

A Comparative Study of Laparoscopic and Open Appendectomy

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Abstract

Background: Acute Appendicitis (AA) can be considered the signature disease encountered by the general surgeon. It is the most frequent abdominal diagnosis treated by surgeons. There have been numerous previous studies comparing Open Appendectomy (OA) with Laparoscopic Appendectomy (LA). Although most of these have concluded that the laparoscopic technique is as good as OA, there has been considerable controversy as to whether LA is superior to OA or not.

Aim of Study: The aim of this study is to compare between laparoscopic and open appendectomy regarding operative time, post-operative pain, complications, time to return to usual activity and cosmesis.

Patients and Methods: We included 40 consecutive patients with acute appendicitis. The patients were randomly allocated into 2 groups; 20 patients for Laparoscopic Appendectomy (LA) group and 20 patients for Open Appendectomy (OA) group. Patients were fully informed about the risks and benefits of the two procedures. Informed consent was obtained from all patients. LA was done with the help of three trocar/cannulae creating pneumoperitoneum with CO₂ whereas OA was performed by McBurney incision.

Results: The operating time in OA group was (34.50±11.48 min.) with range (20-60min.) and in LA group it was (56.42± 8.69min.) with range (30-70min.). LA is safe and had major benefits like less operative time, less post-operative pain, decreased wound infection, short hospital stay, early return to work and a better cosmetic scar than OA.

Conclusion: Laparoscopic appendectomy is safe and feasible. Despite that the operating time for laparoscopic appendectomy is still longer than that for open appendectomy, laparoscopic approach had several advantages over open appendectomy in that, it has less incidence of wound infection, shorter hospital stay, less incidence of severe post-operative pain and faster return of patients to normal activities and more satisfying cosmetic results. We must convert laparoscopic procedure to open surgery when indicated for the safety of the patients.

Key Words: Laparoscopic – Open appendectomy.

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Introduction

HISTORICALLY Claudius Amyand a surgeon at St. George's Hospital, London in 1735 was the first to do appendectomy operation. In 1889, Charles McBurney introduced famous open appendectomy through incision and muscle splitting approach for which continued to be used until the late 20th century. In 1983, Semm (a German gynecologist) performed the first laparoscopic appendectomy, Subsequently, Pier et al., reported on a large case series of laparoscopic appendectomy for acute appendicitis and demonstrated that this technique was safe and could achieve the same results as open appendectomy [1,2].

With the great advances in technology and the surgical techniques, laparoscopic appendectomy has become the novel alternative in the treatment of appendicitis in the last 2 decades. The indications for laparoscopic appendectomy remain controversial, despite the publications of numerous randomized trials, which compared open and laparoscopic appendectomy. Some studies failed to demonstrate clear advantages of LA over OA [3,4].

Some authors consider laparoscopic appendectomy a promising method regarding its less invasiveness with shorter hospital stays, less post-operative pain, less incidence of surgical site infections and reduced the risk of post-operative adhesions. Other authors consider that it has prolonged operative time & higher cost [5].

Some studies have established that laparoscopic appendectomy has a higher incidence of intra-abdominal abscesses and difficult applicability particularly in complicated appendicitis. Besides, the risk of organ specific injuries is considered by some authors to be higher in laparoscopic appendectomy than in open appendectomy although

laparoscopic appendectomy has a better view of the peritoneal cavity that in turns enables safe exploration [6].

Generally all laparoscopic procedures are more time consuming for the following reasons: Inherent nature of slow maneuver of laparoscopic techniques, time taken by careful slow insufflation, and routine diagnostic laparoscopy before starting any laparoscopic procedure [7].

Aim of the work:

The aim of this study is to compare between laparoscopic and open appendectomy regarding operative time, post-operative pain, complications, time to return to usual activity and cosmesis.

Patients and Methods

This study was conducted in Ain Shams University Hospitals, from November 2019 to April 2020.

The inclusion criteria were patients with a clinical picture consistent with the diagnosis of acute appendicitis with appropriate investigations, patients with a clinical picture consistent with diagnosis of recurrent appendicitis with appropriate investigations, age 11 to 60 years, both sexes and no palpable appendicular mass.

The exclusion criteria were patients with history previous abdominal surgery, patients unfit for laparoscopic intervention as patients with cardiac or pulmonary disease, generalized peritonitis, appendicular mass or abscess, pregnancy.

The patients were randomly allocated into 2 groups; 20 patients for each group:

- Group (A): Had Laparoscopic Appendectomy, (LA).
- Group (B): Had Open Appendectomy, (OA).

Patients were fully informed about the risks and benefits of the two procedures. Informed consent was obtained from all patients.

Study procedures:

All patients consented to undergo conversion to open appendectomy if necessary. All patients received prophylactic antibiotics in the form of 3rd generation cephalosporin. Cleansing the skin to prevent post-operative infection. All patients had general anesthesia with endotracheal intubation. Exposure of the abdomen from the level of Anterior

superior iliac spine to the xiphisternal junction. The skin was prepared with 10% povidone iodine solution. The rest of the body was covered by sterile draps.

For open appendectomy:

Surgery was done using a standard Mc Burney incision. The incision was centered over the point of maximal tenderness (Mc Burney's point). The appendix was delivered and meso-appendix ligated & divided then appendix was ligated and divided at the base. The terminal ileum, ovaries and fallopian tube in females were looked out for any alternative pathology.

For laparoscopic appendectomy:

Positioning of the patient:

Patients were placed in a supine position in a 15° Trendelenburg position with both arms tucked. Rotation to the left was done. With the operating surgeon standing on the left side of the patient, and the assistant stood on the surgeon's right side. The monitor was on the patient's right side.

Abdominal entry: In our study we used the closed technique by Veress needle to enter the abdomen and create the pneumoperitoneum. Correct placement is confirmed by demonstrating low pressure and high flow on insufflation. Ten mm port is inserted above the umbilicus for the laparoscope. The abdomen was insufflated with CO₂ to an intra-abdominal pressure of 15mmHg. Insertion of two (5mm) ports; one in right McBurney's point & the other corresponding point in the left side.

The comparison between the 2 groups included the following parameters, operative time from skin incision to skin closure, post-operative pain: Using Visual Analogue Scale (VAS) classification where patient is using numerical scale in which we instruct the patient to choose a number from 0 to 10 that describes their current pain. Zero would mean "no pain" and 10 would mean "worst possible pain", post-operative complications as (secondary hemorrhage intra-peritoneally, abdominal abscess, post-operative hematoma, wound infection and vomiting) and time to return to usual daily activity and cosmesis.

Statistical analysis:

Recorded data were analyzed using the statistical package for social sciences, version 20.0 (SPSS Inc., Chicago, Illinois, USA). Quantitative data were expressed as mean ± Standard Deviation (SD). Qualitative data were expressed as frequency and percentage. *p*-value <0.05 was considered

significant, p -value <0.001 was considered as highly significant, p -value >0.05 was considered insignificant.

RESULTS

Table (1): Comparison between open appendectomy and laparoscopy appendectomy according to demographic data.

Demographic data	Open appendectomy (n=20)	Laparoscopy appendectomy (n=20)	χ^2	p -value
<i>Sex:</i>				
Male	11 (55%)	6 (30%)	1.381#	0.582
Female	9 (45%)	14 (70%)		
<i>Age (years):</i>				
Range	17-40	18-39	0.8/6	0.2/6
Mean \pm SD	26.92 \pm 5.05	27.41 \pm 6.19		

t: Independent sample *t*-test.
χ^2 : Chi-square test. p -value >0.05 NS.

This table shows no statistically significant difference between groups according to demographic data.

Table (2): Comparison between open appendectomy and laparoscopy appendectomy according to operative time (min).

Operative time (min).	Open appendectomy (n=20)	Laparoscopy appendectomy (n=20)	χ^2	p -value
20-30min.	8 (40%)	1 (5%)	6.283	$<0.001^{**}$
>30 -40min.	6 (30%)	1 (5%)		
>40 -50min.	5 (25%)	2 (10%)		
>50 -60min.	1 (5%)			
>60 -70min.	0 (0%)			
Mean \pm SD	34.50 \pm 11.48	56.42 \pm 8.69		
Range	20-60	30-70		

χ^2 : Chi-square test.
 $**$: p -value <0.001 HS.

This table shows highly statistically significant decrease mean of open appendectomy compared to laparoscopic appendectomy according to operative time.

Table (3): Comparison between open appendectomy and laparoscopy appendectomy according to post-operative pain score.

Post-operative pain score	Open appendectomy (n=20)	Laparoscopy appendectomy (n=20)	<i>t</i> -test	p -value
0-1 2-3 4-5	1 (5.0%)	6 (30.0%)	5.922	$<0.001^{**}$
6-7 Mean \pm SD	5 (25.0%) 10 (50.0%)	9 (45.0%) 4 (20.0%)		
	4 (20.0%)	1 (5.0%)		
	3.62 \pm 1.10	2.12 \pm 0.		

t: Independent sample *t*-test.
 $**$: p -value <0.001 HS.

This table shows highly statistically significant decrease mean of laparoscopic appendectomy compared to open appendectomy according to post-operative pain score.

Table (4): Comparison between open appendectomy and laparoscopy appendectomy according to post-operative complications.

Post-operative complications	Open appendectomy (n=20)	Laparoscopy appendectomy (n=20)	χ^2	p -value
Vomiting	3 (15.0%)	2 (10.0%)	0.842	0.359
Abdominal abscess	0 (0.0%)	0 (0.0%)	0.000	1.000
Fever	2 (10.0%)	2 (10.0%)	0.000	1.000
Wound infection	2 (10.0%)	1 (5.0%)	0.842	0.359

χ^2 : Chi-square test.
 p -value >0.05 NS.

This table shows no statistically significant difference between groups according to post-operative complications.

Table (5): Comparison between open appendectomy and laparoscopy appendectomy according to post-operative recovery.

Post-operative recovery	Open appendectomy (n=20)	Laparoscopy appendectomy (n=20)	<i>t</i> -test	p -value
• Duration of hospital stay after surgery (days)	17.13 \pm 0.	11.00 \pm 0.	0.20/	0.862
• Time taken for return to normal work (days)	15.06 \pm 1.	11.0 \pm 1.	5.561	0.052*

t: Independent sample *t*-test.
 $**$: p -value <0.001 HS.

This table shows highly statistically significant decrease mean of laparoscopy group compared to open group according to post-operative recovery regarding time taken for return to normal work (days).

Table (6): Comparison between open appendectomy and laparoscopy appendectomy according to cosmesis.

Cosmesis	Open appendectomy (n=20)	Laparoscopy appendectomy (n=20)	χ^2	p -value
Satisfied	7 (35%)	16 (80%)	6.547	0.011*
Not satisfied	13 (65%)	4 (20%)		

χ^2 : Chi-square test. * : p -value <0 .

This table shows statistically significant decrease patient satisfaction in open appendectomy compared to laparoscopy according to cosmesis.

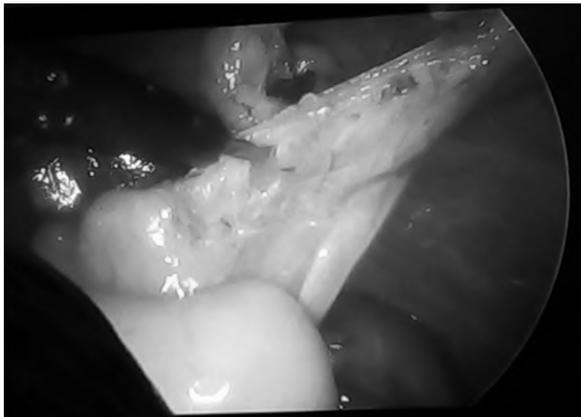


Fig. (1): Picture showing ligation of meso appendix.

Fig. (2): Picture showing 3 ports positions.



Fig. (3): Picture showing dissection of the mesoappendix.



Discussion

Appendectomy for acute appendicitis is a common emergency surgical procedure [8].

With the introduction of laparoscopy, the surgical approach to appendectomy took a new turn and a large number of surgical procedures were attempted with this new technique. In 1981, Kurt Semm a German gynaecologist performed the first Laparoscopic Appendectomy (LA) [1].

Also, laparoscopy allows a complete and thorough assessment of the abdominal cavity so increases diagnostic accuracy, especially in female patients with lower abdominal pain associated with higher rates of negative appendectomies [9].

There have been numerous previous studies comparing Open Appendectomy (OA) with Laparoscopic Appendectomy (LA). Although most of these have concluded that the laparoscopic technique is as good as OA, there has been considerable controversy as to whether LA is superior to OA or not [4].

In our study, the mean age of the patients was 26.92 ± 5.05 years in group A with range from 17 to 40 years old and 27.41 ± 6.19 years in group B with range from 18 to 39 years old. In group A there were 11 males and 9 females, whereas in group B there were 6 males and 14 females as shown in (Table 1). With 1 patient known to be diabetic & hypertensive in each group.

Our study shows highly statistically significant decrease of mean operative time of OA (34.50 ± 11.48 minutes) compared to LA (56.42 ± 8.69 minutes). The range of operative time of OA is (20-60 minutes) compared to range of LA (30-70 minutes), this can be contributed by several factors, the more equipment used and longer setup time in LA procedure, the learning curve of laparoscopy and the status of the appendix.

This was in accordance to the study by Yang et al., [10], that showed that the mean operative time for the LA group was significantly longer (80min) than the OA (65min) with $p < 0.0001$.

Mantoğlu et al., [11] reported decreased operative time of LA (mean 41.42 ± 10.32 minutes) compared to OA (mean 46.25 ± 18.84 minutes) and explained that may be attributed to the fact that their team has enough experience with LA.

An increased proportion of patients experiencing some degree of pain in OA in comparison to LA group, pain was qualitatively stratified into mild, moderate, and severe, according to visual analog scale, in present study, average pain score was 3.62 ± 1.10 in open group as compared to 2.12 ± 0.56 in laparoscopic group with $p < 0.001$ which was significant.

This results is comparable to study by Pogorelic et al., [12] that stated that the amount of analgesics used was lower in patients with laparoscopic appendectomy compared to patients who underwent open procedure ($p = 0.042$).

Also Liu et al., study showed that the pain severity score was substantially lower in the laparoscopic group than in the open appendectomy group from the 2nd to the 26th day after the procedure ($p=0.04$) [13].

There were no differences in post-operative complications (intra-abdominal abscess, vomiting and fever) [14].

Total number of complications was less in the LA group with a significantly lower incidence of wound infection (1.4% vs. 10.6%, $p<0.001$) [15].

On the other hand, Shirazi et al., reported in his study that the rate of overall post-operative complications (LA: 15%, OA: 31.8%, $p<0.0001$) was significantly lower in LA patients group [16].

In study by Taguchi et al., [17], the overall rate of post-operative complications, including incision-al or organ/space SSI and stump leakage, did not differ significantly between groups.

In our study, there was no statistically significant difference between groups according to post-operative complications such as vomiting that was lower in laparoscopic groups [2 patients (10%) as compared with 3 (15%) in open group] and fever was equal in both groups (2 patients) which is comparable to previous studies. Also, in OA group 2 patients developed wound infection and 1 patient in LA. The lower incidence of wound infection in LA may be explained by utilization of laparoscopic port or bag for appendix retrieval which reduced frequency of wound infection, in OA group direct delivery of the appendix through the wound may cause more contamination to wound edges [18].

Pogorelic et al., in there study had higher number of wound infections that was recorded in the open group (n=21; 3.9%) compared to laparoscopic group (n=3; 1%) ($p=0.014$) [12].

In the present study, no patient developed intraabdominal abscess. However, in previous study by Horvath et al., [19], intraabdominal abscess formation is more common in LA (ten patients) compared with the OA (two patients). This can be explained on the basis that CO₂ insufflation in LA may facilitate spreading of microorganisms in the peritoneal cavity, especially in perforated appendicitis.

Also, Ali et al., study showed that the mean length of hospital stay was shorter in the LA group (34±13h. in LA vs. 40±1 h in OA; $p=0.01$) [20].

Svensson et al., [21] showed that laparoscopic appendectomy had a shorter median post-operative length of stay, 43 vs. 57 hours ($p<0.05$).

In study by Karakus, et al., the hospital stay of LA group (2.15±0.7 days) is less than OA groups (2.25±0.7 days) ($p<0.001$) [22].

All previous results of mentioned studies regarding hospital stay are comparable to our study that revealed that the mean period of hospital stay was (1.13±0.75 days) in OA group and (1.00±0.00days) in LA group.

In a study by Talha et al., the mean time taken to resume routine work for laparoscopic procedure was 15.3±3.4 days and for open procedure was 22.3±3.7 days, which signifies that laparoscopic group resumed routine work early compared to open group [23].

In a study by Resutra & Gupta, the mean time taken to resume daily routine activities was 8.16±0.553 days in LA group and 10.16±0.681 days in OA group and the difference was statistically significant ($p<0.05$) [24].

In our study, the time taken to return to normal work shows highly statistically significant decrease in LA group (11.07±1.24 days) compared to OA group (13.06±1.3 days) according to post-operative recovery. These results are comparable to the previous studies.

Shrivastava et al., [25] stated that laparoscopic appendectomy had better cosmetic results both subjectively and objectively (80.5% of patients are satisfied by cosmetic results) compared to open appendectomy group (35% of patients are satisfied of cosmetic results). The post-operative scars are small and hide easily as compared to a relatively longer scar in the right iliac fossa after open appendectomy.

In a study by Resutra & Gupta, revealed that in LA group, 160 (80%) of the patients were fully satisfied with the scar and cosmetic outcome, 30 (15%) patients were partially satisfied and 10 (5%) patients were unsatisfied due to poor scar. In OA group, 40 (20%) patients were fully satisfied with the cosmetic outcome, 50 (25%) were partially satisfied and 110 (55%) of patients were unsatisfied. In the LA, mean cosmesis satisfaction score was 8.16±0.37 as compared to 7.36±0.58 in OA and the difference was statistically highly significant ($p<0.05$) [24].

In our study, there are statistically significant decrease number of cosmetically satisfied patients

in OA group (7 patients) compared to LA group (16 patients), these results are comparable to previous studies.

Conclusion:

Laparoscopic appendectomy is safe and feasible. Despite that the operating time for laparoscopic appendectomy is still longer than that for open appendectomy, laparoscopic approach had several advantages over open appendectomy in that, it has less incidence of wound infection, shorter hospital stay, less incidence of severe post-operative pain and faster return of patients to normal activities and more satisfying cosmetic results. We must convert laparoscopic procedure to open surgery when indicated for the safety of the patients.

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مقارنة نتائج إستئصال الزائدة الدودية عن طريق المنظار والجراحة

المقدمة: يمكن إعتبار إلتهاب الزائدة الدودية الحاد المرض المميز الذي يواجهه الجراح العام. إنه التشخيص الأكثر شيوعاً للبطن الذي يعالجه الجراحون. كانت هناك العديد من الدراسات السابقة التي تقارن إستئصال الزائدة الدودية المفتوح مع إستئصال الزائدة الدودية بالمنظار. على الرغم من أن معظم هؤلاء قد خلصوا إلى أن تقنية تنظير البطن جيدة مثل إستئصال الزائدة الدودية المفتوح، فقد كان هناك جدل كبير حول ما إذا كان إستئصال الزائدة الدودية بالمنظار يتفوق على إستئصال الزائدة الدودية المفتوح أم لا.

الهدف من هذه الدراسة: هو المقارنة بين إستئصال الزائدة الدودية بالمنظار وإستئصال الزائدة الدودية المفتوح فيما يتعلق بوقت الجراحة، والألم ما بعد الجراحة، والمضاعفات، ووقت العودة إلى النشاط المعتاد والتجميل.

المرضى والطرق: قمنا بتضمين ٤٠ مريضاً على التوالي يعانون من إلتهاب الزائدة الدودية الحاد. تم تقسيم المرضى بشكل عشوائي إلى مجموعتين، ٢٠ مريضاً لإستئصال الزائدة الدودية بالمنظار و٢٠ مريضاً لإستئصال الزائدة الدودية المفتوح. تم إطلاع المرضى بشكل كامل على مخاطر وفوائد كلا الإجراءين. تم الحصول على الموافقة المسبقة من جميع المرضى. تم عمل إستئصال الزائدة الدودية بالمنظار بمساعدة ثلاثة ميازل/قنيتات تخلق إسترواح الصفاق بثاني أكسيد الكربون بينما تم إجراء إستئصال الزائدة الدودية المفتوح بواسطة شق ماكبرنى.

النتائج: لم يكن هناك فرق معتد به إحصائياً بين المجموعات وفقاً لمضاعفات ما بعد الجراحة. كانت نسبة حدوث عدوى الجرح في مجموعة إستئصال الزائدة المفتوح ١٠٪ من المرضى وفي مجموعة إستئصال الزائدة بالمنظار كانت ٥.٠٪ من المرضى. هذه النتيجة قابلة للمقارنة مع دراسة بوجورديليك وآخرين في ٢٠١٩م والتي أظهرت عدداً أعلى من إلتهابات الجروح في مجموعة إستئصال الزائدة المفتوح (عدد ٢١، ٣.٩٪) مقارنة بمجموعة إستئصال الزائدة بالمنظار (عدد ٣، ١٪).

في الدراسة الحالية، في مجموعة إستئصال الزائدة المفتوح، كان ٣٥٪ (٧ مرضى) راضين عن النتائج التجميلية وفي مجموعة إستئصال الزائدة بالمنظار، كان ٨٠٪ (١٦ مريضاً) راضين عن النتائج التجميلية. شريفاستافا وآخرون في ٢٠١٩م ذكروا أن مجموعة إستئصال الزائدة الدودية بالمنظار كان له نتائج تجميلية أفضل سواء بشكل شخصى أو موضوعى (٨٠.٥٪ من المرضى كانوا راضين عن النتائج التجميلية) مقارنة بمجموعة إستئصال الزائدة بالمنظار (٣٥٪ من المرضى كانوا راضين عن النتائج التجميلية).

الختامة: إستئصال الزائدة بالمنظار آمن وله فوائد كبيرة مثل وقت جراحى أقل، وألم أقل ما بعد الجراحة، وإنخفاض عدوى الجروح، وإقامة قصيرة في المستشفى، والعودة المبكرة إلى العمل، وندبة تجميلية أفضل من إستئصال الزائدة المفتوح.