Laparoscopic Versus Open Surgery for Suspected Appendicitis

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ABSTRACT

Background: Laparoscopic appendectomy has mostly replaced open surgery. Appendectomy, or surgical removal of the appendix, is one of the most common operations performed by a specialized surgeon and is used to teach the fundamentals of laparoscopy - first by observing and then performing the procedure independently.
Aim of the work: This study compared laparoscopic and open surgery for suspected appendicitis.
Methods: A total of 200 individuals with probable appendicitis participated in this prospective randomized clinical study. All patients over the age of 18 who had a clinical diagnosis of appendicitis were randomly randomized to either open appendectomy (OA) or laparoscopic appendectomy (LA). First prophylactic antimicrobial treatment was administered intravenously. Supine posture and general anesthesia were provided to all patients. After the operation, we followed up for complications and survival. **Results:** The operating time in laparoscopic patients was significantly greater. However, blood loss was substantially lower. The need for analgesics was substantially reduced in the laparoscopic group. There was a substantial difference between included patients in both groups in terms of postoperative stay length, time to return to work/normal activities, and the incidence of postoperative complications. In terms of survival time or complication incidence, there was no significant difference between the two groups.
Conclusion: Despite the longer operational time, LA has a favorable hands-on OA in terms of blood loss, length of postoperative stay, time to return to work/normal activities, and the incidence of postoperative problems. In terms of survival time and complication incidence, there was no significant difference.
Keywords: Appendectomy, Appendicitis, Laparoscopic, Open surgery

INTRODUCTION

In Egypt, the majority of persons with stomach pain seek medical assistance in emergency rooms each year [(1)]. The underlying causes of pain range from benign processes to potentially fatal disorders. The prompt diagnosis and treatment of conditions for which a delay in care might have significant consequences remain a problem. The most common emergency abdominal surgery is an appendectomy [(2)].

Although appendicitis is commonly diagnosed in young boys with stomach pain, the diagnostic variables for premenopausal women with a comparable clinical presentation are more difficult [(3)]. Furthermore, stomach pain in the elderly might be difficult to diagnose owing to delays in seeking medical attention or difficulty compiling a history and performing a thorough physical examination [(4)]. Because delayed diagnosis and treatment of appendicitis are associated with a higher risk of perforation, which leads to increased morbidity and mortality, quick intervention is crucial [(5)].

Although laparoscopy has been promoted for appendicitis diagnosis, its invasiveness has precluded it from being extensively employed. Minimally invasive abdominal surgery became extensively employed in a very short time with the introduction of laparoscopic appendicectomy [(6)]. Laparoscopic appendicectomy was not previously used to treat acute appendicitis since open appendicectomy had fewer risks and side effects. It is, however, now routinely used in hospitals and has been demonstrated to be a safe therapy [(7)].

Laparoscopic appendectomy has mainly taken the place of open surgery. Appendectomy, or surgical removal of the appendix, is one of the most common procedures done by a specialized surgeon and is used to teach the foundations of laparoscopy - first by watching and then autonomously conducting the procedure. Preoperative preparation, accurate diagnosis, good surgical technique, and follow-up treatment are the foundations of successful care. The anatomy of the patient must be considered while placing trocars [(8)].

The appendix is usually straightforward to locate, however, its position and location may fluctuate. The appendix's base and artery are ligated during the treatment, and the appendix is removed in a plastic bag [(9)]. A healthy appendix should also be removed, although in this case, other causes of the symptoms should be examined. A burst appendix requires significantly more difficult surgical excision, and peritonitis should be treated as quickly as feasible [(10)]. A periappendicular abscess is a difficult procedure that should be conducted during the day. Most people who have undergone a non-perforated appendix ectomy may go home within 23 hours after the operation [(11)].
In this study, we compared laparoscopic and open surgery for suspected appendicitis.

MATERIAL AND METHODS

A total of 200 individuals with probable appendicitis participated in this prospective randomized clinical study. The study was performed in Al Azhar University Hospitals from December 2018 to February 2021. All patients over the age of 18 who had a clinical diagnosis of appendicitis were randomly chosen for either open appendectomy (OA) or laparoscopic appendectomy (LA).

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Exclusion criteria: Patients who had prior abdominal surgery or anesthesia reasons that made laparoscopy impossible. Another significant pathology that would change surgical therapy was found in patients who agreed to appendicectomy.

Methods

Prophylactic antimicrobial treatment was administered intravenously (IV) during anesthesia induction, including 1 g of Cefoxitin and 500mg of Metronidazole. Antibiotics were supplied for 48 hours if there was an appendiceal perforation or peritoneal abscess. Using a typical right iliac fossa incision and gridiron technique, two consultant surgeons and one surgical registrar conducted an open appendicectomy. As is typical, the appendix was removed, and the incision was healed in layers. A subcuticular 3/0 proline suture was used to keep the skin closed. There were no drains created.

One experienced consultant surgeon and a surgical registrar executed the laparoscopic appendicectomy under the instruction of the others. The gadget was fully non-disposable. Supine posture and general anesthesia were provided to the patient. A catheter was inserted in the urinary system if the patient could not pee promptly before the procedure. A 10 mm cannula was placed just below the umbilicus and a pneumoperitoneum was generated before introducing the laparoscope into the peritoneal cavity.

A comprehensive examination of the abdominal organs was done. The laparoscopic examination might reveal the presence or absence of the appendix. The surgical table was adjusted head-down and left side down to reposition the small intestine away from the pelvic and right iliac fossa (RIF). At McBurney's site, a 5 mm cannula was placed under strict monitoring. Fluid was aspirated from the pelvic organs after they had been properly evaluated. A 10 mm cannula was inserted under direct vision into the iliac fossa on the left side of the body. There could be no activity without utilizing this port. Using atraumatic grasping forceps, the appendix was grabbed and lifted cephalad through the 5mm incision. If the appendix was thickened, a catgut endloop was introduced at the tip to facilitate retraction and remove the need for gripping forceps. If the appendix was retrocaecal, the caecum and ascending colon were mobilized using laparoscopic scissor dissection. To locate the mesoappendix, doctors used non-disposable laparoscopic clip applicators. Once the mesoappendix was located, it was cut and coagulated close to the appendix. Chromic catgut endoloop was employed to hold the appendix in place. After then, it was taken out. A distal clip was utilized to release the appendix from the ligature. To avoid damaging the skin or subcutaneous tissues, the appendix was retrieved using a 10 mm LIF cannula.

A large forceps was used to widen the port hole and remove the appendix if it became too thick to be drawn through the cannula. The wound was then irrigated with 10% povidone-iodine and any purulent fluid in the peritoneal cavity was suctioned out and saline lavaged. The wounds were closed with Dexon sutures and no drains were constructed.

To objectively evaluate discomfort, the number of narcotic injections or oral analgesics required to manage postoperative pain was employed. There were several post-operative problems. Wound infection was defined as one that required drainage or treatment for erythema in duration or pus. The duration of the postoperative stay was recorded, with day 1 being the day of surgery. Patients were freed if they were able to eat a normal meal and showed symptoms of propulsive bowel function (i.e. flatus, bowel action) (i.e. flatus, bowel action).

Following that, the patient had an outpatient examination or a direct phone conversation concerning their return to work, sports, or normal activities. Patients were given a certificate of sickness that was valid until their next outpatient appointment. All patients were assessed in the outpatient clinic for postoperative complications between the seventh and tenth postoperative days.

Based on specific histological findings, one pathologist evaluated the histology and rated the severity of appendicitis.

Table (1): Histological grades of appendicitis

Normal appendix	No mucosal abnormality
Mild acute appendicitis	Mucosal ulceration and/or intraluminal pus
Suppurative appendicitis	Transmural inflammation
Gangrenous appendicitis	Cellular necrosis with or without perforation

Ethical considerations:

The study was approved by the Ethics Board of Al-Azhar University and informed written consent was taken from each participant in the study. All the patients were informed about the surgery and the autotransplantation technique, value, and possible complications. This work has been carried out following The Code of Ethics of the World Medical Association (Declaration of Helsinki) for studies involving humans.

Statistical Analysis: IBM SPSS version 22.0 was used to analyze computer-generated data. To express quantitative data, percentages and numbers were employed. Before utilizing the median in nonparametric analysis or the interquartile range in parametric analysis, it was required to perform Kolmogorov-Smirnov tests to ensure that the data were normal. We used the (0.05) significance threshold to establish the significance of the findings. The Chi-Square test is used to compare two or more groups. The Monte Carlo test may be used to adjust for any number of cells with a count less than 5. Fischer Chi-Square adjustment was applied to tables demonstrating non-continuous data.

RESULTS

In terms of basal features, there was no significant difference between included patients in both groups.

Table (2): Patients' basal characteristics

	Laparoscopic (N=100)	Open Surgery (N=100)	P-Value
Age	45.5 ± 12.3	43.7 ± 11.8	**0.29**
Sex			
• **Male**	55 (55%)	62 (62%)	**0.32**
• **Female**	45 (45%)	38 (38%)	
BMI (Kg/m²)	23.65 ± 4.5	24.1 ± 3.2	**0.42**
Co-morbidities			
HTN	14 (14%)	13 (13%)	
DM	11 (11%)	10 (10%)	**0.81**
Other	5 (5%)	7 (7%)	
Time from diagnosis to surgery (Hours)	25.01 ± 11.54	27.51 ± 13.02	**0.15**
Previous Abdominal surgery	19 (19%)	26 (26%)	**0.24**
WBC >10.000/ml	70 (70%)	67 (67%)	**0.65**
Preoperative CRP (mg/dL)	13.26 ± 7.5	14.63 ± 8.3	**0.37**

There was no significant difference in the distribution of appendicitis macroscopically or histologically between the enrolled participants in both groups.

Table (3): Appendix specimens macroscopic vs microscopic findings in open versus laparoscopic appendicectomy.

	Laparoscopic (N=100)	Open Surgery (N=100)	P-Value
Macroscopically inflamed appendix	41 (41%)	53 (53%)	**0.089**
Histological appendicitis	41 (41%)	53 (53%)	**0.089**
Macroscopically normal appendix	58 (58%)	47 (47%)	**0.12**
Histological appendicitis	12 (12%)	10 (10%)	**0.65**

There was a nonsignificant difference between included subjects regarding ASA grade. Operative time was significantly longer in laparoscopic cases (P < 0.001). However, blood loss was significantly decreased in this group compared with the open surgery group. Also, the need for analgesics was significantly lower in the laparoscopic group.

Table (4): Operation characteristics

	Laparoscopic (N=100)	Open Surgery (N=100)	P-Value
ASA grade			
• **I**	70 (70%)	65 (65%)	
• **II**	18 (18%)	22 (22%)	**0.73**
• **III**	12 (12%)	13 (13%)	
Operative time (min)	89.26 ± 32.48	68.25 ± 18.36	**0.0001**
Blood loss (g)	38.62 ± 12.69	86.5 ± 20.15	**0.0001**
Need for analgesics	18 (18%)	32 (32%)	**0.022**

There was a substantial difference between included participants in both groups in terms of postoperative stay length, time to return to work/normal activities, and the incidence of postoperative problems. All were decreased in the LA group. Regarding Post operative complications occurrence SSI was significantly more observable in the open surgery group.

Table (5): Post-operative follow-up outcomes

	Laparoscopic (N=100)	Open Surgery (N=100)	P-Value
Days to resumption of liquids	1.3 ± 0.44	1.4 ± 0.42	**0.1**
Days to resumption of solids	4.3 ± 2.1	4.8 ± 2.2	**0.1**
Days to walking	1.6 ± 0.71	1.7 ± 0.62	**0.29**
Duration of drainage (days)	5.2 ± 6.7	5.9 ± 7.3	**0.48**
Duration of intravenous antibiotics (days)	5.6 ± 3.3	4.8 ± 2.7	**0.62**
Length of postoperative stay (days)	6.7 ± 2.3	7.7 ± 2.5	**0.0036**
Time taken to return to work/normal activities (days)	9.5 ± 4.3	11.4 ± 3.6	**0.0001**
Post-operative complications occurrence			
• **SSI**	6 (6%)	18 (18%)	**0.009**
• **Leakage**	3 (3%)	7 (7%)	**0.19**
• **Bowel obstruction**	4 (4%)	3 (3%)	**0.7**
• **Other**	5 (5%)	10 (10%)	**0.18**
Total	18 (18%)	38 (38%)	**0.0016**

There was a significant correlation between open surgery and complications occurrence.

Table (6): Correlation between surgery and occurred complications

		Complication
Surgery	**Pearson Correlation**	0.223**
	P-Value	0.002

There was no significant difference between the two groups regarding survival time and complication occurrence.

Table (7): Survival correlation between surgery and time between diagnosis and surgery.

Surgery	Mean[a]				Median			
	Estimate	Std. Error	95% Confidence Interval		Estimate	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound			Lower Bound	Upper Bound
Laparoscopic	39.790	1.220	37.398	42.182	44.000	.	.	.
Open Surgery	37.920	1.358	35.259	40.581	41.000	4.006	33.147	48.853
Overall	39.135	.966	37.240	41.029	44.000	2.111	39.862	48.138

Overall Comparisons		
	Chi-Square	P-Value
Log Rank (Mantel-Cox)	1.632	.201

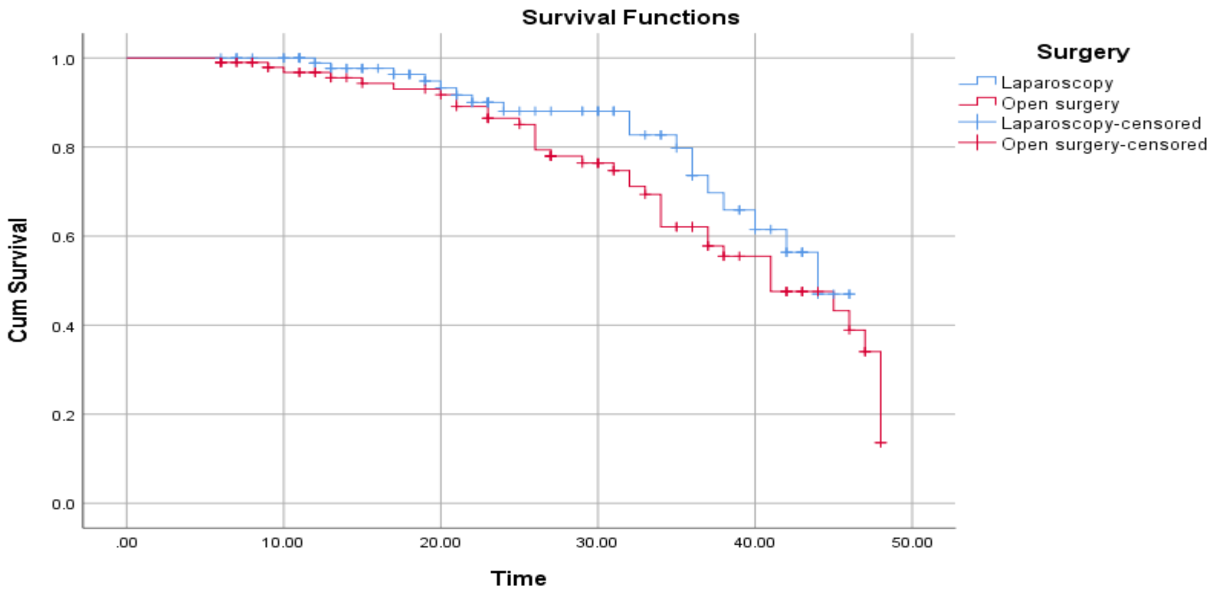

Figure (1): Survival correlation between surgery and time between diagnosis and surgery

DISCUSSION

Acute appendicitis in particular is a potentially fatal condition. Although surgical appendicitis was described in the eighteenth century, appendicitis' therapeutic implications were not recognized until the late nineteenth century [(12)]. With the development of improved anesthetics and antibiotics, OA has emerged as the gold standard for treating acute appendicitis. There are dangers associated with open appendicectomy, such as wound infection rates exceeding 5% and postoperative adhesions that cause small intestinal blockage [(13)]. In addition, despite advancements in ultrasonography and computer-aided diagnosis, a considerable number of normal appendicectomy cases are still being done. Misdiagnosis is especially common in women, with appendicectomy rates ranging from 20 to 47 percent [(14)].

The efficacy of the laparoscopic method for appendicitis has been well researched. However, because of a paucity of high-level data, the relevance of laparoscopy in appendicitis remains unknown (e.g., randomized controlled trials). The current randomized controlled study investigated whether LA for appendicitis successfully lowers the frequency of postoperative complications and improves several postoperative recovery parameters in adults when compared to OA. In our investigation, there was no significant variation in basic features between included patients in both groups.

In our research, there was a considerable increase in the amount of time spent on patients treated with LA. This has been documented in several earlier investigations, such as **Taguchi *et al*.** [(15)] Blood loss was much reduced in the LA group in our investigation, which is consistent with **Shimoda *et al.*** [(16)] results. Another difficulty in the comparison of LA and OA is the longer operational duration and substantial blood loss during LA. In general, those two parameters are determined by the surgeon's expertise [(17)]. Although the majority of surgical staff have done basic and advanced laparoscopic operations, operating time is considerable when performed by novice surgeons and is reduced by gaining knowledge. Blood loss is also affected by the surgeon's expertise and the severity of appendicitis. In our research, the quantity of blood lost during the LA technique was much reduced.

Shortening postoperative hospital stay is one of the most essential criteria for a medical institution's economic management, and to shorten postoperative hospital stay, surgeons must limit the risk of postoperative complications to the best of their abilities. SSI is the most significant postoperative complication in terms of prolonging stay for patients after appendectomy. In our research, there was a significant difference between included participants in both groups in terms of postoperative stay length, time to return to work/normal activities, and the incidence of postoperative problems. **Shimoda *et al*.** [(16)] also found that all were reduced in the LA group. In terms of post-operative complications, SSI was substantially more common in the open surgery group.

According to a recent meta-analysis [(18)], the overall incidence of SSI varies from 0 to 37.4 per 100 appendectomies (95% CI: 1.0–17.6). The incidence ranged from 5.8 per 100 appendectomies in Europe to 12.6 per 100 in Africa, according to a subgroup study that looked at the causes of variation (p less than 0.0001). SSI following appendectomy rose with decreasing wealth, from 6.2 per 100 appendectomies in high-income countries to 11.1 per 100 appendectomies in low-income countries (p=0.015). Open appendectomy (11.0 per 100 surgical procedures) had a greater incidence of SSI (p=0.0002) than laparoscopic (4.6 per 100 appendectomies).

Taguchi *et al*. [(15)] found no statistically significant difference between OA and LA in terms of postoperative hospital stay or liquids and solids resumption. Older research [19] found a substantial difference between the OA and LA groups when it came to resuming normal activities.

The possibility cannot be ruled out that analgesic treatment might not always accurately represent actual pain levels, since this may be dictated by department norms or standards rather than actual demand. To measure postoperative pain, a visual analog scale may be more suitable. It is possible that the advantages of LA would become more apparent in more difficult situations [20], or that there would be some changes in the severity of sicknesses, such as inflammatory response, discomfort, expense, and time of healing, between small and big infected incisions.

There was a strong association between OA and the development of complications in our research. We also discovered no statistically significant difference between the two groups in terms of survival time and complication incidence. So, in spite of urgent situations, time spent on stabilization and preparation for surgery is vital, with no substantial increase in the probability of complication incidence after each operation.

CONCLUSION

Despite the lengthier operating time, LA has a superior hands-on OA in terms of blood loss, postoperative stay duration, time to return to work/normal activities, and postoperative problems. In terms of survival time or complication incidence, there was no significant difference between the two groups.

Declarations:
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