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Is laparoscopic surgery the answer to generalised purulent peritonitis from complicated appendicitis?

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IS LAPAROSCOPIC SURGERY THE ANSWER TO GENERALISED PURULENT PERITONITIS FROM COMPLICATED APPENDICITIS?

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0618649X



A Research report submitted to the Faculty of Health Sciences, University of the Witwatersrand, Johannesburg; in partial fulfilment for the degree of **Master of Medicine in the branch of Surgery.**

Johannesburg, 2010

DECLARATION

I, BROWN CHWIFEH NDOFOR declare that this research report is my own work. It is being submitted for the degree of Master of Medicine in Surgery at the University of the Witwatersrand, Johannesburg, South Africa. It has not been submitted before for any degree or examination at this on any other University.

Brown Chwifeh Ndofor

22rd December 2010.

DEDICATION

I dedicate this research report to my parents, Abraham and Alice, who through all these years have stood beside me, supported me morally, financially and above all spiritually. Special thanks to my brothers, Terence and Hermann, and my sister, Juliet, for their commitment, support and encouragements through all these years of studying.

ABSTRACT

Aim

To compare the different outcomes in a single institution between patients with generalised purulent peritonitis from complicated appendicitis diagnosed intraoperatively which were managed laparoscopically to those managed via the open approach.

Methods

Data was collected from all cases admitted at Sebokeng Hospital over the past two years (2008 & 2009) with an intraoperative diagnosis of generalised purulent peritonitis from complicated appendicitis. Cases which were managed laparoscopically or by the open approach were analysed.

The parameters analysed were the demographic findings, the theater duration, complications, and days to the commencement of full ward diet, and length of hospital stay.

Results

During the study period, a total of 120 cases of appendicectomies with generalised purulent peritonitis were performed. Of these, 58 cases underwent open appendicectomy (OA) and 62 cases had laparoscopic appendicectomy (LA). Both groups were comparable in the demographics and preoperative findings.

The theater duration was significantly higher in the LA group (115.8 minutes for LA compared to 86.7 minutes for OA. The rate of intraabdominal sepsis was also higher in the LA group (12.9% for LA and 8.6% for OA). Both groups showed no statistical significant difference between the wound sepsis or port site sepsis rate, the days to commencement of full ward diet and length of hospital stay. More time was spent in ICU/HCU in the OA group an average of 3.7 days as opposed to 2 days in the LA group.

However age, the duration of symptoms, the clinical presentation and the white blood cell count (WBC) were influencing factors to the outcome of the OA group.

Conclusion

Generalised purulent peritonitis from complicated appendicitis can be managed successfully laparoscopically. Both approaches are feasible, safe and have comparable outcomes. Where facilities are adequately skilled and resourced, the laparoscopic approach should be considered the procedure of choice for complicated purulent appendicitis because it is less influenced by preoperative findings and shows a trend towards less postoperative complications.

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NOMEMCLATURE

LA	Laparoscopic Appendicectomy
OA	Open Appendicectomy
LP	Localised Pain
GP	Generalised Pain
WBC	White Blood Cell Count
CRP	C Reactive Protein
TT	Theater Time
IAS	Intra Abdominal Sepsis
WS	Wound Sepsis
PS	Port site Sepsis
ICU	Intensive Care Unit
HCU	High Care Unit
FWD	Full Ward Diet

CHAPTER 1

INTRODUCTION

1.1 Background

The standard of management of cases presenting with generalised purulent peritonitis from complicated appendicitis is via a midline laparotomy. However, the diagnosis of generalised purulent peritonitis is sometimes only made intraoperatively. In situations where the open approached is used, the surgeon can elect to convert to a midline laparotomy, or extend the incision. On the other hand, in scenarios were the laparascopic approach was used, most cases the operation can be continued to completion. The question as to the appropriate surgical technique in circumstances such as this has always been of great debate among surgeons.

In 1894, Chester McBurney described a right lower quadrant muscle splitting incision (the open approach) for the surgical treatment for acute appendicitis.[1] The laparascopic approach described by Kurt Semm, only came into play in 1983.[2] Its role in the management of generalised purulent peritonitis from complicated appendicitis have is controversial.

1.2 Problem Statement

Appendicectomy remains the most frequently performed emergency abdominal surgical procedure.[3] The lifetime risk of acute appendicitis for men and women is 8.6% and 6.7%, respectively.[4]

Acute appendicitis if left untreated; an inflamed appendix (acute appendicitis) can burst (perforate). The progression from an acute appendicitis to a perforated appendicitis is

sometimes rapid, occurring within 6-12 hours. Though the risk of perforation within 24 hours of symptom onset is less than 30%; after 48 hours, the risk of perforation increases to greater than 70%. [5] Perforation is one of the complications of an acute appendicitis. The natural history of a perforated appendicitis is the development of generalised purulent peritonitis.

Complicated appendicitis is one of the causes of generalised purulent peritonitis in South Africa. Most cases are due to delay in seeking hospital treatment, delays in getting appropriate investigations, results and delays in getting a theater slot. Most cases of complicated appendicitis present to the hospital with right iliac fossa tenderness and the initial clinical diagnosis is acute appendicitis. The majority of these cases are managed via the open approach in theater. The diagnosis of complicated appendicitis with generalised purulent peritonitis is sometimes only made intraoperatively.

Cases which turn out to have generalised purulent peritonitis are fraught with postoperative complications including wound sepsis, intraabdominal collections, septic shock and death.

1.3 Rationale

Ever since the birth of laparoscopic appendicectomy in 1983 by Kurt Semm, [2] the role of laparoscopic appendicectomy has become increasingly common and widely practised as the preferred method for uncomplicated acute appendicitis. Various reports demonstrate its merits in the reduction of postoperative pain, lower incidence of intraabdominal abscess rate and wound sepsis, shorter hospital stay and as an ideal procedure for laparoscopic skill training for surgical registrars.[6,7,8]

However, the role of laparoscopy in the management of complicated appendicitis is controversial.[9,10] Recent meta-analyses of laparoscopic appendicectomy versus open appendicectomy for complicated appendicitis reports increased rates of intraabdominal

abscess, longer operative time and an exceedingly high cost[6,7,11] . However, most have failed to analyse patients who have generalised peritonitis separately from those with non-complicated appendicitis or have completely excluded these cases from their study.[12] Such cases represent a unique challenge.

1.4 Aim and Objective

The aim and objective of the study is to compare the different outcomes between cases which were managed laparoscopically to those managed via the open approach (Mc Burney / Rocky–Davis), of patients with generalised purulent peritonitis from complicated appendicitis which were only diagnosed intraoperatively.

CHAPTER 2

MATERIALS AND METHODS

2.1 Study Design

This study was conducted as a retrospective review of all cases with purulent peritonitis from complicated acute appendicitis diagnosed intraoperatively. Between January 2008 and December 2009, from the theater records, the patients' hospital numbers of all the cases of appendicectomy that was done at Sebokeng Hospital were retrieved from the theater logbook. The theater logbook also provided the surgical approach that was used, laparascopic appendicectomy for the laparascopic approach and appendicectomy for the open approach. Cases that were done via a midline laparotomy were excluded.

With the aid of the hospital numbers from the theater logbook, these patients had their hospital file were retrieved from the hospital archives. From the hospital file, the surgeon's theater notes were reviewed specifically under operative findings. Cases whose operative findings were complicated appendicitis with generalised pus or pus in more than one anatomical location were included.

Additional data retrieved included the patient's demographics, symptoms duration, clinical presentation, theater duration, complications, days to the commencement of full ward diet and length of hospital stay.

2.2 Exclusion Criteria

The exclusion criteria included;

1. All cases of generalised purulent peritonitis from other causes except appendicitis.
2. Cases of generalised purulent peritonitis which were managed via a midline laparotomy, or converted from the initial McBurney or Rocky- Davis incision to a midline laparatomy.
3. Cases of patients with localised pus collection.
4. Finally all cases of patients with complicated appendicitis (appendiceal mass, abscesses, gangrenous appendix or perforated appendix) without the presence of generalised purulent peritonitis.

2.3 Definitions

Complicated appendicitis

This was defined as operative findings of gangrenous or perforated appendix with or without abscess formation.

Generalised peritonitis

This was defined as the presence of pus within multiple (two or more) intraperitoneal sites. These cavities included the right and left paracolic gutters, the pelvic cavity, subphrenic space and in-between the bowel loops (inter-loop collection of pus). Cases of pus found away from the source of the pathology i.e. the appendix was also considered as generalised peritonitis.

Generalised pain

It was defined as non localised abdominal tenderness that could be elicited anywhere in the entire abdomen and not in the setting of an acute abdomen.

Theater time

This was calculated from the time of entry into theater to the time of leaving theater after the procedure.

Intra abdominal sepsis

It was defined as the formation of pus within the abdominal cavity post surgery on ultrasound or CT scan imaging.

Wound sepsis and Port site sepsis

These were defined as surgical site sepsis (wound sepsis in the case of Open appendicectomy and port site sepsis in the case of Laparoscopic appendicectomy). This was diagnosed based on the following criteria;

- The isolation of an organism obtained by aseptic wound culture or
- The presence of pain, tenderness, localised swelling, erythema and warmth over the surgical site.

The length of Hospital stay

This was calculated from the day the patient was admitted into hospital to the discharged day by the Doctor. Extra days spent in the hospital were not counted.

NB: Some patients only left the hospital a couple of days later as a result of social reasons, financial reasons, lack of transport or lack of accommodation.

2.4 The Surgical Team

The surgical team consisted of consultants, registrars and medical officers with laparoscopic experience; however the surgeon in most cases were the registrars supervised by the consultants. The decision to either perform an open or a laparoscopic approach was made by the surgeon; however it is the policy in Sebokeng Hospital that all cases of acute appendicitis should be done laparoscopically.

2.5 Operative Technique

2.5.1 Laparoscopic Appendicectomy Approach

With the patient in the supine position, both arms are tucked to the sides. After prophylactic antibiotic is given, the induction of general anaesthesia follows. The abdomen is prepared and draped in a sterile fashion so as to expose the entire abdomen. A urinary catheter usually is not inserted preoperatively but the patient is always asked to empty the bladder just before the operation.

Laparoscopic appendicectomy is performed using a 30 degree laparoscope inserted through a 10mm infraumbilical port. Pneumoperitoneum is established by insufflating the abdomen with carbon dioxide through an open technique via the infraumbilical port. Two additional ports (10mm and 5mm) are placed one at the suprapubic region and the other at the left lower quadrant respectively.

Once inside the abdominal cavity and encountering generalised purulent (pus) peritonitis, visualisation and finding the source of the pathology is usually impaired. Visualization is enhanced by initially aspirating the pus (including taking specimen for microscopy, culture and sensitivity). Tilting the operating table is employed to attain appropriate gravity dependent posture for easy aspiration. Manipulation of the bowel loops in

cases of inter-loop collections of pus is accomplished by gentle handling of the bowel at the mesenteric side with the usage of atraumatic bowel graspers. Examination of the bowel is commenced from the ileocaecal junction up to the ligament of Treitz.

Once the base of the appendix is identified, the mesoappendix is sequentially diathermised and cut. The base of the appendix is then double ligated with pretied chromic catgut ligatures (the Roeder sliding knot). The appendix is removed from the abdominal cavity either inside the 10 mm suprapubic port or a retriever bag. A four quadrant irrigation with warmed normal saline is done to complete the procedure making sure the recto-vesical pouch in males and pouch of Douglas in females are visualised and irrigated.

2.5.2 Open Appendicectomy Approach

In the open approach, the appendix is accessed through a McBurney (oblique) or Rocky-Davis (transverse) right lower quadrant incision centered over the point of maximum tenderness. This is developed into the abdominal cavity by splitting the muscle in the direction in which the fibres run.

On entering the abdominal cavity in the case of generalised purulent peritonitis, pus usually oozes out requiring the usage of suction to aid in the visibility and decrease contamination of the incision side. The appendix is identified and mobilised onto the incision site with the use of the index finger where it is gentle grasped .By using a rocking motion, the base of the appendix is mobilised to site with clear view of the caecum. The mesoappendix is divided between clamps and tied. The base of the appendix is then crushed approximately 3 mm from the caecum, subsequently suture-ligated and freed with the use of a scalpel.

In cases of perforated appendix, the faecolith is meticulously searched for and removed. The procedure is concluded by thorough irrigation of the abdominal cavity with normal saline. Finally the wound is closed in layers.

2.6 Postoperative Management

Postoperatively, depending on the haemodynamic stability, patients were managed r in an ICU (for cases that were unstable and intubated), or in a HCU (for cases which were unstable, but extubated). All other cases i.e. haemodynamic stable cases were admitted into the ward.

Postoperatively, patients with clinical features suggestive of intraabdominal sepsis, such as a prolonged ileus, fever, persistent high white blood cell counts (WBC) and C reactive protein (CRP) underwent abdominal imaging either by doing an abdominal ultrasound or computer tomography scan (CT scan). Patients found to have collections amendable for drainage were drained.

Antibiotics were continued postoperatively for five days. Two weeks following discharge, patients were assessed in the surgical outpatient clinic.

2.7 Outcome Measures

The main outcome measures (taken from the theater logbook and the clinical records) for the purpose of this study were: the surgical approach (laparoscopic appendicectomy approach versus open appendicectomy approach), the theater duration, the post operative complications, the duration of stay in an Intensive Care Unit / High Care Unit (ICU/HCU), the commencement of full ward diet (FWD) and finally the length of hospital stay. Other measures taken were the demographic data which included the age, gender, duration of symptoms prior to admission and lastly the clinical presentation of the patients (whether he / she presented with localised pain or generalised pain)

2.8 Data Analysis

The Data was recorded in EXCEL (Microsoft) and comparisons between groups were made using SAS Version 9.1/Statistical. Patient numbers, gender and variable (age), means (±standard deviation) or median were reported in tables and graphs. Comparisons between the two groups, open vs. laparoscopic group, were made using a t-test on normally distributed, data. When the data was non-normally distributed differences between these groups were determined with the non-parametric (Mann-Whitney) statistical test. A Chi-squared test was used to determine whether there were statistically significant differences in the proportion of males or females, whether clinical presentation was localised or generalised and the proportion of complications in the OA or LA groups. A Fischer exact test was used when the number in a group was less than 5. Multiple logistic regression was used to determine theatre time, time to commencing a full ward diet and time to discharge from the Hospital. A p value of <0.05 was regarded as being of significance.

CHAPTER 3

RESULTS

During the study period, a total of 120 cases of appendicectomies with generalised purulent peritonitis were recorded. Of these, 58 cases underwent open appendicectomy and 62 cases had laparoscopic appendicectomy. One case was converted from laparoscopic approach to open approach, a conversion rate of 1.6%. No deaths occurred in this study. The results of the OA and the LA groups are summarised in Table 1.

Table 1: Summary of data

	Number of cases	Average age (years)	Gender	Average symptoms duration (days)	Average WBC	Average CRP	Clinical presentation	Average theatre duration (minutes)	Complications	Average ICU/HCU duration (days)	Average days to FWD	Average hospital stay (days)
Open approach	58	18.5	34 M 24 F	2.9	14.7	143.5	32 LP 26 GP	86.7	IAS 5 WS 9 Septic shock 1	3.7	3.7	7
Laparoscopic approach	62	22.1	36 M 26 F	2.9	15.8	183.8	26 LP 36 GP	115.8	IAS 8 PS 2 Pneumonia 1	2	4.1	6.7

Key

M	Male	IAS	Intra Abdominal Sepsis
F	Female	WS	Wound Sepsis
LP	Localised Pain	PS	Port site Sepsis
GP	Generalised Pain		

3.1 Demographics and Diagnostic Evaluation

The study populations were comparable in both groups. The average ages was 20 years and most were male presenting at the Hospital 3 days after onset of symptoms. There were no statistically significant differences with respect to age, gender, clinical presentation, duration of symptoms, white cell count and CRP between the two groups. (Table 3.2).

Table 2: Patients' demographics and preoperative observations compared with the type of surgery.

Characteristics	Type of Surgery Number (Percentage)		*P*-value
	OA	LA	
Age (years)			
< 16	29 (50%)	28 (45.1%)	0.299
≥16	29 (50%)	34 (54.8%)	
Gender			
Male	34 (58.5%)	36 (58.0%)	0.951
Female	24 (41.4%)	26 (41.9%)	
Clinical Presentation			
LP	32 (55.1%)	26 (41.9%)	0.147
GP	26 (44.8%)	36 (58.0%)	
Duration of symptoms			
< 2 days	26 (44.8%)	24 (38.7%)	0.121
≥ 2 days	32 (55.1%)	38 (61.2%)	
WBC ($x10^9$/L)			
< 12	19 (38.7%)	19 (34.5%)	0.345
≥12	30 (61.2%)	36 (55.4%)	
CRP(mg/l)			
< 100	8 (47.1%)	9 (27.2%)	0.554
≥ 100	13 (52.9%)	24 (72.7%)	

3.2 Outcome Measures

3.2.1 Theater Duration

The mean theater duration was considerably longer in the LA group than that in the OA group.

3.2.2 Complications

Other than the number of patients with wound sepsis, there were no differences between the groups with respect to the number or type of complications. If number of patients

who developed port site sepsis in the LA group (n=2/62) were compared wound sepsis in the OA group (9/58), the sepsis rate remained significant less in the LA group (p=0.0374).

A case of septic shock with renal failure was encountered in the OA group and a single case of pneumonia was recorded in the LA group as one of the complications.

Table 3: Patients' postoperative course and complications compared with the type of surgery

Variables	**Type of Surgery Mean (range)**		***P*-value**
	OA	**LA**	
Theater duration	86.7 (40 – 190)	115.8 (50 – 240)	0.005*
Complications- ***Number (percentage)***			
• **Wound sepsis/Port site sepsis**	9 (15.5%)	2 (3.2%)	0.582
• **Intraabdominal sepsis**	5 (8.6%)	8 (12.9%)	0.009*
• **Septic shock**	1 (1.7%)	0	
• **Pneumonia**	0	1 (1.1%)	
ICU/HCU duration	1.1 (0 – 13)	0.2 (0 – 6)	0.01*
Days to commencement of FWD	3.7 (1 – 20)	4.1 (1 – 48)	0.345
Length of Hospital stay	7 (2 – 51)	6.7 (2 – 59)	0.246

* *P* value < 0.05

3.2.3 Postoperative Evaluation

The primary outcomes compared between the LA and OA groups were the time to commencing of a full ward diet and the length of hospital stay. The average times for both these outcomes were 4 days and 7 days respectively, no significant difference was noted between the groups (Table 3.3). Although the average times were not different, to determine whether more patients in either group commenced full ward diet or were discharged earlier, the data was re-analysed using Kaplan-Meier curves. No differences between the curves were noted for these parameters, as shown in Figures 3.1 and 3.2 respectively.

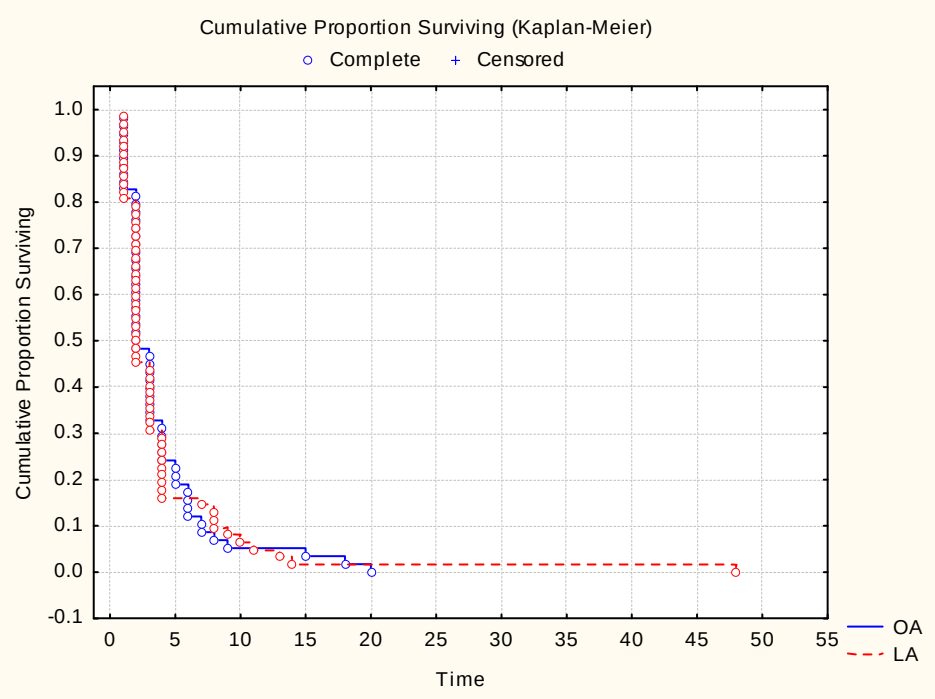


Figure 1: Cumulative proportion graph demonstrating the similarities between OA and LA in regards to the commencement of FWD.

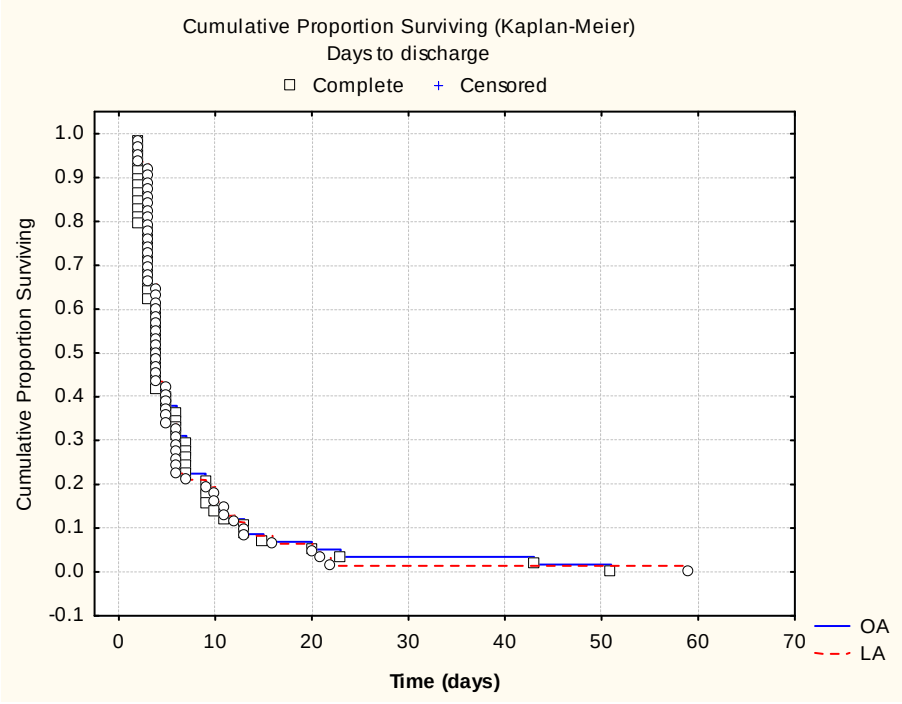


Figure 2: Cumulative proportion graphs demonstrating the similarities between OA and LA in regards to days spent in the hospital.

3.3 Analytical Statistics

In order to determine whether preoperative variables affected the outcome measures of each surgical approach, the data was further analysed. In order to do this, the pre-operation parameters were dichotomized by age (< or ≥16 years), duration of symptoms (<2 days or ≥2 days), white blood cell count (<12 $x10^9$/L or ≥12 $x10^9$/L) or a C-reactive protein concentration (<100 or ≥100 mg/L). As shown in Table 3.2 there were no differences between the OA or LA groups with respect to the number of patients in each of these categories.

The means and proportion of each of these dichotomized pre-operative variable was tabulated for OA and LA and differences determined for each between the surgical procedures used (Table 3.4).

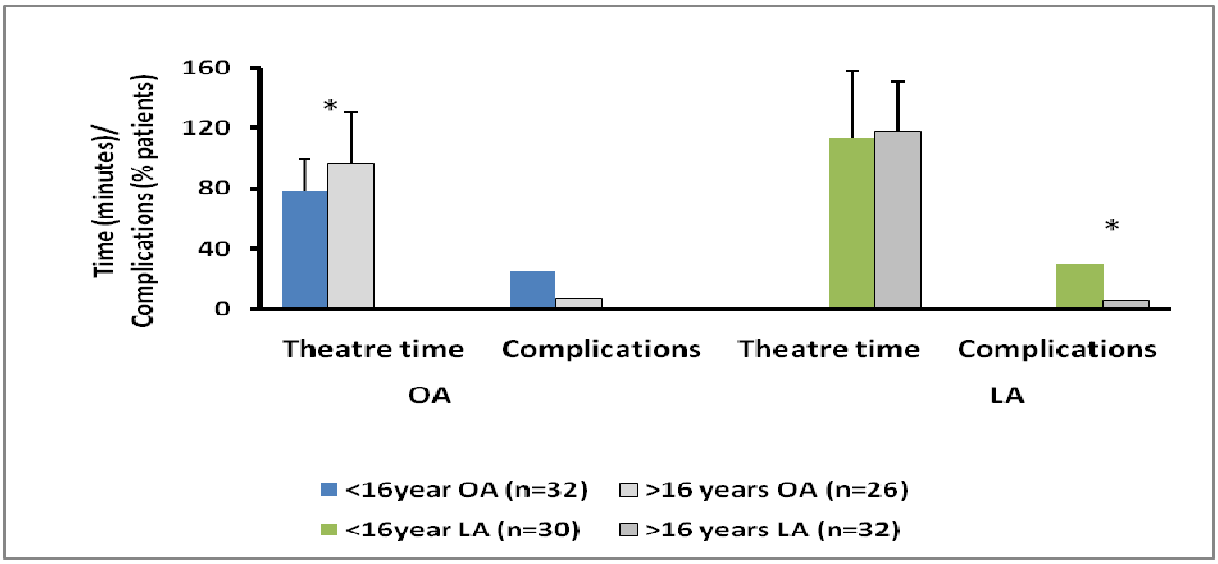
		Theater duration		Complications		ICU/HCU duration		Days to FWD		Length of hospital stay	
		OA	**LA**	**OA**	**LA**	**OA**	**LA**	**OA**	**LA**	**OA**	**LA**
Age											
< 16 years											
	Number	32	30	8 (25%)	9 (30%)	12	8	32	30	32	30
	Mean	78.46	113.67			1.56	0.53	4.59	5.87	8.09	9.17
	SD	21.19	43.88			2.94	1.25	4.05	8.80	8.20	10.76
≥ 16 years											
	Number	26	32	2 (7%)	2 (6%)	5	0	26	32	26	32
	Mean	96.92	117.97			0.54	0	2.81	2.46	5.65	4.56
	SD	33.94	32.91			1.24	0	3.29	1.41	9.47	3.44
	P-value	0.025*	0.296	0.086	0.042*	0.673	1	0.007*	0.064	0.013*	0.007*
Gender											
Male											
	Number	34	36	4 (11.7%)	5 (13.8%)	8	4	34	36	34	36
	Mean	83.29	115.56			0.68	0.19	3.03	3.53	5.17	6.03
	SD	20.73	32.38			1.34	0.63	2.12	2.72	3.31	4.27
Female											
	Number	24	26	6 (25%)	6 (23.1%)	9	4	24	26	24	26
	Mean	91.63	116.34			1.71	0.35	4.88	4.92	9.58	7.84
	SD	37.57	46.06			3.32	1.19	5.24	9.38	12.81	11.59
	P-value	0.711	0.423	0.110	0.444	0.834	0.899	0.171	0.318	0.411	0.642
Duration of symptoms											
< 2 days											
	Number	27	24	1 (3.7%)	2 (8.3%)	2	1	27	24	27	24
	Mean	77	115.20			0.14	0.08	2.18	2.45	3.70	5.08
	SD	18.09	34.11			0.53	0.40	1.61	1.58	2.18	4.24
≥ 2 days											
	Number	31	38	9 (29%)	9 (23.6%)	15	7	31	38	31	38
	Mean	95.22	116.31			1.93	0.36	5.19	5.15	9.87	7.86
	SD	33.81	41.24			3.02	1.10	4.57	7.92	11.16	9.76
	P-value	0.023*	0.971	0.014*	0.285	0.224	1	0.0001*	0.076	0.0001*	0.066
Clinical presentation											
LP											
	Number	32	26	1 (3.1%)	3 (11.5%)	3	1	32	26	32	26
	Mean	86.06	106.34			0.18	0.11	2.25	3.34	3.96	5.38
	SD	32.61	24.43			0.59	0.58	1.31	3.17	2.42	3.76
GP											
	Number	26	36	9 (34.6%)	8 (22.2%)	14	7	26	36	26	36
	Mean	87.57	122.77			2.23	0.36	5.69	4.66	10.73	7.80
	SD	24.16	44.95			3.20	1.07	4.91	7.94	11.95	10.15
	P-value	0.406	0.191	0.031*	0.285	0.115	1	0.0001*	0.252	0.001*	0.316
WBC											
< 12 X 10^9/L											
	Number	21	19	1 (4.7%)	2 (10.5%)	4	2	21	19	21	19
	Mean	80.23	117.10			0.38	0.10	2.66	3.26	4.52	5.42
	SD	24.21	46.70			0.80	0.31	1.42	2.62	3.20	3.02
≥12 X 10^9/L											
	Number	28	30	9 (32.1%)	9 (30%)	12	5	28	30	28	30
	Mean	94.14	117.66			1.89	4.33	5.25	4.06	10.03	7.10
	SD	33.56	33.31			3.17	1.25	4.94	3.49	11.67	5.80
	P-value	0.220	0.4.3	0.021*	0.191	0.071	0.285	0.042*	0.217	0.01*	0.506
CRP											
<100											
	Number	8	9	0 (0%)	1 (11.1%)	0	1	8	9	8	9
	Mean	76.25	100.55			0	0.22	2.12	2.33	3.62	4.88
	SD	15.05	20.98			0	0.66	1.12	1.11	1.59	3.33
≥100											
	Number	13	24	10 (80%)	10 (42%)	1	1	13	24	13	24
	Mean	85.15	113.54			0.23	0.25	3.92	6.58	7.07	9.50
	SD	22.77	38.14			0.83	1.22	2.81	9.48	5.78	11.76
	P-value	0.425	0.441	4.405	0.216	1	1	0.218	0.034*	0.232	0.121

*P-value <0.05 as significant SD Standard Deviation

Table 4: Analysis of the preoperative parameters compared to the outcome findings of OA and LA.

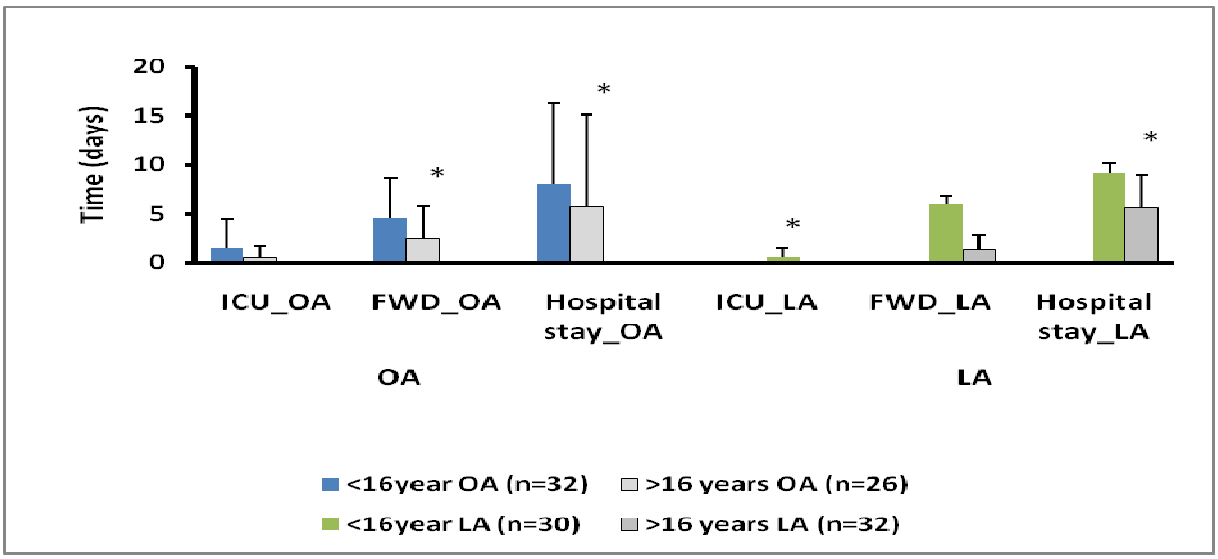
3.3.1 The Impact of Age

Patients of age 16 years and older, in the OA group had significantly longer theatre duration, time taken to commenced full ward diet and hospital stay, whereas with LA, the old age group had fewer complications and a shorter hospital stay (Fig.3.3A. and 3.3B.).



*p < 0.05

Figure 3A: Impact of age on theater time and complications, comparing OA and LA.

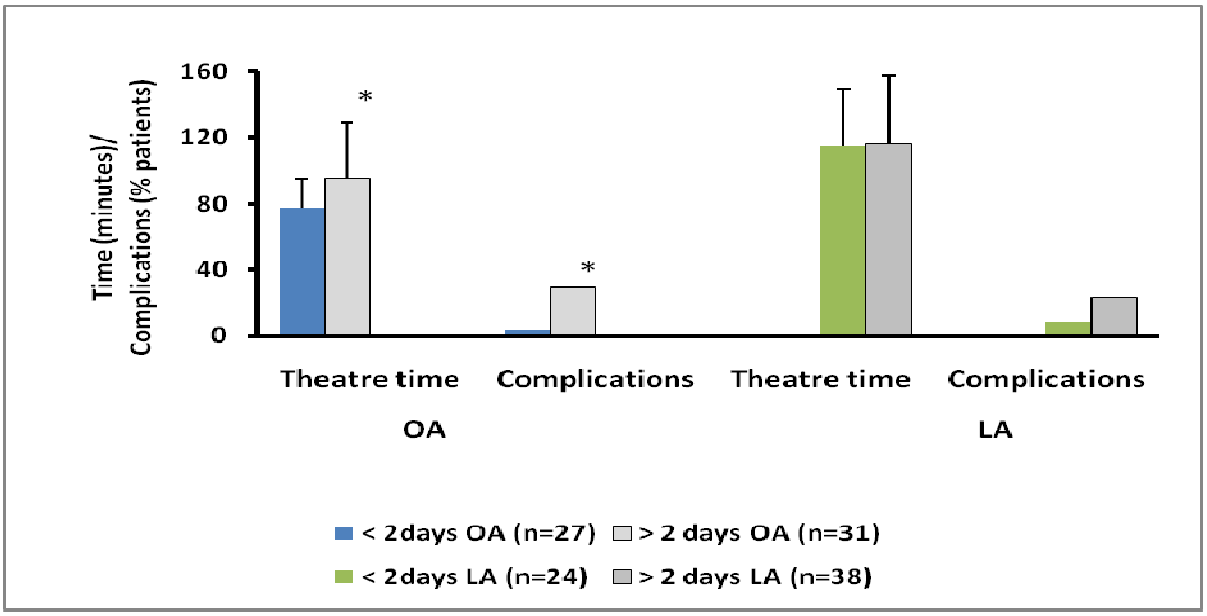


*p < 0.05

Figure 3B: Impact on age on the ICU, FWD and hospital stay, comparing OA and LA.

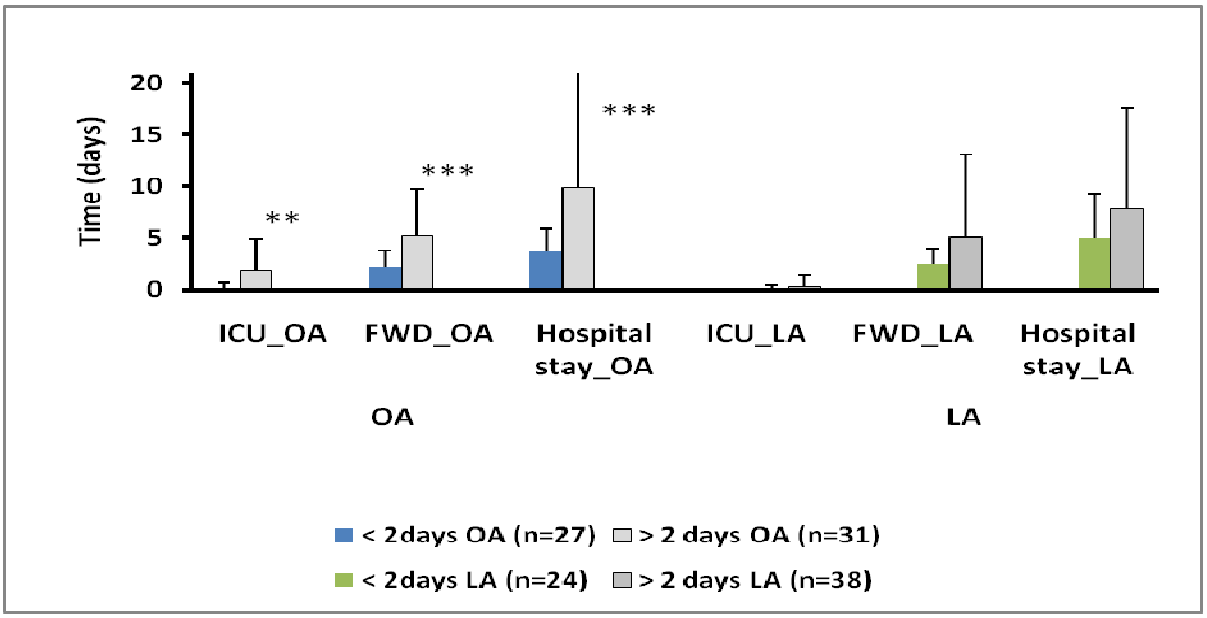
3.3.2 The Impact of Duration of Symptoms

A longer duration of symptoms appeared to significantly increased the length of theatre duration, the time to commencing a full ward diet, the length of hospital stay and the number complications in the OA group whereas there was no significant effect in LA group



*p < 0.05

Figure 4A: The impact of duration of symptoms on theater time and complications, comparing OA and LA.

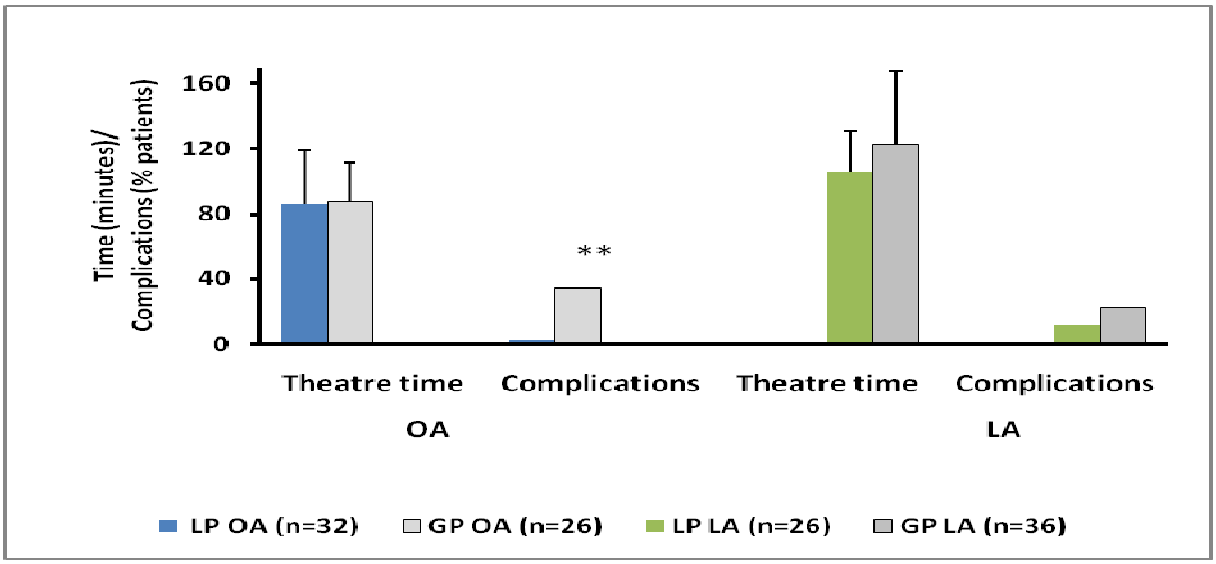


*p < 0.05, **p < 0.005, ***p <0.0005

Figure 4B: The impact of duration of symptoms on the ICU, FWD and hospital stay, comparing OA and LA.

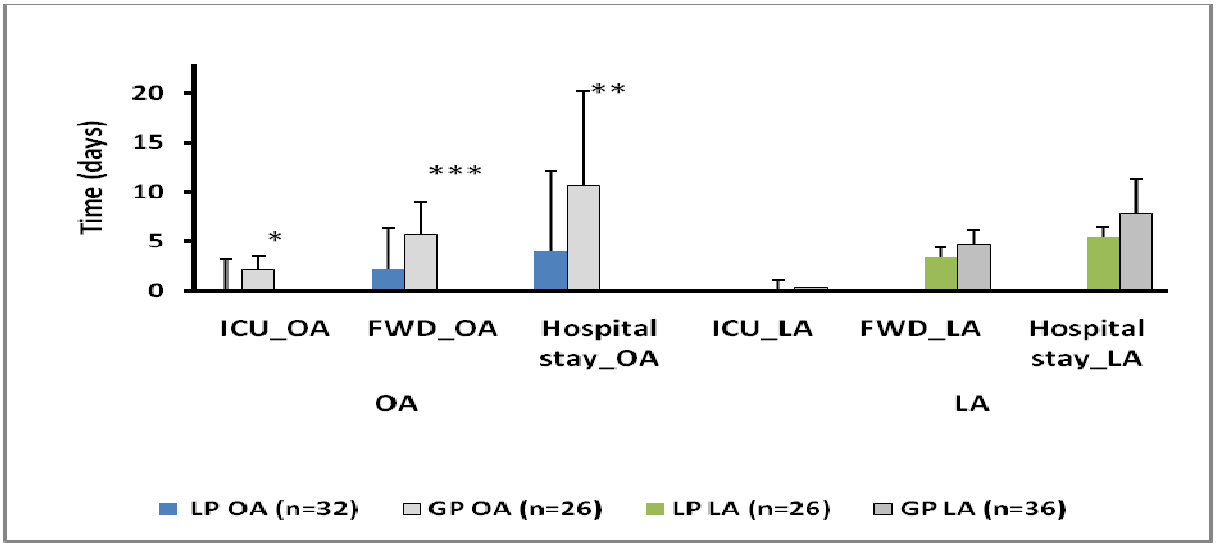
3.3.3 The Impact of Clinical Presentation

A clinical presentation of generalised pains in the OA group was associated with an increased number of complications, days to commencement of a full ward diet, the length of ICU and hospital stay. There was no statistical difference with any of these measured variables in the LA with respect to the clinical presentation (Fig. 3.5A and 3.5B).



** p < 0.005

Figure 5A: The impact of clinical presentation on theater time and complications, comparing OA and LA.

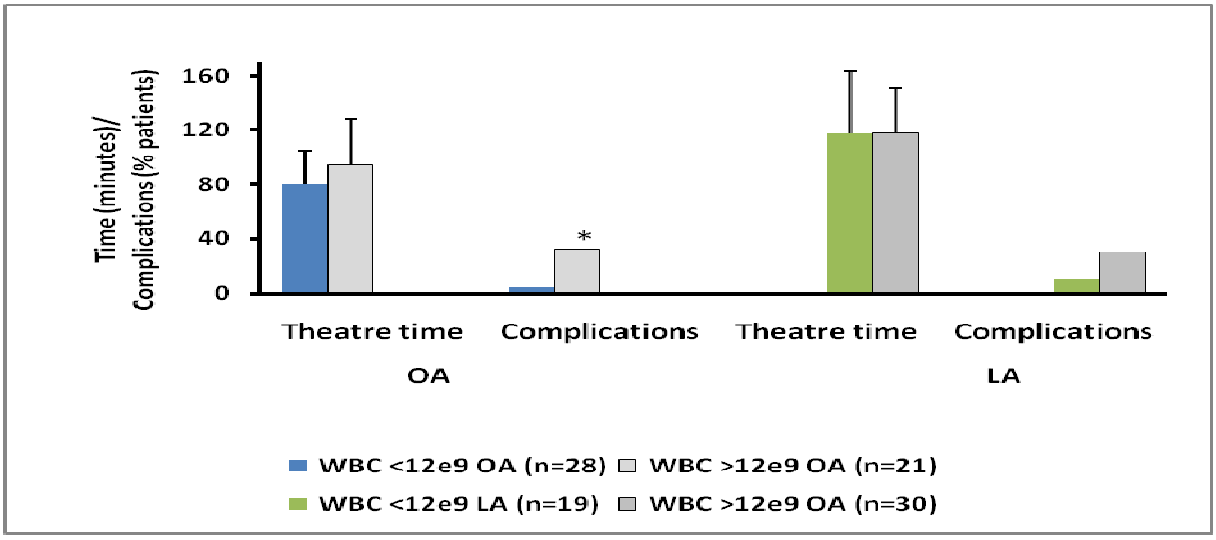


***** p < 0.05, ** p < 0.005, *** p < 0.0005

Figure 5B: The impact of clinical presentation on the ICU, FWD and hospital stay, comparing OA and LA.

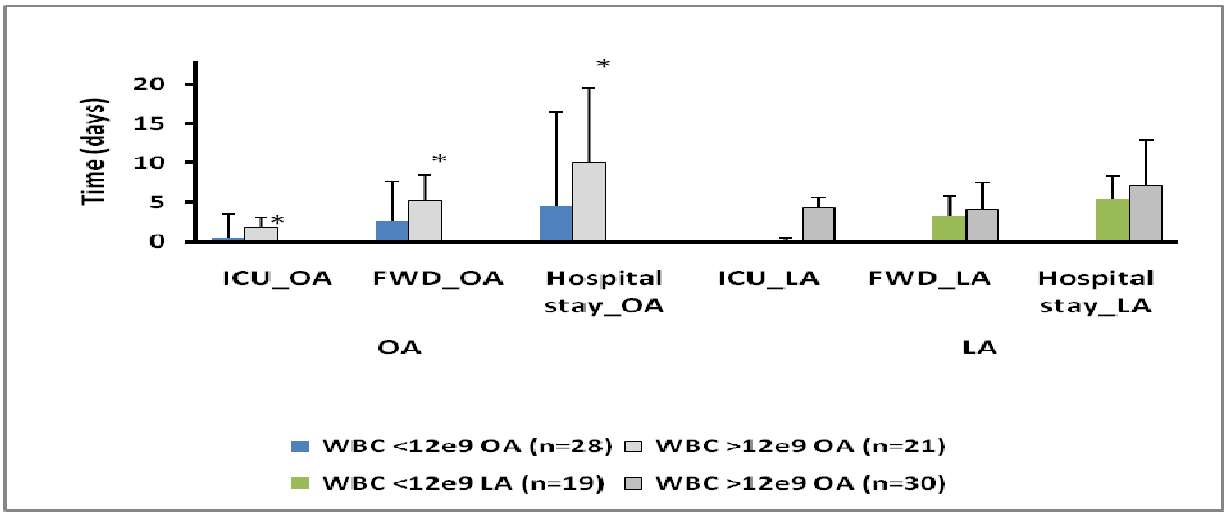
3.3.4 The Impact of WBC

As for clinical presentation, an elevated WBC was associated with significantly increased number of complications, days to commencement of a full ward diet, the length of ICU and hospital stay. In contrast, an increased WBC was not associated with outcome measures when LA was performed (Fig. 3.6A and 3.6B).



* $p < 0.05$

Figure 6A: The impact of WBC on the theater time and complications, comparing OA and LA.



*$p < 0.05$

Figure 6B: The impact of WBC on ICU, FWD and hospital stay, comparing OA and LA.

CHAPTER 4

DISCUSSION

Laparoscopic appendicectomy has not benefited from the same enthusiasm that surrounded the universal acceptance of laparoscopic cholecystectomy, since open appendicectomy can be performed through a small incision with minimal complications. The absence of a prospective randomised trial with appropriate sample size explains the lack of consensus.

4.1 Limitations of the Study

4.1.1 Selection Bias

The shortcomings of the current study are reflected by the lack of defined selection criteria for the operative approach for complicated appendicitis. I cannot exclude selection bias in the present study. In 2008, the surgical department of Sebokeng Hospital adopted the policy of LA for all patients who presented to Casualty with signs and symptoms in keeping with those of acute appendicitis. However, it is the preference of the surgical team on call rather than the preoperative signs, operative findings nor surgeon's technical skills (the consultants are readily available) that determine selection of operative procedure. The two main factors that influenced the decision making in regards to the operative approach were:

1. First, the work load. In situations where there were several cases pending for surgery, the surgical team on call in most instances chose to do OA rather than LA for cases with acute appendicitis.

2. Second, the accessibility of laparascopic equipments. This tends to be especially poor after hours, on public holidays and weekends, because of the lack of adequate working force during such periods.

It is important to emphasize that the selection was never based on the severity of illness.

4.1.2 Sample Size

Another limitation of this study is the sample size, however this is a problem shared by every other trial analysed. Considering that conventional appendicectomy is already a simple and minimally invasive operation with low morbidity and a near zero mortality, any possible improvement may only be modest, therefore the trial size should be appropriately large to detect an advantage beyond reasonable doubt, if any exist. Yet the largest randomised trial comparing LA vs. OA for complicated appendicitis had fewer than 100 patients in each group.[14]

4.1.3 Heterogeneous Nature of Sample Size

A further handicap of this study (shared with other meta-analyses of LA versus OA for complicated appendicitis) has always been the heterogeneous nature of its effective sizes. This has resulted in the conflicting findings reported in individual small trials. There have been over 16 prospective randomized trials of LA versus OA, but a consensus of opinion has not been reached.[13, 14]

The question whether meta-analysis of small trials is comparable with a single large randomized controlled trial has been studied by Cappelleri et al, [15] who found that the two are usually comparable unless there is clearly an explainable difference.

I acknowledge the intrinsic weakness of a retrospective study and the results of subgroup analyses have to be interpreted with caution.

4.2 Demographics and Diagnostic Evaluation

4.2.1 Age

Because of the heterogeneous nature of the age distribution (2 to 73 years), it was further categorised into two groups for analysis. The first group (<16years) represented the paediatric age population, and the second group (≥16 years) represented the adult age group.

Based on the age groups both OA and LA were comparable (Table 2). However, with OA, there was a statistically significant difference between the age groups on theater duration, days to the commencement of FWD and length of hospital stay. The paediatric age population in the OA group spent a significantly less amount of time in theater, took longer to commence feeding and stayed longer in the hospital. With LA, the age only influenced the outcome in the complications and length of hospital stay. The paediatric population had more complications and stayed longer in the hospital in the LA group (Figures 3A and 3B).

4.2.2 Gender

The gender on the other hand had no influence on the outcome of either group.

4.2.3 Duration of Symptoms

Likewise the duration of symptoms was also subdivided into two groups: the first group (< 2 days) representing early presentation and the second group (≥ 2 days) for late presentation to hospital. This was based on the study by Hayden CK et al that showed that after 48 hours, the risk of perforation increases to greater than 70%.[3]

Based on the duration of symptoms, both groups were comparable (Table 2). However, the theater duration, the complications, days to the commencement of FWD and length of hospital stay as outcomes findings of OA were influenced by the duration of symptoms. Cases that presented late (≥ 2 days) in the OA group spent significantly longer time in

theater, had more complications, recommenced feeding later and had a longer stay in the hospital. This was not noted with LA (Figures 6A and 6B).

The mean duration of symptoms was the same in both groups, 2.9 days. This time reflects the delay in seeking medical assistance in a health institution.

4.2.4 Clinical Presentations

Based on the fact that 48.3% of the cases had localised pain (LP) as their initially clinical presentation to the hospital, the intraoperative findings of generalised purulent peritonitis cannot be diagnosed with certainty on clinical presentation.

Both groups i.e. OA and LA were comparable (Table 2). When appendicectomy was performed by OA approach, those cases that presented with generalised pain were associated with a statistically significant increase in the complications rates, took longer to commence feeding, and spent a longer time in hospital; whereas none of these parameters appeared to be affected when the procedure was performed by LA (figures 5A and 5B).

4.2.5 WBC

The WBC was subdivided based on the normal reference value of 12 x 10^9/L. Both OA and LA groups were comparable under these subdivisions (Table 2). The complications, days to commencement of FWD and length of hospital stay as outcomes measures of OA were influenced by it (figures 6A and 6B). Cases (in the OA group only) which presented with an abnormal WBC had more complications, were slower in the commencement of feeding and spent a longer time in hospital.

4.2.6 CRP

Likewise the CRP was also subdivided into two groups (< 100 and ≥ 100), however these subdivisions were not created based on previously established criteria in the literature but rather intended to find out if there were any correlations between the CRP and the outcome measures.

The CRP groups were comparable in both OA and LA (Table 2), but showed a statistically significant influence on the days to the commencement of FWD in the LA group in which cases with CRP < 100 started feeding earlier (table 4).

As far as can be determined no other study appears to have determined the influence of age, gender, duration of symptoms prior to the admission, WBC and CRP, on the outcome measures when comparing OA and LA.

4.3 Theater Duration

One case was converted from laparoscopic approach to open approach owing to technical difficulties as a result of grossly dilated loops of bowel, a conversion rate of 1.6%. A literature review on conversion rates shows that it ranges from 0 to as high as 20%, and the main reasons for converting were poor visualisation, adhesions, iatrogenic injury to bowel and dilated loops of bowel.[13]

Based on the results on theater duration from this study, there was a statistically significant difference between the groups (p= 0.005). The LA group spent more time in theater than their OA counterparts, which is keeping with other similar studies in the literature. [6,7,11] The current study (unlike others), considered the theater duration from the time the patient was taken into theater to the time the patient was removed.

A review of the literature on meta-analysis of laparoscopic versus open appendicectomy for acute appendicitis showed that most studies calculated the theater time from time of incision to time of wound closure. However Tate et al [20] used the time from induction to the time of reversal. Minne et al [17] recorded total time spent in the operating theater. The results from Minne and associates for median operating time were 81.7 minutes for the LA group and 66.8 minutes for the OA group. Comparing these results with those of this study (whose median operating times were 105 minutes for the LA group and 80 minutes for the OA group) show a slightly longer time but the figures are comparable.

The theater time in this study was calculated from the time the patient was taken into theater to the time the patient was removed because the Nursing staff kept accurate records of this time and the actual operating time was not available.

4.4 Complications

4.4.1 Intraabdominal Sepsis (IAS)

The five cases (8.6%) of intra-abdominal sepsis (IAS) in the OA group and 8 cases (12.9%) in the LA group were diagnosed by abdominal imaging. Of the 5 cases with IAS in the OA group, 2 were managed conservatively with intravenous antibiotics, one collection was drained rectally and the remaining 2 cases needed an exploratory laparotomy for drainage of the IAS. However, of the 8 cases with IAS in the LA group, 3 were managed conservatively with intravenous antibiotics, 4 were managed by laparoscopic drainage and 1 case needed an exploratory laparotomy with a right hemicolectomy following a caecal perforation (Table 3).

Some of the collections picked up by sonar where actually irrigation fluid than actual pus, as a results the patients responded to antibiotics. The clinical picture was the final arbiter

in deciding whether or not the patient will be subjected to surgery even though the imaging had showed IAS.

Studies suggest an increase in intra abdominal sepsis rates following the laparoscopic approach especially for perforated appendicitis[16, 17.] Consequently an open approach has been advocated. However, a study by Katkhouda et al [6] on intra-abdominal abscess rates after laparoscopic appendicectomy, reviewed 645 cases of acute appendicitis, of which 67 were perforated and 61 gangrenous. He was able to show that the IAS rate following LA for perforated appendicitis was significantly lower compared to what was previously mentioned in the literature.

The findings of the present study indicate that LA for purulent peritonitis from complicated appendicitis is associated with a statistically significant higher incidence of IAS of 12.9% as opposed to 8.6% in the OA group (p= 0.009).

Although the difference in the incidence of IAS in each group did reach statistical significance, it has been suggested that the increase in IAS in the LA group is secondary to an increase in incidence of bacterial translocation caused by the carbon dioxide pneumoperitoneum.

Animal models of peritonitis have shown that carbon dioxide pneumoperitoneum may increase septic complications. Bloechle et al, [18] in a rat model of gastric perforation, found a statistically significant increase in the degree of peritonitis in the pneumoperitoneum group compared to the control group. This study implies that a carbon dioxide pneumoperitoneum may adversely affect a patient who has intra-abdominal infection. Additionally, a further study in rats challenged with intraperitoneal faecal inoculums showed a higher number of IAS in the group that underwent laparotomy as compared with those rats that underwent laparoscopy.[19] No explanation was offered for the divergence of the results, and as yet there is no prospective randomised human trial to confirm or dispute the above speculations.

The following steps were undertaken to reduce the IAS rates during the LA:

1. First, the copious irrigation of the peritoneal cavity, this included the right and left paracolic gutters, supra and subhepatic spaces, perisplenic, pelvic and inter-loop areas. During this procedure the table is occasionally adjusted to create gravity dependent areas for easy irrigation and drainage.
2. Secondly as mentioned above, the appendix is always retrieved through the port.
3. Finally the usage of prophylaxis antibiotics as a single dose preoperatively.

4.4.2 Wound Sepsis / Port Site Sepsis

Nine cases (15.5%) of wound sepsis were recorded in the OA group and 2 cases (3.2%) of port site sepsis were noted in the LA group; all these cases were managed by daily dressings only. One of the reasons for the lower incidence of wound sepsis/port site sepsis in the LA group was that the inflamed appendix was removed through the operating port without making contact with the wound itself.

4.4.3 Other Complications

One case of septic shock with renal failure occurred in the OA group; the patient in question spent a long time in ICU and required haemodialysis for renal failure. He ultimately recovered and was subsequently discharged home. A single case of pneumonia occurred in the LA group as a complications. This also had an uneventful course.

4.5 Postoperative Outcomes

In favour of the LA group, there was a statistically significant difference between the days spent in ICU/HCU between the two groups. The days to commencement of full ward

diet and the duration of hospital stay were comparable between the OA group and the LA group as shown in Figures 1 and 2.

CHAPTER 5

CONCLUSION

Acknowledging that the standard surgical approach in a preoperative diagnosis of generalised purulent peritonitis from a complicated appendicitis is the midline laparotomy, the benefit of LA over OA (McBurney or Rocky-Davis incision) in cases where the diagnosis of generalised purulent peritonitis is only made intraoperatively, is likely to be small and difficult to prove, getting a consensus on the choice for the appropriate initial operative approach or the subsequent approach (after an intraoperative diagnosis of generalised purulent peritonitis) among surgeons will be difficult.

From this study, the outcome measures of open appendicectomy depended on several factors; the age, the duration of symptoms, the clinical presentation and the patient's WBC. However the outcome measures of laparoscopic appendicectomy were influenced only by the patient's age and the CRP. The implication of this is that, in the interpretation of data comparing the outcome measures between OA and LA, we should be fully aware that these individual outcome measures are affected by the preoperative parameters, and these same preoperative parameters exhibit different effects based on the surgical approach. I do believe that the scepticism on LA has solely been based on its complications, which unfortunately are dependent on other factors.

Generalised peritonitis from complicated appendicitis can be managed successfully laparoscopically. It is feasible, safe; less influenced by preoperative parameters and should be considered the procedure of choice for complicated purulent appendicitis.

RECOMENDATIONS

1. When faced with an unexpected intraoperative finding of generalised purulent peritonitis from a complicated appendicitis, in facilities which are well skilled and resourced in both LA and OA, from this study, the surgeon should carry on with the initial approach.
2. In scenarios where the technical skills and resources are lacking, converting to a midline laparotomy leaving the skin open is advocated.
3. When in doubts in regards to the diagnosis of generalised purulent peritonitis in the preoperative stage, the decision in choosing any of the approaches should be based on the surgical skills of the surgeon and the availability of equipment.
4. Once the decision for an appendicectomy is made, irrespective of the surgical approach, the patient must first be optimised, deranged electrolytes corrected, appropriate blood workup and imaging must be done prior to surgery.

REFERENCES

1. McBurney C. The incision made in the abdominal wall in cases of appendicitis with a description of a new method of operation. Ann Surg. 1894 July; 20(1):38-43.
2. Semm K. Endoscopic appendicectomy. Endoscopy 1983 Mar; 15(2):59-64.
3. David RF, Thomas DK. Evaluating diagnostic accuracy in appendicitis using administrative data. J Sur Res. 2005 Aug; 123(1):257-61.
4. Shelton T, McKinlay R, Schwartz RW. Acute appendicitis: Current diagnosis and treatment. Curr Surg. 2003 Sept; 60(5):502-5.
5. Hayden Jr CK, Kuchelmeister J, Lipscomb TS. Sonography of acute appendicitis in childhood: Perforation versus nonperforation. J Ultrasound Med 1992 May; 11(3):209-216.
6. Katkhouda N, Friedlander MH, Grant SW, Achanta KK, Essani R, Paik P, Velmahos G, Campos G, Mason R, Mavor E. Intraabdominal abscess rate after laparoscopic appendicectomy. Am J Surg. 2000 Dec; 180(6):456-461.
7. Klingler A, Henle KP, Beller S, Rechner J, Zerz A, Wetscher GJ, Szinicz G. Laparoscopic appendicectomy does not change the incidence of postoperative infectious complications. Am J Surg. 1998 Dec; 175(1):232-235.
8. Mahadevan D. Laparoscopic appendicectomy: the ideal procedure for laparoscopic skill training for surgical registrars. Asian J Surg. 2008 Apr; 31(2):55-58.
9. Frazee RC, Bohannon WT. Laparoscopic appendicectomy for complicated appendicitis. Arch Surg. 1996 May; 131(5):509-512.
10. Jeffery RH, Monford DC, Brett HM, John RM. Should laparoscopic appendicectomy be avoided for complicated appendicitis in children? J Paed Surg Nov. 1997(11); 32:1601-1603.
11. Cothren CC, Ernest EM, Jeffery LJ, David JC. Can we afford to do laparoscopic appendicectomy in an academic hospital? Am J Surg. 2005 Dec; 190(6):973-977.
12. Kwok KY, Wing TS, Chun NT, George PC. Laparoscopic versus open appendicectomy for complicated appendicitis. Am J Surg 2007 July; 205(1):60-65.
13. Golub R, Siddique F, Pohl D. Laparoscopic versus open appendicectomy: meta-analysis. Am Coll Surg. 1998 May; 186(5):545-553.

14. Raphael SC, Douglas YR, Li P, Diaz J. A meta-analysis of randomized controlled trial of laparoscopic versus conventional appendicectomy. Am J Surg. 1999 Nov; 177(5):250-256.
15. Cappelleri JC, Loannidis J P, Schmid C H. Large trails versus meta-analysis of smaller trials: how do their results compare? JAMA 1996 Feb; 276(5):1332-1338.
16. Martin LC, Puente I, Sosa JL, Bassin A, Breslaw R, McKenney MG, Ginzburg E, Sleeman D. Open versus Laparoscopic appendicectomy: a prospective randomised comparison. Ann Surg. 1995 Nov; 22(1)2:256-262.
17. Minne L, Varner D, Burnell A. Laparoscopic versus Open appendicectomy: prospective randomised study of outcomes. Arch Surg. 1997 Aug; 132(6):708-712.
18. Bloechle C, Emmermann, Treu H. Effect of pneumoperitoneum on the extent and severity of peritonitis induced by gastric ulcer perforation in rats. Surg Endosc. 1995 Oct; 9:898-901.
19. Jacobi CA, Ordemann J, Bohm B: Does laparoscopy increase bacteriamia and endotoxemia in peritonitis model? Surg Endosc. 1997 Jan; 11(6):235-238.
20. Tate JT, Dawson JW, Chung SCS, Li AKC. Laparoscopic versus open appendicectomy: prospective randomised trial. Lancet 1993 Sept; 342(8872):633-637.

APPENDIX A

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

Division of the Deputy Registrar (Research)

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)
R14/49 Dr Brown C Ndofor

CLEARANCE CERTIFICATE	**M090570**
PROJECT	Is Laparoscopic Surgery the answer to Generalised Peritonitis from Complicated Appendicitis?
INVESTIGATORS	Dr Brown C Ndofor.
DEPARTMENT	Department of Surgery
DATE CONSIDERED	09.05.29
DECISION OF THE COMMITTEE*	Approved unconditionally

Unless otherwise specified this ethical clearance is valid for 5 years and may be renewed upon application.

DATE 09.05.29 **CHAIRPERSON** .....
(Professor P E Cleaton Jones)

*Guidelines for written 'informed consent' attached where applicable

cc: Supervisor : Dr MZ Koto

DECLARATION OF INVESTIGATOR(S)

To be completed in duplicate and **ONE COPY** returned to the Secretary at Room 10004, 10th Floor, Senate House, University.
I/We fully understand the conditions under which I am/we are authorized to carry out the abovementioned research and I/we guarantee to ensure compliance with these conditions. Should any departure to be contemplated from the research procedure as approved I/we undertake to resubmit the protocol to the Committee. **I agree to a completion of a yearly progress report.**

PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES...

APPENDIX B

Faculty of Health Sciences
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Reference: Ms Tania Van Leeve
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13 January 2010
Person No: 0618649X
PAG

Dr BC Ndofor
1011 Fitzpatrick Building
Johannesburg Hospital
Jubilee Road
Parktown
2193
Johannesburg, South Africa

Dear Dr Ndofor

Master of Medicine in the specialty of Surgery: Approval of Title

We have pleasure in advising that your proposal entitled "*Is laparoscopic surgery the answer in generalised purulent peritonitis from complicated appendicitis?*" has been approved. Please note that any amendments to this title have to be endorsed by the Faculty's higher degrees committee and formally approved.

Yours sincerely

Mrs Sandra Benn
Faculty Registrar
Faculty of Health Sciences