consists of three symptoms, three signs and two laboratory markers of inflammation. The symptoms are migration pain, anorexia and nausea or vomiting. The signs are tenderness in right lower quadrant, rebound and elevation of temperature. The laboratories are leukocytosis and shift to the left. All have value score of one except tenderness and leukocytosis value score of two. The maximum score is 10. A score less than 4 is unlikely acute appendicitis and a score of 5 or 6 is compatible with a diagnosis of acute appendicitis. A score of 7 or 8 indicating probable acute appendicitis and a score of 9 or 10 indicating a very probable acute appendicitis. Those with a score less

than 6 required observation while those with a score of 7 and above needed to proceed to surgery due to most likely patients had acute appendicitis (Alvarado, 1986). The use of this scoring system is to differentiate patients in need of surgical intervention or not. The Alvarado score was based on a retrospective review of patients who suspected acute appendicitis and operated. Alvarado found patients who had a score more than 7 had a 93% having acute appendicitis. There was no direct relationship between the pain score with Alvarado score (Ahmad KI *et al.*, 2011). The Alvarado score was developed before the availability of computerized tomography, but today in equivocal Alvarado scores of 4 to 6, CT scan is recommended to confirm the diagnosis of acute appendicitis (McKay and Shepherd, 2007). Female patients who had Alvarado score more than 7, additional test like ultrasound or CT scan abdomen should be done to exclude other causes, because of high false positive result (Kumar and Yin, 2014). The higher the Alvarado score the more accurate the diagnosis. The combined use of both Alvarado score and graded compression ultrasound did not result in a significant improvement in sensitivity and specificity in the diagnosis of acute appendicitis (Ashmawy IH *et al.*, 2006).

The Modified Alvarado scoring system has been shown by recent studies to be easy, simple and cheap to diagnose acute appendicitis. Its can reduce negative appendicectomy and complication rates. This scoring system is divided into two groups. First group includes of patients with score seven and more, this score likely to have acute appendicitis. Second group were patients with score less than six and these patients are unlikely to have acute appendicitis. Modified Alvarado scoring system has high sensitivity (95.8%) and specificity (94.1%) (Kanumba *et al.*, 2011; Nasiri *et al.*, 2012).

1.10 Treatment

Early diagnosis and prompt surgical treatment are still the most important principles in dealing with acute appendicitis and this applies to patients of all age groups. Appendicectomy is the treatment of choice in treating acute appendicitis and 2013 World Society of Emergency Surgery (WSES) guidelines recommended the appendicectomy remains the treatment of choice for acute appendicitis. Before appendicectomy can be done, appropriate resuscitation, intravenous fluid therapy, adequate analgesic and antibiotic is the initial treatment for acute appendicitis. Uncomplicated appendicitis is categorized as clean contaminated wound and perforated appendix are categorized as contaminated wound. Data strongly support that patients with acute appendicitis should receive preoperative broad spectrum intra venous antibiotics (K. Daskalakis, 2013). Antibiotic should be given preoperative one to three doses to all patients with suspected acute appendicitis. Perioperative antibiotic have been shown to decrease the incidence of surgical site infection and pelvic collection. Single dose of preoperative antibiotics (cefuroxime and metrodinazole) in uncomplicated appendicitis was sufficient to reduce the rate of surgical site infection but not postoperative complications (Muhammad Ibrar Hussain, 2012). In National Antibiotic Guideline 2008 Ministry of Health Malaysia, preferred antibiotic in appendicitis are intravenous ampicillin, gentamicin and metrodinazole. This guideline suggests starting antibiotic upon diagnosis and discontinued after surgery. In the complicated appendicitis intravenous broad spectrum antibiotics are recommended until 3-5 days (K. Daskalakis, 2013). Results from swabs culture and sensitivity 95.9% showed isolated commensal flora or bacterial strains already sensitive to prophylaxis broad

spectrum antibiotics (intravenous cefuroxime and metrodinazole) (Foo FJ, 2008). Culture from inflamed appendix usually reveal the infection is mixed growth and there is hardly pyogenic organism. The commonest organisms found in intraoperative cultures are Escherichia coli (85%), Streptococcus and Bacteroides fragilis. Post operative antibiotics for uncomplicated appendicitis did not add an appreciable clinical benefit to the patients (Muhammad Ibrar Hussain, 2012).

Pain control is a part of treatment for acute appendicitis, it minimizes stress response, reduce anxiety and facilitates patients cooperation during physical examination. Patient with suspected acute appendicitis should be given adequate analgesic. Thus, it will not mask the clinical sign, does not adversely affect diagnostic and clinical decision making (Alex R Attard *et al.*, 1992; G Scott Brewster *et al.*, 2000). Analgesia was traditionally withheld from patients presented with acute abdomen but current evidence strongly suggested to give opiods such as morphine to patients and it is not only safe but also aid the diagnosis process (Amoli *et al.*, 2008). Preconsultation use of analgesic for patients with suspected acute appendicitis in emergency department is not associated with a longer delay to operation and not associated with the increase rate of perforated appendicitis (C-F Chong *et al.*, 2004).

1.11 Appendicectomy

Appendicectomy is a classic surgical procedure, which was introduced around 1880. The emergency appendicectomy in adults with acute appendicitis became the basic for the management of acute appendicitis. Most surgeons still practice emergency appendicectomy for uncomplicated appendicitis because it relatively low morbidity and mortality. There is a trend away from performing immediate operation including appendicectomy done in the middle of the night. About 17.7% of emergency surgical procedures done in Kings College Hospital, London from 1997 to 2004 were appendicectomy (Faiz *et al.*, 2007). Gridiron incision and Lanz's incision is a method for open appendicectomy. Gridiron incision is the incision made at the McBurney's point and perpendicular to a line joining the umbilicus and anterior superior iliac spine. Lanz's incision is made at McBurney's point and parallel to skin crease. After the peritoneum is entered, the inflamed appendix is identified and delivered into the field. The inflamed appendix must be gentle handled gently to minimize the risk for rupture during the procedure. In difficult cases, enlarging the incision and working down the trajectory of the taeniae on the cecum will often facilitate localization and delivery of the appendix. The mesoappendix is divided between clamps and ties. The base of the appendix is skeletonized at its junction with the caecum. An absorbable tie is placed around the base of the appendix and the specimen is clamped and divided. An absorbable purse-string suture or Z stitch is placed into the caecal wall and the appendiceal stump is inverted into a fold in the wall of the caecum. The wound is closed primarily in most cases because the surgical site infection rate is less than 5%.