Comparing laparoscopic appendectomy to open appendectomy in managing generalised purulent peritonitis from complicated appendicitis: the uncharted path

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Background: The objective of the study was to compare the outcomes of patients with generalised purulent peritonitis from complicated appendicitis diagnosed intraoperatively who were managed laparoscopically to those managed via the open approach in a single institution.
Methods: Data were collected from all cases admitted at Sebokeng Hospital, Johannesburg, over the past two years (2008 and 2009) with an intraoperative diagnosis of generalised purulent peritonitis from complicated appendicitis. Cases managed laparoscopically or by the open approach were analysed. The demographic findings, theatre duration, complications, days to the commencement of a full ward diet and the length of the hospital stay were the analysed parameters.
Results: One hundred and twenty appendectomies with generalised purulent peritonitis were performed during the study period. Of these, 58 patients underwent open appendectomy, and 62 patients had laparoscopic appendectomy. Both groups were comparable with regard to the demographics and preoperative findings. Theatre duration was significantly higher in the laparoscopic appendectomy group –116 minutes for a laparoscopic appendectomy compared to 87 minutes for an open appendectomy. The rate of intra-abdominal sepsis was also higher in the laparoscopic appendectomy group – 13% for a laparoscopic appendectomy, and 9% for an open appendectomy. A statistically significant decrease in the wound sepsis rate was shown in the laparoscopic appendectomy group. No statistical significant difference was demonstrated with regard to other postoperative complications, days to the commencement of a full ward diet and the length of hospital stay in both groups. More time (an average of 3.7 days) was spent in the intensive care unit and high care unit by those in the open appendectomy group, than those in the laparoscopic appendectomy group (an average of 2.0 days). However, age, duration of symptoms, clinical presentation and white blood cell count were influencing factors on the outcome measures in the open appendectomy group.
Conclusion: Generalised purulent peritonitis from complicated appendicitis can be managed successfully laparoscopically. Both approaches are feasible, safe and have comparable outcomes. The laparoscopic approach resulted in fewer postoperative wound sepsis complications.
Keywords: complicated appendicitis, generalised purulent peritonitis, laparoscopic appendectomy, open appendectomy

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Introduction

The laparoscopic appendectomy was first described by Semm in 1983.[1] Since then, it has grown in popularity as a surgical option for the management of suspected or uncomplicated acute appendicitis. The benefits of various aspects of this approach over open surgery have been debated, with a reduction surgical site infection being the most consistent benefit.[2] In South Africa, a midline laparotomy is considered the standard of management for patients with generalised purulent peritonitis from complicated appendicitis.[3] However, a diagnosis of generalized purulent peritonitis is sometimes only made intraoperatively. Traditionally in these circumstances, the surgeon can elect to convert to a midline laparotomy or extend the original McBurney's point centered incision. Where the laparoscopic approach is used, the one can either convert or continue laparoscopically. Against this background, we compared the McBurney extension approach to the laparoscopic approach in a South African context.

Objectives

The main objectives of this study were to determine the role of a FAST as a screening tool in order to detect BAT in children who sustained HET, and whether or not it could replace CT scanning as a modality, given the limitations of the latter.

A secondary objective was to establish whether or not the combination of a FAST and a physical examination was adequate in detecting IAI.

Method

Study design and inclusion criteria

This study was conducted as a retrospective review of all cases with generalised purulent peritonitis from complicated acute appendicitis diagnosed intraoperatively at Sebokeng Hospital between January 2008 and December 2009. Generalised peritonitis was defined as a finding of purulent exudate at surgery, involving more than a single quadrant. Cases managed laparoscopically were compared to those managed via McBurney's initial incision, i.e. they were not converted to a midline laparotomy after the finding of generalised peritonitis, but rather the incision was extended. The decision to utilise either an open or a laparoscopic approach was made by the surgeon.

Exclusion criteria

Exclusion criteria included:

- All cases of generalised purulent peritonitis from other causes, except appendicitis.
- Cases of generalised purulent peritonitis which were managed via a midline laparotomy, or converted from McBurney's initial incision or Rocky-Davis incision to a midline laparotomy.
- Cases of patients with single, localised pus collection.
- All cases of patients with complicated appendicitis, i.e. appendiceal mass, gangrenous appendix or perforated appendix, without the presence of generalised purulent peritonitis.

Outcome measures

The main outcome measures for the purposes of this study were:

- The surgical approach, i.e. a laparoscopic appendectomy approach versus an open appendectomy approach.
- Theatre duration.
- Postoperative complications.
- The duration of stay in an intensive care unit (ICU) or high care unit (HCU).
- Time to the commencement of a full ward diet.
- Length of hospital stay.

Other measures included obtaining the demographic data, i.e. age, gender and duration of symptoms, prior to admission, and the clinical presentation of the patients, i.e. whether they presented with localised pain or generalised pain. These data were analysed.

Data analysis

The data were recorded in Microsoft® Excel® and comparisons between the groups made using SAS® version 9.1. Fisher's exact test was used when the number in a group was less than or equal to (≤) 5. Multiple logistic regression was used to determine the theatre time, time taken to the commencement of a full ward diet, and time to discharge from the hospital. A p-value of ≤ 0.050 was considered to be significant.

Results

During the study period, a total of 120 cases of appendectomies with generalised purulent peritonitis were recorded. Of these, 58 cases underwent an open appendectomy and 62 cases a laparoscopic appendectomy. One case was converted from a laparoscopic approach to an open approach, constituting a conversion rate of 2%. Death did not occur in this study. The results of the open appendectomy and the laparoscopic appendectomy groups are summarised in Table 1.

Demographics and diagnostic evaluation

The study populations were comparable in both groups. The average age was 20 years, and most were males who presented at the hospital three days after the onset of the symptoms. There were no statistically significant differences with respect to age, gender, clinical presentation, duration of symptoms, WBC and CRP between the two groups (Table 2).

Outcome measures and complications

Table 3 shows the analysed outcomes variable for the two groups. The mean theatre duration was on average 30 minutes ($p = 0.005$) longer in the laparoscopic appendectomy group than in the open appendectomy group. The number of patients who developed wound/port site sepsis was significantly less in the laparoscopic appendectomy group than in the open appendectomy group (2/62 and 9/58 respectively, $p = 0.037$) The 5 cases (9%) of intra-abdominal sepsis (IAS) in the open appendectomy group and 8 cases (13%) in the laparoscopic appendectomy group were diagnosed by abdominal imaging. Of the 5 patients with IAS in the open appendectomy group, two were managed conservatively with intravenous antibiotics, one collection was drained rectally, and an exploratory laparotomy for drainage was required for the remaining two. However, of the eight patients with IAS in the laparoscopic appendectomy group, three were managed conservatively with intravenous antibiotics, four by laparoscopic drainage, and an exploratory laparotomy with a right hemicolectomy following caecal perforation was required for one patient. The clinical picture was the final arbiter in deciding whether the imaging shown IAS would be subjected to surgery.

A case of septic shock with renal failure was reported in the open appendectomy group, and a single case of pneumonia in the laparoscopic appendectomy group. Time to commencement of a full ward diet and the length of hospital stay were not different between the two groups.

Postoperative evaluation

Time to commencement of a full ward diet and the length of hospital stay were primary outcomes that were compared between the laparoscopic appendectomy and open

Table 1: A summary of the data

Type of approach	Number of cases	Average age (years) Median, range	Gender	ASD (days) Median, range	Average WBC count (x 10^9/l) Median, range	Average CRP (mg/l) Median, range	Clinical presentation	ATD (minutes) Median, range	Complications	Average ICU/HCU duration (days) Median, range	ADC of a full ward diet Median, range	AHS (days) Median, range
Open approach	58	18.5 20, 2 – 73	34 (males) 24 (females)	2.9 3, 1 - 7	14.7 15.1, 3.8 – 36.8	143.5 194, 4.3 - 448	32 LP 26 GP	86.7 105, 50 - 240	IAS 5 WS 9 Septic shock 1	3.7 2, 1 - 6	3.7 3, 1 - 48	7.0 5, 2- 59
Laparoscopic approach	62	22.1 19, 5 – 48	36 (males) 26 (females)	2.9 3, 1 - 21	15.8 14.8, 5.4 – 40.9	183.8 203, 16.1 - 344	26 LP 36 GP	115.8 91, 40 - 190	IAS 8 PS 2 Pneumonia 1	2.0 4, 2 - 13	4.1 3, 1 - 20	6.7 7, 2- 51

ADC: average days to commencement, AHS: average hospital stay, ASD: average symptom duration, ATD: average theatre duration, CRP: C-reactive protein, GP: generalised pain, HCU: high care unit, IAS: intra-abdominal sepsis, ICU: intensive care unit, LP: localised pain, PS: port site sepsis, WBC: white blood cell, WS: wound sepsis

Table 2: Patient demographics and preoperative observations compared with the type of surgery

Characteristics	Type of surgery		p-value
	Open appendectomy	Laparoscopic appendectomy	
	n (%)	n (%)	
Age (years)			
≤ 16	29 (50.0)	28 (45.1)	0.299
≥16	29 (50.0)	34 (54.8)	
Gender			
Male	34 (58.5)	36 (58.0)	0.951
Female	24 (41.4)	26 (41.9)	
Clinical presentation (pain)			
Localised	32 (55.1)	26 (41.9)	0.147
Generalised	26 (44.8)	36 (58.0)	
Duration of symptoms (days)			
≤ 2	26 (44.8)	24 (38.7)	0.121
≥ 2	32 (55.1)	38 (61.2)	
White blood cell count (x 10^9/l)			
≤ 12	19 (38.7)	19 (34.5)	0.345
≥ 12	30 (61.2)	36 (55.4)	
C-reactive protein (mg/l)			
≤ 100	8 (47.1)	9 (27.2)	0.554
≥ 100	13 (52.9)	24 (72.7)	

Table3 : The patients' postoperative course and complications with the different types of surgery

Variables	Type of surgery		p-value
	Open appendectomy	Laparoscopic appendectomy	
Theatre duration, mean (range)	86.7 (40–190)	115.8 (50–240)	0.005*
Complications, n (%)			
Wound sepsis or port site sepsis	9.0 (15.5)	2.0 (3.2)	0.037*
Intra-abdominal sepsis	5.0 (8.6)	8.0 (12.9)	0.009*
Septic shock	1.0 (1.7)	0.0 (0.0)	1.000
Pneumonia	0.0 (0.0)	1.0 (1.1)	1.000
HCU/ICU duration, mean (range)	1.1 (0.0–13.0)	0.2 (0.0–6.0)	0.010*
Days to commencement of a full ward diet	3.7 (1.0–20.0)	4.1 (1.0–48.0)	0.345
Length of hospital stay	7.0 (2.0–51.0)	6.7 (2.0–59.0)	0.246

HCU: high care unit, ICU: intensive care unit
*: p-value = ≤ 0.05, statistically significant

appendectomy groups. The average times for both these outcomes were four and seven days, respectively. A significant difference was not noted between the groups (Table 3).

Although the average times to the commencement of full ward diet and length of hospital stay were not different, to determine whether more patients in either group commenced full ward diet or were discharged earlier, the data were re-analysed using Kaplan-Meier curves. No differences between the curves were noted for these parameters.

Discussion

General factors at presentation remain risk factors for outcome variables in appendicitis. The duration of symptoms was subdivided into early (≤2 days) and late (≥2 days). This was based on the study by Hayden et al. in which it was demonstrated that the risk of perforation increased to ≥ 70% after 48 hours.[4] The mean duration of symptoms was the same in both groups (2.9 days). This time reflects the delay in seeking medical assistance at a health institution. Based on the fact that 48% of the cases reported localised pain at their initial clinical presentation to the hospital, the intraoperative finding of generalised purulent peritonitis could not have been diagnosed with certainty on clinical presentation hence supporting a standard operative approach.

One case was converted from a laparoscopic approach to an open approach owing to technical difficulties as a result of grossly dilated loops of bowel (a conversion rate of 2%). It was shown in a literature review that conversion rates vary considerably from 1.7% to as high as 39%.[5] The main reasons for conversion were poor visualisation, adhesions, and iatrogenic injury to the bowel and dilated loops of bowel.

The patients in the laparoscopic appendectomy group spent approximately 30 minutes longer in theatre than their open appendectomy counterparts, which is in keeping with the findings of other similar studies in the literature.[5–7] Unlike the other studies, theatre duration (the time from when the patient was taken into theatre to the time that he or she was removed) was considered in this study. It was shown in a review of the literature with regard to a meta-analysis of laparoscopic versus open appendectomy for acute appendicitis, that the theatre time was calculated from the time of incision to the time of wound closure in most studies. However, Tate et al.[8] used the time from induction to the time of reversal. In uncomplicated appendicitis, as in this study, Minne et al.[9] recorded the total time spent in the operating theatre. Their results for median operating time were 82 minutes for the laparoscopic group, and 67 minutes for the open group. This was shorter than in this study which dealt with complicated appendicitis with peritonitis in whom peritoneal toilet added to the total time for theater.

An increase in the intra-abdominal sepsis (IAS) rate following the laparoscopic approach, especially for perforated appendicitis, has been documented in studies.[9,10] Consequently, an open approach has been advocated. However, in a study by Katkhouda et al.[6] on intra-abdominal sepsis rates after laparoscopic appendectomy, 645 cases of acute appendicitis were reviewed, of which 67 were perforated and 61 gangrenous. They were able to show that the IAS rate following laparoscopic appendectomy for perforated appendicitis was significantly lower that what had been reported in the literature. The findings of the present study indicated that laparoscopic appendectomy for purulent peritonitis from complicated appendicitis was associated with a statistically significant higher incidence of IAS of 13%, as opposed to 9% in the open appendectomy group (p = 0.009). However, in terms of management, the majority did not require an open surgical procedure and could be managed laparoscopically. The increase in intra-abdominal sepsis in the laparoscopic appendectomy group may be due to bacterial translocation caused by carbon dioxide

pneumoperitoneum. Bloechle et al.[11] in a rat model of gastric perforation, found a significant increase in the degree of peritonitis in the pneumoperitoneum group, compared to that in the control group. The results conflict with another rat's study where intraperitoneal fecal inoculums, resulted in a higher number of IAS compared with rats that underwent laparoscopy.[12] There are several studies which attest to equivalent rates of IAS in open and advanced cases. [13,14]

The wound sepsis rate was 4 times higher in the open appendectomy group, with only 2 cases (3%) of port site sepsis in the laparoscopic appendectomy group. One of the reasons for the lower incidence of port site sepsis in the laparoscopic appendectomy group was that the inflamed appendix was removed through the operating port without making contact with the wound itself otherwise a plastic bag extraction was used. This is a consistent finding in the laparoscopic versus open appendectomy meta-analysis. [2,5,7,10,13,15]

One case of septic shock with renal failure occurred in the open appendectomy group. The patient in question spent a long time in ICU, and required haemodialysis for renal failure. He ultimately recovered and was subsequently discharged. A single case of pneumonia occurred in the laparoscopic appendectomy group as a result of complications. An uneventful course was also reported.

As far as can be determined, the influence of age, gender, duration of symptoms prior to admission, WBC count and CRP on outcome measures when comparing open appendectomy and laparoscopic appendectomy has not been established in any other study. The outcome measures of an open appendectomy depended on several factors in this study; age, the duration of symptoms, clinical presentation and the patient's WBC count. However, the outcome measures of a laparoscopic appendectomy were influenced only by the patient's age and the CRP.

The intrinsic weakness of a retrospective study is acknowledged. The results of the subgroup analyses should be interpreted with caution. The shortcomings of the current study were reflected by lack of defined selection criteria for the operative approach for complicated appendicitis. Selection bias cannot be excluded in the present study. In 2008, the surgical department of Sebokeng Hospital adopted a policy of laparoscopic appendectomy in all patients who presented to the emergency room with signs and symptoms of acute appendicitis. However, it is the decision of the surgical team on call, rather than the preoperative signs, operative findings and surgeon's technical skills (consultants are readily available) that determines the type of operative procedure.
The sample size was another limitation in this study. However, this is a problem shared by every other trial analysed. Considering that conventional appendectomy is already a simple and minimally invasive operation with low morbidity and near-zero mortality, any possible improvement would only be modest. Therefore, the trial size should be appropriately large to detect an advantage beyond reasonable doubt, if any doubt exists.

Conclusion

The intrinsic weakness of a retrospective study is acknowledged. The shortcomings of the current study by the potential selection bias in a lack of standardised criteria for the choice of operative approach for complicated appendicitis. However, the study does show in selected patients that continuing a laparoscopic approach when peritonitis is observed is safe when compared to using local extension of the initial open incision. The approach comes at the cost of increased operating time and more IAS but it is offset by a fourfold lower wound infection rate.

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