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# Comparative Study between Laparoscopic versus Open Appendectomy in Management of Acute Appendicitis

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## Abstract

*Background:* Acute appendicitis is the most common surgical cause of acute abdomen. The treatment of choice of acute appendicitis is appendectomy. Appendectomy is one of the most commonly performed general surgical operations and it is the most common abdominal emergency surgery.

*Aim of Study:* The aim of this study was to compare between laparoscopic and open appendectomy in treatment of acute appendicitis regarding the efficacy, safety, postoperative complications and outcome.

*Patients and Methods:* This prospective comparative study was conducted in General Surgery Department at Damanhour Medical National Institute in the period between January 2023 and December 2024. It included 100 patients with acute appendicitis who were randomly divided into two equal groups: A (underwent laparoscopic appendectomy) and B (underwent open appendectomy).

*Results:* The operative time was comparable in both groups. 4 cases of laparoscopic appendectomy were converted to open (8.0%). The length of hospital stay and the duration needed to return to normal daily activities were significantly shorter in the laparoscopic group. In addition, the early postoperative pain, incidence of wound infection and total number of postoperative complications were significantly less in the laparoscopic group.

*Conclusion:* Laparoscopic appendectomy, whenever feasible, is the more preferred option compared to conventional open appendectomy especially in obese as well as muscular patients in whom open appendectomy represents a technical challenge.

***Key Words:*** *Acute appendicitis – Laparoscopic appendectomy – Open appendectomy.*

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## Introduction

**THE** vermiform appendix is a hollow tubular structure that arises from the posteromedial aspect of the caecum and is blind distally. Its average length is 8cm. It is usually completely covered with peritoneum and suspended by a peritoneal fold called the mesoappendix through which the appendicular blood vessels run **[1]**.

Appendicitis is the inflammation of the appendix. If not properly managed, it can lead to serious complications or even mortality **[2]**.

Acute appendicitis is the most common surgical cause of acute abdomen worldwide with 7-8% lifetime risk and peak incidence between the age of 10 and 30 years **[3]**.

Complications of acute appendicitis include gangrene, perforation, periappendicular phlegmon, abcess, purulent peritonitis and sepsis **[4]**.

The mortality rates in acute uncomplicated appendicitis, gangrenous appendicitis and perforated appendicitis are 0.1%, 0.6% and 5% respectively **[5]**.

The treatment of choice of acute appendicitis is appendectomy. Appendectomy is one of the most commonly performed general surgical operations and it is the most common abdominal emergency surgery **[6]**.

Open appendectomy through a muscle splitting incision in the right lower quadrant of abdomen was first describedby Charles McBurney in 1894 **[7]**.

Since that time, this operation remained the standard treatment of acute appendicitis due to its safety and efficacy **[6]**.

Kurt Semm reported the first laparoscopic appendectomy in 1983 **[8]**. Laparoscopic appendectomy gained popularity among surgeons and worldwide acceptance because of the advantages of minimally invasive surgery e.g. faster recovery, shorter postoperative ileus, reduced postoperative pain, less incidence of wound infection, less postoperative intraabdominal adhesions and better cosmetic results **[6]**.

On the other hand, laparoscopic appendectomy has some disadvantages e.g. higher costs, general anaesthesia is mandatory and longer operative time **[9]**.

Nowadays, while many surgeons prefer the laparoscopic approach, others believe that traditional open appendectomy is the more practical choice especially in complicated cases **[10]**.

*Aim of the study:*

The aim of this study is to compare between laparoscopic and open appendectomy in treatment of acute appendicitis regarding the efficacy, safety, postoperative complications and outcome.

## Patients and Methods

This prospective study was done on a consecutive sample of 100 patients with acute appendicitis who were admitted to General Surgical Emergency Department at Damanhour Medical National Institute and fullfilled the inclusion criteria to be enrolled in the study during the period between January 2023 and December 2024.

All patients participated in the study after taking informed consent according to the ethical committee of the hospital.

*Inclusion criteria:*

Clinical diagnosis of acute appendicitis confirmed radiologically, age between 10 and 50 years, fitness for surgery and patients' agreement to undergo the operation with either the laparoscopic or the open approach.

*Exclusion criteria:*

Unestablished preoperative diagnosis of acute appendicitis, patients younger than 10 or older than 50 years of age, pregnant females, patient with chronic medical illness (e.g. diabetes mellitus, cirrhotic liver, chronic kidney disease and immunological diseases) and contraindications to general anesthesia or laparoscopy (e.g. severe cardiopulmonary diseases and coagulation disorders).

*All patients were subjected preoperatively to:* Detailed history taking, thorough clinical examination and routine preoperative laboratory investigations including: Complete Blood Count (CBC), coagulation profile, random blood sugar, liver and kidney function tests. Pregnancy test (serum beta HCG) was added in adult females. Abdominal ultrasonography was done routinely to exclude other intraabdominal pathology. Abdominal Computed Tomography (CT) was done only if needed. Chest plain X-ray was done in patients with history of smoking, bronchial asthma or clinical signs of chest troubles. Electrocardiography (ECG) and Echocardiography were done in patients above 40 years. The 100 patients were randomly divided into two equal groups (A and B) using closed envelope method. Patients in Group A were treated with laparoscopic appendectomy, whereas patients in Group B were treated with open appendectomy. All cases of laparoscopic appendectomy were done under general anaesthesia whereas patients of open appendectomy were operated under either spinal or general anaesthesia. All patients received intravenous 3rd generation cephalosporin and metronidazole preoperatively. These antibiotics were continued postoperatively for at least 3 days.

*Surgical techniques:*

In the operating room, the patient was placed in the supine position with both arms extended in open appendectomies and both arms tucked to the side in laparoscopic appendectomies. A urinary catheter was inserted in patients of laparoscopic appendectomy preoperatively and removed immediately at the end of operation in the operating room. For both laparoscopic and open methods, a sterile surgical field was created from just above the bilateral costal margins extending inferiorly to the pubic symphysis and laterally to both flanks. In the laparoscopic group, the video monitor was placed at the foot of the table towards the right side while the surgeon stood on the left side of the patient and the camera man stood to the right of the surgeon near the head of the patient.

*In Group A (laparoscopic appendectomy):*

Laparoscopic access was achieved by inserting a 10mm port just above the umbilicus using the Veress needle technique except in children and thin patients where the open method was preferred. The peritoneal cavity is insufflated with carbon dioxide to a maximum pressure of 14mmHg. A 30° angled laparoscope was inserted. Then, two working ports were inserted under direct vision. A 10mm port was placed in the right hypochondrium 5cm below the costal margin in midclavicular line, and a 5mm port was then placed in the suprapubic region 5cm above the symphysis pubis in the midline.

After port placement, the patient was positioned into Trendelenburg position with the right side up. The abdomen was explored to rule out other abdominal or pelvic diseases. If pus was found, it was immediately aspirated to prevent spread of infection and a sample sent for culture and sensitivity.

If the appendix was not easily found, the cecum was identified, at first, by following the terminal ileum using non traumatic graspers. Then, by following the taenia coli, the appendix could be identified.

If adhesions were encountered, adhesiolysis was done using combined blunt and sharp dissection. When sharp dissection was needed, it was done taking extreme care when operating near the bowel to avoid contact and conductive injury.

Once the tip of the appendix was visualized, it was grasped and elevated anteriorly. Using a Maryland dissector, a window was created in the mesoappendix at the appendicocecal junction. The middle part of the free margin of mesoappendix was divided after being either clipped or coagulated using Maryland forceps or hook. The proximal part of the mesoappendix was coagulated and divided off the appendix till reaching the previously created window leaving a small distal part of the mesoappendix attached to the appendicular tip.

The base of the appendix was doubly ligated intracorporeally using Vicryl No. 0 or 2/0 suture. Ligation was done flush to the cecum to avoid leaving an appendicular stump. Clipping was done 1cm distal to the ligature to avoid spillage of appendicular contents after division. The appendix was divided between the ligature and the clip using scissor. The resected appendix was introduced inside the right 10mm port. Then, the port was removed with the appendix inside it without contact to the wound.

Good peritoneal toilet with irrigation and suction was done. When drain is needed, it was inserted through an additional stab in the right loin to be dependent.

At the end, the working ports were removed under vision and their sites were assessed for hemostasis. The abdomen was deflated and skin incisions were closed.

*In Group B (open appendectomy):*

Surgery was done using a standard Grid-iron incision made on McBurney's point. Skin was incised using a scalpel. Electrocautery was used to dissect the subcutaneous fat and open the external oblique aponeurosis. The internal oblique and transversus abdominis muscles were splitted to expose the peritoneum. Muscle cutting was done only if necessary. The peritoneum was grasped and incised.

If pus was found, it was sucked and a sample was taken for culture and sensitivity. Omental or bowel adhesions, if present, were lysed gently. Once the appendix was identified, the mesoappendix was dissected, ligated with Vicryl No. 0 or 2/0 suture and divided. Then, the base of appendix was crushed, doubly ligated and divided. The excised appendix was removed.

Hemostasis was confirmed. Good mopping of surgical field, right paracolic gutter and pelvis was done. An intraperitoneal drain was inserted through a separate stab incision if needed especially if there was pus collection. Lastly, closure of the incision in layers was done.

*In all patients, the following operative details were recorded:*

- Operative time (from incision to skin closure).
- Intraoperative complications e.g. bleeding and inadvertent bowel injury.
- Conversion to open approach in the laparoscopic group.

*Post-operative management:*

The patients started clear liquid diet when flatus is observed and were advanced to regular diet when the liquid diet was tolerated. The time needed to start oral intake was recorded. All patients received the same postoperative analgesia. Intravenous antibiotics were given twice daily for 3 days postoperatively and were continued only if infection was encountered. Assessment of post-operative pain was done 24 hours after surgery using visual analogue score (VAS).

Patients were discharged after tolerating oral nutrition, achieving good pain relief and being a febrile. The duration of postoperative hospital stay was recorded.

Antibiotics were continued orally up to 7 days unless infection occurred. Drains were removed when the daily drainage decreased to below 20cc. The time of drain removal was recorded.

All patients were asked to follow-up after one week, then every week for one month and if having any abdominal complaint thereafter to evaluate the outcome of the operation and detect any delayed postoperative complications. The duration needed to return to the normal daily activities was recorded.

The two techniques were evaluated and compared regarding the following parameters: Operative time, intraoperative complications, time needed to start oral intake, postoperative pain, time of drain removal, hospital stay, duration needed to return to the normal daily activities and postoperative complications (e.g. wound infection, enterocutaneous fistula and intraabdominal collection).

*Statistical analysis:*

The statistical analysis of the data was performed using IBM SPSS software version 20.0 (Armonk, NY: IBM Corp, released 2011). Categorical data were summarized as numbers and percentages. To compare between the two studied groups, the Chi-square test was used. However, when more

than 20% of the cells had an expected count less than 5, the Fisher Exact test was applied. For continuous data, normality was assessed using the Kolmogorov-Smirnov test. Quantitative data were described using range (minimum and maximum), mean, standard deviation, median and interquartile range (IQR). Student *t*-test was used to compare two groups for normally distributed quantitative variables, while the Mann Whitney test was used for non-normally distributed quantitative variables. Significance of the obtained results was judged at the 5% level.

## Results

100 patients with acute appendicitis were enrolled in this study. They were randomly divided into 2 equal groups: Group A (50 patients underwent laparoscopic appendectomy) and Group B (50 patients underwent open appendectomy).

There were 54 males and 46 females. The mean age of patients of Group A was 23.98 years, while in Group B it was 25.66 years. The mean body mass index (BMI) of patients of Group A was 25.50kg/ $m^2$, while it was 24.02kg/$m^2$ in Group B with no statistically significant difference.

The mean operative time in the laparoscopic group was 71.80 minutes while in the open group it was 67.80 minutes. This difference was not statistically significant.

Intraopertaively, bleeding was encountered in 2 cases of the laparoscopic group (4.0%). In one of them it was controlled successfully but in the other case conversion to open was required. Bleeding occurred in 4 cases of the open group (8.0%). Heamostasis was achieved successfully and blood transfusion was not needed in any case.

In the open group serosal tear in the caecal wall occurred in 3 cases (6.0%). repair was done using NO. 3/0 continuous absorbable sutures. Serosal tears did not occur in any case of the laparoscopic group.

In the laparoscopic group, conversion to open was required 4 cases (8.0%) due to extensive dense adhesions and phlegmon formation in 3 cases and due to bleeding in one case that could not be controlled laparoscopically.

There was no statistically significant difference between the two groups regarding intraoperative complications.

Intraperitoneal drain was inserted in 14 cases of the laparoscopic group (28.0%) and in 19 cases of the open group (38.0%). The difference in the need for drain insertion was statistically insignificant.

The mean time to start oral intake was significantly shorter in the laparoscopic group (mean = 7.26 hours) than in the open group (mean = 13.80 hours).

The postoperative pain was less in the laparoscopic group (A) than in the open group (B). This difference was statistically significant with a mean postoperative pain score 24 hours after surgery of 3.72 in Group A and 5.20 in Group B.

In the laparoscopic group, the majority of cases (92.0%) were discharged from the hospital in the first postoperative day. 4 cases only (8.0%) stayed for 2 days. The hospital stay in the open group was 1 day in 26 cases (52.0%), 2 days in 14 cases (28.0%), 3 days in 5 cases (10.0%) and 4 days in the remaining 5 cases (10.0%).

The mean hospital stay in the laparoscopic group was 1.08 days while in the open group it was 1.78 days. This difference was statistically significant.

The time of drain removal was significantly shorter in the laparoscopic group (mean = 41.14 hours) than in the open group (mean = 70.74 hours).

The duration needed to return to normal daily activities ranged between 3 and 5 days in the laparoscopic group with a mean value of 3.58 days while in the open group it ranged between 7 and 14 days with 10.28 days in mean. This difference was statistically significant.

The open group exhibited a significantly higher incidence of complications (48.0%) compared to the laparoscopic group (14.0%). Wound infection was the most common postoperative complication that occurred in 14 cases of open appendectomy (28.0%) and 2 cases of the laparoscopic group (4.0%). All the cases showed good response to conservative treatment with broad spectrum antibiotics and frequent dressings. Other complications include prolonged ileus that occurred in 6 cases of the open group (12.0%) and in 2 cases of the laparoscopic group. Intraabdominal collection was noted in 2 cases of the open group (4.0%) and in 3 cases of the laparoscopic group (6.0%). They were managed conservatively except one case that needed ultrasound guided aspiration of the collection. Incisional hernia and adhesive intestinal obstruction were not recorded in any patient of the laparoscopic group but each occurred in one patient of the open group (2.0%). The difference between the 2 groups regarding the incidence of wound infection was statistically significant but was not significant regarding the other complications.

Table (1): Demographic data of the study group.

| | Group A (n=50) | Group B (n=50) | Test of Sig. | *p* |
|---|---|---|---|---|
| Age (years): | | | | |
| Min.-Mx. | 10.0-49.0 | 11.0-50.0 | U=1134.5 | 0.426 |
| Mean ± SD | 23.98±9.44 | 25.66±10.65 | | |
| Median (IQR) | 24.0 (16.0-29.0) | 24.0 (18.0-34.0) | | |
| *Sex:* | | | | |
| Male | 26 (52.0%) | 28 (56.0%) | $\chi2$=0.161 | 0.688 |
| Female | 24 (48.0%) | 22 (44.0%) | | |
| *BMI (kg/m2):* | | | | |
| Min.-Mx. | 17.0-38.0 | 18.0-37.0 | *t*=1.296 | 0.198 |
| Mean ± SD | 25.50±5.63 | 24.02±5.80 | | |
| Median (IQR) | 25.0 (20.0-28.0) | 22.0 (20.0-27.0) | | |

IQR: Inter quartile range. U: Mann Whitney test. $\chi2$: Chi square test. *t*: Student *t*-test test.
*p*: *p*-value for comparing between the two studied groups.
*: Statistically significant at $p \leq 0.05$.

Table (2): Comparison of the two groups regarding the operative time.

| Operative time (minutes) | Group A (n=50) | Group B (n=50) | Test of Sig. | *p* |
|---|---|---|---|---|
| Min.-Mx. | 40.0-130.0 | 30.0-120.0 | U=1140.00 | 0.446 |
| Mean ± SD | 71.80±23.77 | 67.80±23.28 | | |
| Median (IQR) | 65.0 (55.0-80.0) | 65.0 (65.0-85.0) | | |

IQR: Inter quartile range. U: Mann Whitney test.
*p*: *p*-value for comparing between the two studied groups.
*: Statistically significant at $p \leq 0.05$.

Table (3): Comparison of the two groups according to intraoperative complications.

| Intraoperative complications | Group A (n=50) | Group B (n=50) | Test of Sig. | *p* |
|---|---|---|---|---|
| No | 44 (88.0%) | 40 (80.0%) | $\chi2$=1.190 | 0.275 |
| Yes | 6 (12.0%) | 7 (14.0%) | | |
| Bleeding | 2 (4.0%) | 4 (8.0%) | | |
| Serosal tear | 0 (0.0%) | 3 (6.0%) | | |
| Conversion | 4 (8.0%) | | | |

$\chi2$: Chi square test.
*p*: *p*-value for comparing between the two studied groups.
*: Statistically significant at $p \leq 0.05$.

Table (4): Comparison of the two groups according to need for drain insertion.

| Drain insertion | Group A (n=50) | Group B (n=50) | Test of Sig. | *p* |
|---|---|---|---|---|
| No | 36 (72.0%) | 31 (62.0%) | $\chi2$=1.131 | 0.288 |
| Yes | 14 (28.0%) | 19 (38.0%) | | |

$\chi2$: Chi square test.
*p*: *p*-value for comparing between the two studied groups.
*: Statistically significant at $p \leq 0.05$.

Table (5): Comparison of the two groups according to time to start oral intake.

| Time to start oral intake | Group A (n=50) | Group B (n=50) | Test of Sig. | *p* |
|---|---|---|---|---|
| Min.-Mx. | 3.0-36.0 | 6.0-72.0 | U=516.00* | <0.001* |
| Mean ± SD | 7.26±8.57 | 13.80±16.59 | | |
| Median (IQR) | 3.0 (3.0-12.0) | 6.0 (6.0-12.0) | | |

IQR: Inter quartile range. *p*: *p*-value for comparing between the two studied groups.
U : Mann Whitney test. *: Statistically significant at $p \leq 0.05$.

Table (6): Comparison of the two groups according to postoperative pain.

| Postoperative pain score after 24 hours | Group A (n=50) | Group B (n=50) | Test of Sig. | *p* |
|---|---|---|---|---|
| Min.-Mx. | 2.0-7.0 | 4.0-7.0 | *t*=7.046* | <0.001* |
| Mean ± SD | 3.72±0.93 | 5.20±1.16 | | |
| Median (IQR) | 4.0 (3.0-4.0) | 5.0 (4.0-6.0) | | |

IQR: Inter quartile range. *p*: *p*-value for comparing between the two studied groups.
*t* : Student *t*-test test *: Statistically significant at $p \leq 0.05$.

Table (7): Comparison of the two groups according to hospital stay.

| Hospital stay (days) | Group A (n=50) | Group B (n=50) | Test of Sig. | *p* |
|---|---|---|---|---|
| 1 | 46 (92.0%) | 26 (52.0%) | FET=20.852* | <0.001* |
| 2 | 4 (8.0%) | 14 (28.0%) | | |
| 3 | 0 (0.0%) | 5 (10.0%) | | |
| 4 | 0 (0.0%) | 5 (10.0%) | | |
| Min.-Mx. | 1.0-2.0 | 1.0-4.0 | U=730.00* | <0.001* |
| Mean ± SD | 1.08±0.27 | 1.78±1.0 | | |
| Median (IQR) | 1.0 (1.0-1.0) | 1.0 (1.0-2.0) | | |

IQR: Inter quartile range. *p*: *p*-value for comparing between the two studied groups.
FET: Fisher exact test. *: Statistically significant at $p \leq 0.05$.
U : Mann Whitney test.

Table (8): Comparison of the two groups according to time of drain removal.

| Tme of drain removal | Group A (n=50) | Group B (n=50) | Test of Sig. | *p* |
|---|---|---|---|---|
| Min.-Mx. | 24.0-72.0 | 48.0-96.0 | *t*=4.380* | <0.001* |
| Mean ± SD | 41.14±19.81 | 70.74±18.72 | | |
| Median (IQR) | 36.0 (24.0-48.0) | 72.0 (48.0-84.0) | | |

IQR: Inter quartile range. *p*: *p*-value for comparing between the two studied groups.
*t* : Student *t*-test test *: Statistically significant at $p \leq 0.05$.

Table (9): Comparison of the two groups regarding the duration to return to normal daily activities.

| Duration to return to normal daily activities | Group A (n=50) | Group B (n=50) | Test of Sig. | *p* |
|---|---|---|---|---|
| Min.-Mx. | 3.0-5.0 | 7.0-14.0 | *t*=17.472* | <0.001* |
| Mean ± SD | 3.58±0.57 | 10.28±2.65 | | |
| Median (IQR) | 4.0 (3.0-4.0) | 10.0 (7.0-13.0) | | |

IQR: Inter quartile range. *t*: Student *t*-test test
*p*: *p*-value for comparing between the two studied groups.
*: Statistically significant at $p \leq 0.05$.

Table (10): Comparison of the two groups according postoperative complications.

| Postoperative complications | Group A (n=50) | Group B (n=50) | Test of Sig. | *p* |
|---|---|---|---|---|
| No | 3 (86.0%) | 26 (52.0%) | $\chi 2$=13.511* | <0.001* |
| Yes | 7 (14.0%) | 24 (48.0%) | | |
| Wound infection | 2 (4.0%) | 14 (28.0%) | $\chi 2$=10.714* | 0.001* |
| Paralytic ileus | 2 (4.0%) | 6 (12.0%) | $\chi 2$=2.174 | FE*p*=0.269 |
| Intra-abdominal collection | 3 (6.0%) | 2 (4.0%) | $\chi 2$=0.211 | FE*p*=1.000 |
| Incisional hernia | 0 (0.0%) | 1 (2.0%) | $\chi 2$=1.010 | FE*p*=1.000 |
| Adhesive intestinal obstruction | 0 (0.0%) | 1 (2.0%) | $\chi 2$=1.010 | FE*p*=1.000 |

$\chi 2$: Chi square test. FE: Fisher Exact test.
*p*: *p*-value for comparing between the two studied groups.
*: Statistically significant at $p \leq 0.05$.

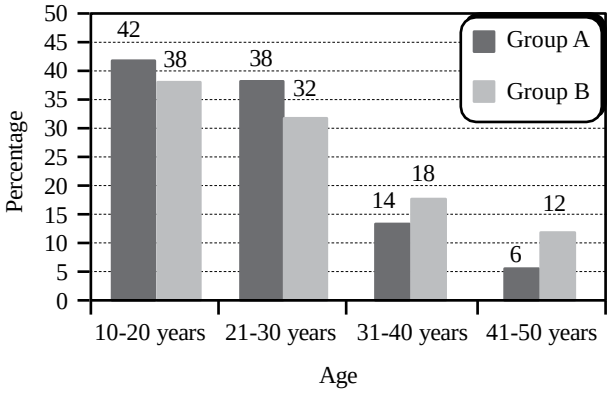


Fig. (1): Age distribution of the studied patients.

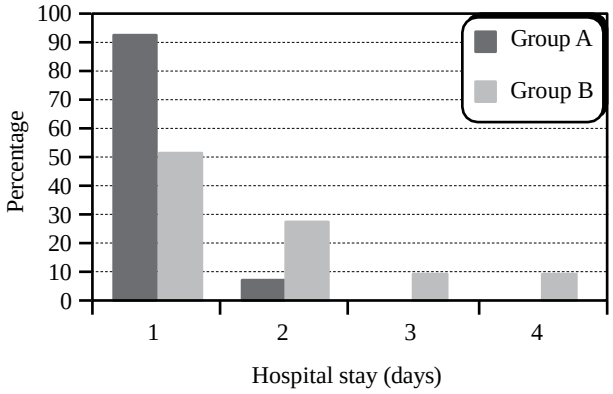


Fig. (2): Comparison between the two groups according to hospital Stay.

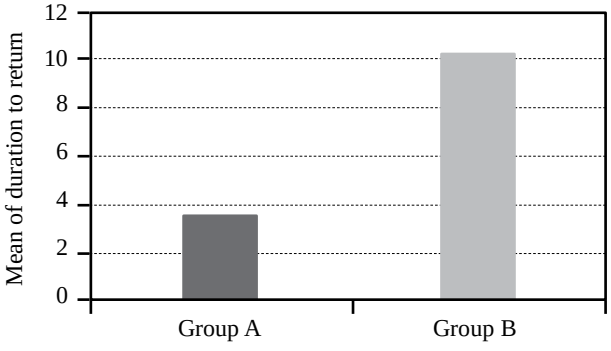


Fig. (3): Comparison between the two studied groups according to duration to return to normal daily activities.

## Discussion

Laparoscopic approach has proven efficiency, safety and increasing popularity in different surgical operations **[11].**

The aim of this study was to compare between laparoscopic and open appendectomy in treatment of acute appendicitis regarding the efficacy, safety, postoperative complications and outcome.

100 patients of acute appendicitis with varying degrees of disease progression and complications were enrolled in the study and randomly divided

into 2 equal groups where 50 patients underwent laparoscopic appendectomy and 50 patients underwent open appendectomy.

In this study, the age of the studied cases ranged between 10 and 50 years with a mean age of 24.82 years. The highest incidence was among patients with the age range of 10–19 years (40.0%) followed by 20–29 years (35.0%).

This is comparable to the results obtained by Khorshid et al., in a study on 60 patients of acute appendicitis with no age restriction in 2022. They found that the peak incidence of acute appendicitis (53.33%) was between 10 and 30 years of age. The mean age of their cases was 27.37 years **[12]**.

In their study on 712 patients of acute appendicitis, Jailani et al., reported that the majority of the cases were in their third decade and the mean age was 31 years **[13]**.

In our study, the male to female ratio was 1.2:1. This correlates with most of the literature noting slight male predominance **[12]**.

In their study of the epidemiology of acute appendicitis in the United States with a huge sample of 200000 cases of appendectomy, Addiss et al., reported that males are at greater risk than females with a ratio of 1.4:1 and that the lifetime risk of appendicitis has been estimated at 8.6% in men and 6.7% in women **[14]**.

In our study, the operative time was slightly longer in the laparoscopic group than in the open group with no statistical significance.

This result comes in correspondence with the study of Singh et al., which showed that the mean operative time for the laparoscopic appendectomy was 54.23 minutes and for open appendectomy was 51.18 minutes **[6]**.

Sharma and Karan found that the mean operative time was significantly longer in the laparoscopic group (101.4 minutes) than in the open group (84.4 minutes) **[9]**.

In contrary, Khadilkar et al., reported that the mean operative time in laparoscopic appendectomy (32.8 minutes) was significantly shorter than in open appendectomy (81.1 minutes) **[15]**.

Regarding the intraoperative complications, bleeding occurred in 4 cases of the open group (8.0%) and in 2 cases of the laparoscopic group (4.0%). Caecal serosal tear occurred in 3 cases (6.0%) of the open group but not recorded in the laparoscopic group. This is probably due to the larger field of vision provided by the laparoscopic approach that minimizes the traction on bowel loops and makes it easier to identify and control bleeding more rapidly. However, in one case of laparoscopic appendectomy bleeding was the reason for conversion to open surgery.

In our study, conversion to open occurred in 4 cases (8.0%). The main reason for conversion was extensive adhesion and bowel amalgamation causing technical difficulty in proceeding with laparoscopic approach.

Similarly, Talha et al., reported that conversion to open was required in 5 out of 60 cases of laparoscopic appendectomy (8.3%) **[16]**.

The conversion rate was 5.0% in the study of Singh et al. (2 out of 40 cases) **[6]**. 0.0% conversion was reported by Khadilkar et al. **[15]** while performing 50 cases of laparoscopic appendectomy.

We believe that conversion to open should not be viewed as failure of laparoscopic surgery nor as a complication; rather it should be regarded as another option in the surgeon's toolbox to achieve maximum benefits and minimal risk to his patients.

In our study, the incidence of drain insertion was higher in the open group (38.0%) than in the laparoscopic group (28.0%) but this difference was not statistically significant.

In the study done by Ibrahim et al., **[17]** in 2024, drain insertion was significantly higher in the open group (100.0%) compared to the laparoscopic group (50.0%).

Regarding the time needed to start oral intake, patients of the laparoscopic group had earlier resumption of oral intake (mean 7.26 hours) as compared to the open group (mean 13.8 hours). The difference was statistically significant.

Similar results were obtained by Singh et al., **[6]** who reported that the mean duration needed for resumption of oral intake was significantly shorter in the laparoscopic group (14.25 hours) than in the open group (23.5 hours).

Another study by Eskandaros et al., **[18]** showed that laparoscopic approach leads to significant reduction of the time needed to start oral intake after appendectomy as compared to the open approach.

Postoperative pain was assessed by using visual analogue score 24 hours postoperatively. In our study, patients in the laparoscopic group had significantly less postoperative pain as compared to the open group. This result is consistent with those obtained by Talha et al. **[16]** (mean pain score 3.5 in laparoscopic group versus 5.9 in open group) and by Rajyalakshmi et al. **[19]** (mean pain score 2.4 in laparoscopic group versus 3.14 in open group).

Limbu et al., **[20]** reported that patients of the laparoscopic group had less postoperative pain (mean pain score 3.6 in laparoscopic group versus 4.0 in open group) but with no statistical significance.

Smaller incision and minimal tissue handling may be the reason for decreased postoperative pain in the laparoscopic group **[6]**.

In our study, the mean duration of postoperative hospital stay was significantly shorter in the laparoscopic group (1.08 days) than in the open group (1.78 days).

Comparable results were also obtained by Singh et al., **[6]** who reported that the mean duration of hospital stay was 1.90 days in the laparoscopic group versus 2.83 days in the open group with statistically significant difference.

In contrary, Marzouk et al., **[10]** found that the mean length of hospital stay in the laparoscopic group was longer than that in the open group (4.08 versus 3.56 days) but this difference was statistically insignificant.

In our results, the duration of abdominal drainage was significantly shorter in the laparoscopic group than in the open group with a statistically significant difference. This is matching with results obtained by Talha et al. **[16]** and also by Ibrahim et al. **[17]**.

In the current study, we found that time to return to normal daily activities was also significantly shorter in the laparoscopy group (3.58 days) compared with the open group (10.28 days).

This result is similar to those reported by Ismail et al. in 2020 **[21]** and by El Shayeb et al. in 2023 **[22]**.

On the other hand, another study by Katkhouda et al., showed that there was no difference between the two groups as regards the duration needed to return to the routine daily activities **[23]**.

Regarding postoperative complications in our study, we found that the laparoscopic group was associated with less complications like wound infection and postoperative ileus when compared to the open group. Whereas other complications like intraabdominal collection, incisional hernia and adhesive intestinal obstruction were comparable.

Wound infection occurred in 4.0% of patients of laparoscopic group versus 28.0% in open group. This difference was statistically significant. Our results are in accordance with results obtained by Singh et al., **[6]** who reported that incidence of wound infection was significantly higher after open appendectomy (17.5%) than laparoscopic appendectomy (2.5%).

Similar results were obtained by Rajyalakshmi et al., **[19]** who concluded that laparoscopic appendectomy was better than open appendectomy regarding postoperative wound infection.

The reduced incidence of wound infection is a major advantage of laparoscopic appendectomy. The extraction of specimen through the trocar port rather than directly through the surgical wound as done in open procedure can explain reduced incidence of infection. Moreover, the smaller size of laparoscopic incisions as compared to open also reduces the probability of infection **[6]**.

In our study, the incidence of postoperative ileus was higher in the open group (12.0%) than the laparoscopic group (4.0%) but without statistical significance.

Similar results were obtained by El Shayeb et al., **[22]** Who found that laparoscopic appendectomy was associated with fewer incidence of postoperative ileus compared to open appendectomy (0.0% versus 4.0%).

Singh et al., **[6]** reported significantly lower incidence of postoperative ileus after laparoscopic appendectomy (10.0%) than after open appendectomy (22.5%).

Minimal handling of bowel, less postoperative pain and earlier mobilization may explain the lower incidence of postoperative ileus after laparoscopic appendectomy.

In our study, postoperative intraabdominal collection occurred in 6.0% of patients of laparoscopic group and in 4.0% of patients of open group. This difference was not statistically significant.

In accordance, Horvath et al., **[24]** documented that intraabdominal abscess formation was more common in laparoscopic than open appendectomy. They explained that on the basis that carbon dioxide insufflation in laparoscopic procedure may facilitate spreading of microorganisms in the peritoneal cavity, especially in perforated appendicitis.

During the one year, at least, follow-up period, one case of the open group was presented with adhesive intestinal obstruction and was managed conservatively. Another one case of the same group developed an incisional hernia and was repaired electively with sublay mesh repair under spinal anesthesia. Incisional hernia and adhesive intestinal obstruction were not recorded in any patient of the laparoscopic group.

Our results are also in accordance with Ismail et al., **[21]** who reported non-significant higher incidence of incisional hernia after open appendectomy.

Tsao et al., found that the incidence of adhesive bowel obstruction after laparoscopic appendectomy

is significantly lower than after open appendectomy **[25]**.

However, Håkanson et al., reported that the risk for adhesive intestinal obstruction after appendectomy is significantly related to appendiceal perforation and postoperative intraabdominal abscess and not to the surgical approach **[26]**.

As regard the total number of complications in our study, it was significantly less in the laparoscopic group (14.0%) as compared to the open group (48.0%).

This result is consistent with those obtained by Singh et al., **[6]**, Ismail et al. **[21]** and Barrawy et al. **[27]**.

Sharma et al., **[9]** also, found that the total incidence of complications is higher after open appendectomy but with no statistical significance.

*Conclusion:*

Laparoscopic appendectomy is a safe and effective procedure in management of acute appendicitis. It is our belief that the laparoscopic approach, whenever feasible, is the more preferred option compared to conventional open appendectomy as it is superior in terms of less postoperative pain, shorter hospital stay, faster recovery to normal activities, and fewer complications especially in obese as well as muscular patients in whom open appendectomy represents a technical challenge.

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## دراسة مقارنة بين استئصال الزائدة الدودية بمنظار البطن الجراحى مقابل استئصالها بفتح البطن فى حالات التهاب الزائدة الدودية الحاد

يعد التهاب الزائدة الدودية الحاد هو السبب الجراحى الأكثر شيوعا لآلام البطن الحادة. ويتطلب لعاج هذه الحالات استئصال الزائدة الدودية. تعد عملية استئصال الزائدة الدودية هى واحدة من أكثر العمليات الجراحية شيوعا. وكما أن لاستخدام منظار البطن بعض المميزات مثل تقليل آلام ما بعد الجراحة، وتقليل حدوث عدوى الجرح، وتقليل تكون الالتصاقات داخل البطن بعد الجراحة ونتائج تجميلية أفضل إلا أنه له بعض العيوب كارتفاع التكاليف، وطول وقت العملية والاضطرار إلى التخدير العام.

الهدف من الدراسة: هو المقارنة بن استئصال الزائدة الدودية بالمنظار وفتح البطن فى عاج التهاب الزائدة الدودية الحاد من حيث الفعالية والسامة والمضاعفات بعد الجراحة والنتائج.

المرضى وطرق البحث: تم إجراء هذه الدراسة فى قسم الجراحة العامة بالمعهد الطبي القومي بدمنهور على ١٠٠ مريض يعانون من التهاب الزائدة الدودية الحاد حيث تم تقسيمهم بالتساوى عشوائياً إلى مجموعتن. فى المجموعة الأولى تم استئصال الزائدة باستخدام منظار البطن الجراحى والمجموعة الثانية تم استئصالها عن طريق فتح البطن. وتم تقييم الوقت المستغرق فى الجراحة والمضاعفات اثناء وبعد الجراحة وآلام ما بعد الجراحة وفترة المكوث بالمستتشفى والوقت الازم للعودة لممارسة الأنشطة اليومية.

الخلاصة: يعتبر استخدام منظار البطن الجراحى فى استئصال الزائدة الدودية هو الخيار الأفضل مقارنة باستئصال الزائدة الدودية التقليدى عن طريق فتح البطن خاصة فى المرضى الذين يعانون من السمنة المفرطة وكذلك المرضى ذوى البنية العضلية.