

# Laparoscopic Appendectomy as a Standard of Care for Both Complicated and Uncomplicated Appendicitis in South Africa, Is It Safe? Single Center Experience

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## ABSTRACT

**Aim:** The aim of this descriptive analytical study was to describe the outcomes of using laparoscopic appendectomy (LA) as the standard of care for both complicated and uncomplicated cases of acute appendicitis in South Africa.

**Background:** Laparoscopic appendectomy has been widely accepted as safe when performed in uncomplicated cases of acute appendicitis. However, acceptance of this procedure as the standard of care has been surrounded by controversies, with the main concern been around the safety of this procedure in complicated cases of appendicitis. Currently, there is no consensus in published literature regarding the use of LA as the standard of care in both complicated and uncomplicated appendicitis.

**Materials and methods:** A retrospective analysis of all patients who were diagnosed with acute appendicitis at Dr George Mukhari Academic Hospital over a 3-year period was reviewed. Data were retrieved from our departmental database and analyzed using descriptive statistics.

**Results:** A total of 746 patients were reviewed and 576 were included in the study. All these patients were offered LA. The mean age was 26.37, with 66% of our patients been males. Complicated cases formed 38% of our total study population. Laparoscopic appendectomy was performed in both complicated and uncomplicated cases of appendicitis with a success rate of 96%. Intraoperative complication rate and the relook rate was 0.5 and 7% respectively, with an overall mortality of 1.7%.

**Conclusion:** The positive outcome found in this study when LA was used in both complicated and uncomplicated cases of acute appendicitis suggests that this approach is possible in carefully selected patients and with appropriate basic laparoscopic skills.

**Clinical significance:** Complicated appendicitis is not a contraindication to laparoscopy.

**Keywords:** Appendicitis, Complicated appendicitis, Laparoscopic appendectomy, Uncomplicated appendicitis.

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## INTRODUCTION

Laparoscopic appendectomy (LA), initially described by Semm in 1983, has increasingly gained favor in the past decade in management of selected cases of acute appendicitis.<sup>1</sup> The benefits of LA as a minimal access surgery include less postoperative pain, shorter hospital stay, early return to work, and better cosmesis.<sup>2-4</sup> These benefits have made this approach attractive. However, despite all these benefits, LA has not been widely accepted as a standard of care for management of all cases.<sup>5</sup> This is due to dispute regarding its advantage compared with open surgery.<sup>1,6-9</sup>

The controversies around high procedure-related complication rate and conversion rate associated with LA when used in complicated cases of appendicitis have led to some authors questioning the safety of this procedure, especially in complicated cases.<sup>10-12</sup> Most acute appendicitis cases present after hours are often managed by residents. This has also been quoted in the literature as a potentially contributing factor to high complication rate due to lack of skill.<sup>13</sup> Currently, there is no general consensus regarding the safety and feasibility of using LA in complicated cases of appendicitis.

Contrary to what has been practiced and reported in the literature, LA was introduced as the standard of care at Dr George Mukhari Academic Hospital (DGMAH) for both complicated and uncomplicated cases of appendicitis in 2011. Most of the cases at this facility present after hours and are managed by residents on site. The DGMAH is a tertiary teaching hospital with a bed capacity of 1,500, situated in Gauteng province. The hospital takes referrals from at least three provinces namely Gauteng, Northwest, and Limpopo provinces.

A departmental database was used to store all the information of patients managed with LA and it is updated and checked for accuracy during our weekly morbidity and mortality meetings.

All patients who presented with a preoperative assessment of acute appendicitis, in all age groups were offered LA, hence, were considered for the study.

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The uncertainty about the safety of using LA as a standard of care in the management of both complicated and uncomplicated cases of appendicitis needs clarification. The outcomes of this study will suggest if LA as the standard of care for both complicated and uncomplicated cases of acute appendicitis can be safely practiced.

## MATERIALS AND METHODS

A retrospective analysis of a prospectively collected data on patients who were offered LA from June 2012 to October 2015 at DGMAH was done. A database from the Department of General Surgery at Sefako Makgatho Health Sciences University (SMU) was used to retrieve all the data used in this study. An ethics clearance was obtained from SMU in accordance with Helsinki declaration.

A diagnosis of appendicitis was made based on the clinical and/or special investigations. The Alvarado score (Appendix 1) of 7 or more was considered diagnostic, and imaging (ultrasound or CT scan) was done to confirm the diagnosis if the Alvarado score was 4 to 6. Also, all patients with an Alvarado score of 3 or less were managed nonoperatively, hence excluded from the study.

### Inclusion Criteria

All patients with a preoperative diagnosis of acute appendicitis and were performed an emergency LA were included in the study.

### Exclusion Criteria

Laparoscopic appendectomy for incidental appendectomies and interval appendectomies.

### Data Collected

All data concerning patients' demographics, such as age, sex were collected. The intraoperative findings, such as four quadrant pus, appendicular abscess, and appendicular mass as well as procedure-related complications were documented. The outcomes, such as relooks, postoperative complications (see paragraph below) as well as mortality were recorded.

Complicated appendicitis was defined as a ruptured appendicitis with either localized pus, four-quadrant pus, or appendix mass.

Uncomplicated appendicitis was defined as an inflamed appendix.

Procedure-related complications was defined as iatrogenic bowel injury, appendicular artery bleed (>500 mL), port-side bleed (>100 mL)

Postoperative complications were defined as intraabdominal collections, port-site sepsis, and port-site hernia.

Poor visibility was defined as intraoperative bowel distension which precludes adequate visualization of intraabdominal contents.

Successful LA was defined as a patient who underwent LA without conversion.

### Statistical Analysis

Means ( $\pm$ SD) are presented for continuous variables and frequencies (%) are presented for categorical variables. All analyses were performed using SAS version 9.3 (SAS Institute, Cary, NC).

## RESULTS

A total of 746 records were reviewed and 576 met the inclusion criteria and hence were included in the analysis (Flow Chart 1); 170 patients were excluded due to insufficient data, managed nonoperatively, operated as elective case (i.e. interval appendectomy) and incidental appendectomy. There were 221 complicated cases of acute appendicitis with majority been four-quadrant pus, as indicated in Flow Chart 1. The complicated cases were subdivided based on intraoperative findings.

The age distribution ranges from pediatric population to geriatric population with majority of the patients above age 21 years as indicated in Table 1. Males contributed 66% of the study population (Table 1).

Among 576 patients who were offered LA, the procedure was successful in 552 (Table 2). The conversion rate was higher in the four-quadrant pus subgroup.

A total of 43 patients were taken for a relook laparoscopy and more than half were from the four-quadrant

Flow Chart 1: Analysis

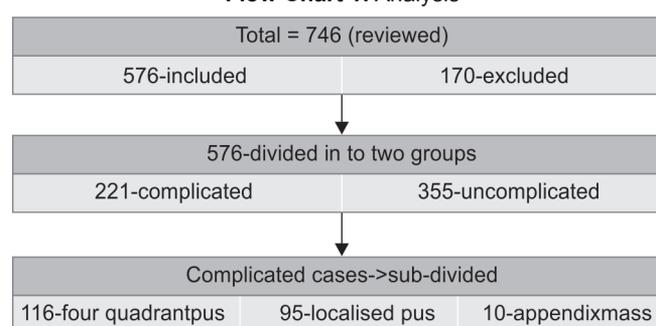


Table 1: Demographics

Variable	Obs.	Mean	Std. dev.	Min	Max
Age	576	26.37153	12.76357	4	82
		Male		Female	
Age in years	n	%	n	%	Total
0-13	50	68.49	23	31.51	73
14-21	113	64.94	61	35.06	174
22-82	217	66.04	112	33.96	329
Total	380	66.02	196	33.98	576

pus subgroup. The most frequent intraoperative finding in this subgroup was pelvic collection.

The complications were divided into two major categories namely intraoperative and postoperative complications. Intraoperative complication rate was 0.5% and majority were from the four-quadrant pus subgroup and all were iatrogenic bowel injuries. Postoperative

complication rate was 5% and majority were from the four-quadrant subgroup and the commonest complication was pelvic collections.

The most common cause of morbidity was pneumonia. Mortality was grouped according to the subgroups, which indicated high mortality rate being among the four-quadrant pus subgroup and significant cause was systemic sepsis.

**Table 2: Results**

	Total % (n)	Subgroup	Indications
<b>Outcomes</b>			
Successful LA converted	96% (552)		
	4% (24)	u (5)	Poor visibility (4) Hypoxia (1)
		am (0)	
		aa (3)	Poor visibility (3)
		4qp (16)	Poor visibility (7) Hemodynamic instability (7) Iatrogenic bowel injury (2)
<b>Relooks</b>			
Total	7% (43)	u (6)	Findings Port-site bleed (1) Port-site hernia (1) Negative finding (4)
		am (0)	
		aa (8)	Pelvic collection (2) Port-site sepsis (1) Negative finding (5)
		4qp (29)	Pelvic collection (22) Subphrenic collections (3) Port-site sepsis (2) Liver abscess (1) SBO (1)
<b>Complications</b>			
Intraoperative	0.5% (3)	4qp (2)	Nature IBI (2)
		u (1)	Port-site bleedings
Postoperative	5% (29)	u (2)	Port-site hernia (1) Port-site bleed (1)
		aa (3)	Pelvic collection (2) Port-site sepsis (1)
		4qp (24)	Pelvic collection (22) Port-site sepsis (2)
<b>Morbidity and mortality</b>			
Morbidity	2% (12)		Cause Pneumonia (4) Adhesive bowel obstruction (3) DVT (3) ARDS (2)
	1.7% (10)	u (2)	Port-site bleed (1) Hypoxia (1)
Mortality		aa (1)	Pneumonia (1)
		4qp (7)	Systemic sepsis (4) ARDS (2) Liver abscess (1)

LA: Laparoscopic appendectomy; U: Uncomplicated appendix; aa: Appendicular abscess; am: Appendicular mass; 4qp: four-quadrant pus; DVT: Deep vein thrombosis; ARDS: Acute respiratory distress syndrome; IBI: Iatrogenic bowel injury; SBO: Adhesive small bowel obstruction

## DISCUSSION

The results of this study demonstrate positive outcome in using LA as the standard of care for both complicated and uncomplicated cases of acute appendicitis.

The four-quadrant pus subgroup contributed a significant proportion to the conversion rate of 4%. This rate is, however, not higher than what is generally reported in the literature.<sup>14</sup> The main indication for conversion was noted to be poor visibility due to bowel distension. Majority of this patients presents with abdominal distension which can be picked up on clinical examination in the preoperative assessment. These suggest that careful preoperative assessment could select this subgroup of patients and hence offer them an open surgery from the start.

The relook rate of 7% is slightly lower than reported in the literature.<sup>15</sup> Our main indication was intraabdominal collection, documented on imaging or suspected on clinical examination. In many cases this collection was deemed amenable to percutaneous drainage, but due to lack of intervention radiology services at our center, all these patients were taken back for a relook laparoscopy. Intraoperative findings at relook were mainly serous fluid instead of pus; this could possibly be the residual fluid from the peritoneal lavage at the index operation. However, a separate study would be needed to establish if peritoneal lavage contribute to intraabdominal collections.

Intraoperative complicated rate of 0.5% where majority of cases were from the four-quadrant pus subgroup, all those patients had iatrogenic bowel injury. The main contributing factor was poor visibility due to bowel distension. These complications can be avoided in the future by doing open surgery for patients with bowel distension. However, the complication was not higher than what is reported in other studies.<sup>16</sup>

Postoperative complication rate of 5% was mainly coming from the four-quadrant pus subgroup with majority been pelvic collection. As discussed earlier, we do not have sufficient information to suggest whether peritoneal lavage was a contributing factor or not. Although Tate reported a postoperative intraabdominal collection of 1.4%, significantly lower than in our study, in the same paper the subanalysis showed that the rate was as high as 7.5% when the appendix was complicated.<sup>17</sup>

The main cause of morbidity was ventilator-associated pneumonia and deep vein thrombosis (DVT). These were patients who were admitted to intensive care unit (ICU). Also, improvement in ICU care and appropriate use of venous thromboembolism are measures we should improve on.

Mortality was 1.7%, which is higher than reported by other researchers.<sup>18</sup> Majority of the causes were nonprocedure-related causes. Systemic sepsis and acute respiratory distress syndrome (ARDS) contributed to a significant proportion to mortality. Both of the causes were found in the four-quadrant pus subgroup. Majority of these patients were delayed presentation and often came in septic shock and needed postoperative care in ICU. Many of them were ventilated for more than a week. Therefore, delayed presentation, septic shock, and prolong ICU stay seem to be a major contributing factors to mortality.

The results of this study seem to be comparable to previous studies and the negative outcome seen in the four-quadrant pus subgroup seem to be due to patients' factors and not procedure-related.

## CONCLUSION

The positive outcome found in this study when LA was used in both complicated and uncomplicated cases of acute appendicitis suggests that this approach is possible in carefully selected patients and with appropriate basic laparoscopic skills.

However, we recognize the limitations of our study: Retrospective study, with a small study population size. Therefore, more studies with large population size are needed to establish the role of LA as the standard of care in both complicated and uncomplicated cases of appendicitis (Appendix 1).<sup>19</sup>

**Appendix 1: Alvarado score**

Variables	Clinical features	Score
Symptoms	Migratory RIF pain	1
	Anorexia	1
	Nausea and vomiting	1
Signs	Tenderness (RIF)	2
	Rebound tenderness	1
	Elevated temperature	1
Laboratory	Leukocytosis	2
	Shift to left (neutrophils)	1
Total score		10
Score	Significance	Plan
≤ 3	Appendicitis unlikely	Observation
4–6	Appendicitis likely	Imaging (U/S or CT)
7–10	Appendicitis highly likely	

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