

Clinical Outcomes of Laparoscopic Versus Open Appendectomy for Acute Appendicitis in a Resource-limited Setting

Mohammed Omer Abass¹ , Yassir Altahir Abdullah², Elssayed Osman Elssayed¹, Abdelrahman Babekir Mhammed¹, Mohamed Saeed Alfaki³

¹Department of Surgery, Faculty of Medicine, Shendi University, Shendi, Sudan

²Faculty of Medicine, Shendi University, Shendi, Sudan

³Quality Department, King Abd-ul-Aziz Specialty Hospital, Taif, Saudi Arabia

Correspondence to: Dr. Mohammed Omer Abass; email: kenzomohnd@hotmail.com

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Abstract

Background: Acute appendicitis is the most common cause of the acute abdomen; thus, appendectomy is part of most daily emergency surgical duties. It is conducted through either open or laparoscopic approach. **Methods:** A prospective hospital-based study compared the clinical outcomes of open versus laparoscopic appendectomy for patients with acute appendicitis in El-Mek Nimir University Hospital, Sudan. **Results:** A total of 550 cases of acute appendicitis were studied, of which 328 (59.6%) underwent open appendectomy surgery and 222 (39.4%) underwent laparoscopic appendectomy. The majority of the study's population was female. Laparoscopic appendectomy generally involved a longer operation time than open appendectomy (mean duration, 42.4±12.5 vs. 29±16 minutes), lesser incidence of severe pain postoperatively (3% vs. 11%; p=0.000), shorter hospital stay (i.e., <24 hours; 96% vs.77%; p=0.000), and a higher rate of patient return to normal

activities within 1 week (92% vs.15%; p=0.000). Differences in the occurrence of bleeding, wound infection, or intra-abdominal septic collection were not statistically significant. **Conclusion:** Both open and laparoscopic appendectomy procedures are safe for the management of acute appendicitis; however, laparoscopic appendectomy is associated with fewer complications and a faster recovery.

Keywords: acute appendicitis, open appendectomy, laparoscopic appendectomy, complications.

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Introduction

Acute appendicitis is the most common surgical emergency, with an approximate lifetime risk of 7% and a peak incidence between the ages of 10 and 30 years (1,2); hence, appendectomy is the most prevalent emergency procedure and is a daily practice within surgical duties worldwide (3,4). McBurney is credited for consolidating the surgical technique of classical open appendectomy at the end of the 19th century when there

was no significant changes to the technique (5). In recent decades, minimal access surgery has emerged as a novel operative option and has revolutionized the surgical field (6). Laparoscopic appendectomy was first described in 1983 by Kurt Semm, and since then, its use has continued to increase (7). It has now largely replaced open surgery. It can be employed for simple or complicated presentations of acute appendicitis (8-10).

Surgery in a resource-limited setting is challenging yet important because it provides help to those who are unable to receive treatment at their localities, raising the values of health equity. The provision of advanced medical care, such as laparoscopic surgery, is far more challenging for multiple reasons, including the cost and beliefs of the rural community. The present study aimed to reflect on the current practice in the management of acute appendicitis by comparing the clinical outcomes of open and laparoscopic approaches employed in a resource-limited setting.

Materials and methods

The study was conducted in El-Mek Nimir University Hospital, Shendi University, Shendi, Sudan, located 172 km north of Khartoum on the eastern bank of the River Nile. The hospital, built in 2002, serves both the people of Shendi and the nearby city of Almatama. Both locations are mostly rural. The hospital has a capacity of approximately 250 beds, and most major specialist treatments are available. Patients for whom specialist treatment is not available are referred to the capital (Khartoum). The surgical department is run by four general surgeons, one urologist, one orthopedic surgeon, and one anesthetist. The surgical wards comprise 60 beds with 4 high-dependency unit beds—there is no ventilator or other intensive care unit equipment available. Laparoscopy was introduced in the Surgery Department in 2018 and has since been gaining popularity.

The current study included all patients who presented with acute appendicitis and underwent an appendectomy at El-Mek Nimir University Hospital between January 2019 and January 2020. Patients who presented with right lower quadrant pain underwent detailed clinical evaluation (history and examination) in conjunction with laboratory tests and imaging studies to ensure a clear diagnosis of acute appendicitis. Patients in whom a diagnosis other than acute appendicitis was discovered intra-operatively and those who presented with a perforated appendix (generalized peritonitis) or appendicular abscess were excluded from the study. After discussing their condition and need for appendectomy with a medical professional, patients

chose between open or laparoscopic appendectomy following an explanation of the two procedures. Consent regarding the procedure and their participation in the study was obtained from patients or guardian. Ethical approval was obtained from the Committee of El-Mek Nimir University Hospital (approval no. 09.01.2019).

Surgical procedures were performed by surgical residents and interns, with some contribution from the general surgery specialist in the case of open appendectomy. Laparoscopic appendectomies were performed by either general surgeons or surgical residents. Open appendectomies were performed through a Lanz's incision of approximately 3–4 cm, centered at the McBurney's point. Laparoscopic appendectomies were performed using three ports: a 10-mm port in the umbilicus, a 5-mm port in the left lower quadrant, and a 5-mm port in the suprapubic skin crease. Operative time from skin incision to closure was measured in minutes, namely the exact time required by the surgeon to complete the procedure. Post-operatively, patients received standardized intravenous antibiotics (usually cephalosporine and metronidazole) as required. Post-operative pain was assessed after the patients had fully recovered from anesthesia using a modified verbal rating scale to categorize patients in one of three categories: no or mild pain, moderate pain, or severe pain. The standard post-operative analgesia included non-steroidal anti-inflammatory drug (NSAID) in the form of diclofenac sodium, paracetamol (if NSAID was contraindicated), and opiates in the form of pethidine. Patients received no analgesia for no or mild pain, NSAID/paracetamol for moderate pain, and opiates for severe pain. Complications, namely bleeding, wound infection, and intra-abdominal septic collection, were recorded as either occurred or did not occur. Post-operative hospital stay was measured in days. The time required by the patient to return to normal activities was measured in weeks since it was expected that patients would provide an approximate rather than exact figure. The study focused on the immediate post-operative outcome since most of the morbidities were expected to occur early following appendectomy with few long-term complications. The operative cost of open appendectomy in our setting was 2500 SDG, whereas

that of laparoscopic appendectomy was 3500 SDG. The total costs of both procedures were not studied.

Data were collected using a predesigned questionnaire and then plotted onto an Excel sheet, coded, and transferred to SPSS version 24 (IBM Corp., Armonk, NY, USA). A descriptive analysis was conducted along with a chi-square test for categorical variables. The results were considered statistically significant at $p < 0.05$. Data are presented as frequencies and percentages or mean \pm standard deviation.

Results

Of the 550 cases of acute appendicitis, 328 (59.6%) underwent open appendectomy, whereas 222 (39.4%) underwent laparoscopic appendectomy. The mean age of patients was 20.5 ± 10.4 years (range, 5–72 years) in the open appendectomy group and 22.7 ± 11.5 years (range, 4–70 years) in the laparoscopic appendectomy group ($p = 0.18$). There were 239 (72.9%) and 185 (83.3%) female patients in the open and laparoscopic appendectomy groups, respectively.

Laparoscopic appendectomy was associated with a longer mean operative time than open appendectomy (42.4 ± 12.5 vs. 29 ± 16 minutes; $p = 0.000$). The majority of patients in both groups received NSAID (Table 1).

A significant difference was observed in the occurrence of severe pain requiring opiate analgesia ($p = 0.000$, $r = 62.7$, $df = 2$). Wound infections were more common in the open appendectomy group than in the laparoscopic appendectomy group (6.7% and 3.2%, respectively); however, the difference was not statistically significant ($p = 0.067$, $r = 15.616$, $df = 1$). Intra-abdominal septic collection occurred more often in the laparoscopic appendectomy group than in the open appendectomy group (1.5% and 2.3%, respectively); however, the difference was also not significant ($p = 0.535$, $r = 3.348$, $df = 1$). Bleeding occurred in one patient in the laparoscopic appendectomy group. No patients in the open appendectomy group experienced bleeding ($p = 0.404$, $r = 1.480$, $df = 1$).

Regarding length of stay, 96.4% of the patients in the laparoscopic appendectomy group remained in hospital for < 24 hours, compared with 77.4% for the open appendectomy group ($p = 0.000$, $r = 37.933$, $df = 2$). The

majority of patients who underwent laparoscopic appendectomy (92.3%) returned to normal activities within 1 week of the operation, whereas 76.2% of patients who underwent open appendectomy returned to their normal activities within 2 weeks ($p = 0.000$, $r = 322.426$, $df = 2$) (Table 2).

Table 1. Immediate outcome measures regarding open versus laparoscopic appendectomy

Immediate Outcome	Open Appendectomy	Laparoscopic Appendectomy	P Value
Analgesic requirement			
Not required	19 (6)	7 (3)	0.000
NSAIDs	273 (83)	209 (94)	
Opiates	36 (11)	6 (3)	
Wound infection			
Yes	22 (7)	7 (3)	0.067
No	306 (93)	215 (97)	
Intra-abdominal collection			
Yes	5 (2)	5 (2)	0.535
No	323 (98)	217 (97)	
Bleeding			
Yes	0 (0)	1 (0.5)	0.404
No	328 (100)	221 (99.5)	
Hospital stay			
< 24 hours	254 (77)	214 (96)	0.000
24–48 hours	51 (16)	4 (2)	
> 48 hours	23 (7)	4 (2)	

Values are presented as frequency (%).

NSAIDs, non-steroidal anti-inflammatory drugs.

Table 2. Time required by the patient to return to normal activities following open versus laparoscopic appendectomy

Return To Normal Activity	Open Appendectomy	Laparoscopic Appendectomy	P Value
< 1 week	48 (15)	205 (92)	0.000
1–2 weeks	250 (76)	13 (6)	
> 2 weeks	30 (9)	4 (2)	

Values are presented as frequency (%).

Discussion

There are numerous surgical challenges associated with laparoscopic surgery that require innovation. Laparoscopic surgery may be safe, effective, feasible, and cost-effective in low- and middle-income countries; however, it often has limited accessibility, acceptability, and quality (11).

Several studies have confirmed that both laparoscopic and open appendectomies are safe and effective procedures for the treatment of acute appendicitis (12,13). Laparoscopy has recently been introduced into our surgical practice, and the results of the present study are promising.

The World Society of Emergency Surgery published guidelines for acute appendicitis recommending that laparoscopic appendectomy should be the first choice where laparoscopic equipment and skilled surgeons are available. This is because it offers clear advantages in terms of reduced pain, lower incidence of surgical-site infection, decreased length of hospital stay, earlier return to work, and reduced overall costs (14).

The majority of the study's population were female, which contrasts with most international literature (15-17). This finding could be explained by the fact that the study population was seen in one hospital out of seven in our district (i.e., not all cases of acute appendicitis in the locality were studied), most of the general population were female due to the high migration rate among male in comparison to female in rural communities, differences in the disease tolerance itself, and the possibility of misdiagnosing other patients who presented with acute appendicitis. This female preponderance is considered a potential area for future research.

Published literature has mostly reported longer operative times, less post-operative pain, reduced incidence of complications, shorter hospital stays, and a faster recovery in patients who underwent laparoscopic appendectomy, compared with open appendectomy (18-20). In the present study, there was less post-operative pain in the laparoscopy group, as shown by the low pain scores and infrequent need for post-operative analgesia. This difference was evident in the severe pain category where opiate analgesia was required.

Regarding post-operative wound infection and intra-abdominal septic collection, no significant difference was observed between the two groups, although wound infections were less common in patients who underwent laparoscopic appendectomy. Several studies have indicated that wound infection is less prevalent in patients receiving laparoscopic appendectomies (21, 22), whereas the occurrence of intra-abdominal abscesses has been variable (23,24).

In addition, the length of hospital stay and the time taken for patients to return to normal activities were shorter in the laparoscopic appendectomy group. The post-operative length of hospital stay correlates with the amount of physical activity performed, and therefore, physical activity data may be capable of predicting functional recovery post-operatively (25, 26). This is because physical activity following laparoscopic appendectomy is expected to be greater, owing to less post-operative pain and fewer complications.

Conclusion

Both laparoscopic and open appendectomy for treating acute appendicitis are safe and effective. Laparoscopic appendectomy is associated with a lower morbidity, reduced hospital stays, and a faster recovery, compared with open appendectomy. Operator differences need to be further compared, as this is one limitation of this study. With more practice and experience, the longer operative time of laparoscopic appendectomy could be reduced. Further research need to be done on the economic aspect and on the challenges of performing laparoscopic procedures in resource-limited settings.

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