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Laparoscopic versus Open Appendectomy for Complicated Cases of Acute Appendicitis in Adults

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ABSTRACT

Background:Appendicitis is most frequently seen in patients in their second and third decades of lifebut it is quite rare in the young age, probably because the configuration of the appendix at this age makes obstruction of the lumen unlikely. There is a rough parallelism between the amounts of lymphoid tissue in the appendix and the incidence of acute appendicitis. The aim of the present study was toevaluate intra-operative difficulties and operative time in laparoscopic method versus open Appendectomy. Toassess post-operative bowel movement recovery, start of oral intake, resuming physical activity, length of hospital stay and analgesia use frequency in adults with complicated appendicitis.Patients and methods:A prospective cohort study was conducted on 26 adult patients with complicated acute appendicitis. Patients were divided into 13 patients for laparoscopic appendectomy (LA) and 13 patients for open appendectomy (CA) at Emergency unit of General surgery department ofZagazig University Hospitals. Before treatment, all patients were evaluated clinically by using "the modified Alvarado score", laboratory investigations and radiological investigations. Results: We found that the mean operating time in laparoscopic appendectomy was shorter than that in the open approach. The overall post-operative complications were lesser in laparoscopic group. The incidence of wound infection was in open group (15.4%). This finding supports the current surgical dogma that early treatment for appendicitis by laparoscopy is the best practice, to prevent further inflammation of the pelvis by removing the source of infection. Conclusion: LA constitutes a safe and feasible procedure for the treatment of CA. In the case of CA, endobags and endostapler should be used or the appendiceal stump should be inverted after applying Roeder knots.

Keywords:Acute Appendicitis; Laparoscopy Appendectomy; Open Appendectomy

INTRODUCTION

Acute appendicitis remains one of the most common emergencies requiring surgical intervention with an incidence of 8.6% for males and 6.7% for females**(1)**. Most cases present as simple non complicated acute appendicitis cases but about 25-30% of cases present as complicated acute appendicitis **(2).**In early 1980s, Semm described the first laparoscopic appendectomy (LA) then LA has evolved until became the routine treatment for non-complicated acute appendicitis due to its advantages in reducing postoperative pain, wound infection rates, hospital stay and also it gave more patient satisfaction compared to open appendectomy. These advantages have encouraged surgeons to use laparoscopic approach in complicated cases of acute appendicitis (**3**).

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Studies had reported reduced postoperative wound infection rates after LA compared to open appendectomy (OA) in complicated acute appendicitis, and were actually recommending it as the more favorable treatment for patientswith complicated acute appendicitis, the elderly and those withcomorbidities **(1).**Other studies reported that, using LA in complicated acute appendicitis is associated with increased rates of intra-abdominal abscess formation **(3).**

Therefore, this studyaimed to evaluate intra-operativedifficulties and operative time in laparoscopic method versus open Appendectomy. To assesspost-operativebowel movement recovery, start of oral intake, resuming physical activity, length of hospital stay and analgesia use frequency in adults with complicated appendicitis.

PATIENTS AND METHODS

This is a prospective cohort study that was conducted to compare between laparoscopic and open appendectomy in complicated cases of acute appendicitis in adults in 26 patients,13 patients for laparoscopic appendectomy and 13 patients for open appendectomy.It was conducted at Emergency unit of General surgery department of Zagazig University Hospitals.All patients signed a written informed consent.

Inclusion criteria:

All patients above 18 years old diagnosed as complicated acute appendicitis (perforated, gangrenous, causing intra- abdominal abscess, or peritionitis) either preoperatively or intraoperatively. Preoperative diagnosis was based on history, clinical examination, laboratory findings and ultrasonography, while intraoperative diagnosis was based on gross appearance.

Exclusion Criteria:

Pregnant females.Patients with non-complicated acute appendicitisand patient with previous abdominal operation.Patients unfit for surgery according to American Society of Anesthesiologists (ASA) as cardiovascular disease, pulmonary compliance, coagulopathy, etc…

Preoperative evaluation:

All patients were subjected to full history, complete clinical examinations,laboratory investigations and radiological investigestion includedultrasonography and CT.All patients received preoperative one gram of 3rd generation cephalosporins I.V, and 500 mg of Metronidazole I.V.

Operative Technique:

All patients underwent laparoscopic appendectomy had general anesthesia and muscle relaxant, but those of open appendectomy either general or spinal anesthesia. Also, skin preparation and draping was performed.

I-Open Appendectomy technique:

This operation performed via a lower midline or extended Mc Burney's incision. Muscle splitting was done in the direction of the abdominal wall muscle fibers.Peritoneum was incised after grasping with two curved mosquito forceps and

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abdomen was entered. If free peritoneal fluid was found, aspiration was done for culture and sensitivity.Finger dissection was used gently to release any inflammatory adhesions and release the omentum from the appendix.Interloop fibrous adhesions were released and the pus cavity was drained.When the cecum was identified, it was delivered through the wound.If the extraction of the cecum was difficult, possibility of lengthening the incision laterally and above the iliac crest had done.Mesoappendix was held and divided sequentially between curved mosquito forceps and ligated with absorbable sutures.The appendix was crushed at its base using Kocher forceps 5 mm above the cecum and then moving the forceps few millimeters distally.Double ligation was performed with absorbable sutures at the crushed portion, and then the appendix was excised proximal to the forceps using a scalpel with cauterization of mucosa of the remaining stump to prevent mucocele formation.If dissection of the appendix was still difficult, it could be divided near its base and the distal appendix was dissected in a retrograde manner.Suction/irrigation was carried out using sufficient saline solution.Drains inserted in pelvis through a separate stab incision.Wound was closed in layers with absorbable sutures.Skin was closed with non-absorbable sutures with subcutaneous drain if needed**(Figure 1)**.

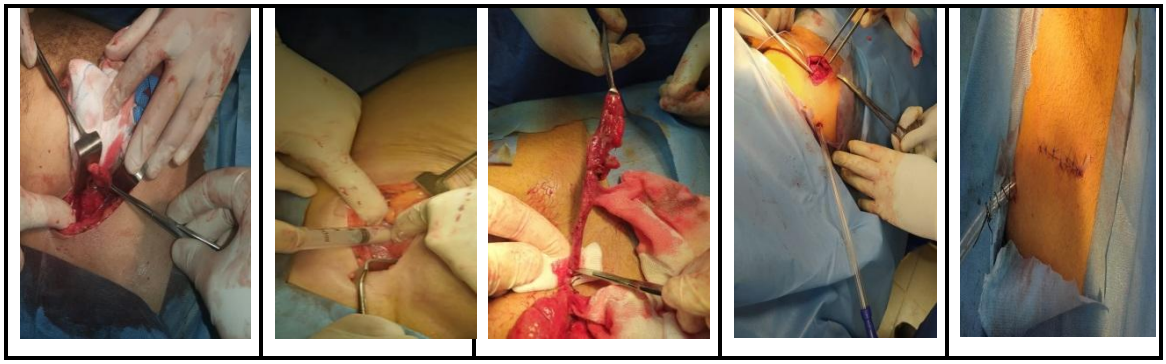

Figure (1): illustrating the steps of open appendectomy technique.

II- Laparoscopic Appendectomy technique:

It executed under the three-trocar protocol and 4th trocar if needed. After pneumoperitoneum had been obtained, a 10-mm umbilical port used for the camerathrough a semicircular incision around umbilicus and inspection of abdomen was done. Two working ports were introduced under direct vision; one to the suprapupic region at the midline (5-mm) & the other to the left lower quadrant at the level of the iliac spine (10-mm). The patient was turned to a Trendlenburg position with the right site slightly elevated approximately 30°. If purulent fluid was found, it was aspirated. After finding the appendix, the mesoappendix was grasped near the tip of the appendix towards the abdominal wall for full retraction of the appendix. Hook diathermy was used to divide the mesoappendix carefully from the distal end of the artery towards the cecal base.Base of appendix will be ligated by clipping, intra or extracorporeal roader knots followed by scissor cutting of appendix.The appendix was removed through the port.Interloop adhesions were released and the pus cavity was drained when encountered.Suction/irrigation was carried out if needed using sufficient saline solution till the aspirate become clear. Drains will be left in dependant spaces

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and this drains will be brought out through lt.iliac fossa port or suprapubic.The operative field was checked for haemostasis, abdomen was desufflated, trocars were removed and skin was closed with sutures**(Figure 2)**.

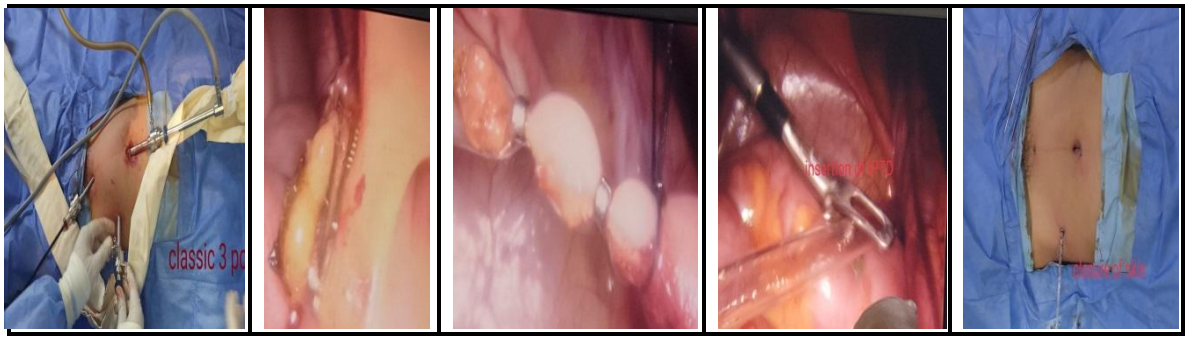

Figure (2): illustrating the steps of laparoscopic appendectomy technique

Postoperative care:

Post-operative treatment that include antibiotic 3rd-generation cephalosporins(Cefotaxime) 1 gm vial / 12 H I.V and Metronidazole 500 mg / 8 H I.V for 3-5 days or more according to need.Pain severity will be assessed every 6 hours using Visual analogue score (VAS) and Analgesia (Diclofenac 75 mg I.M) will be given accordingly.

Body temperature checked 6 hours starting immediately after surgery .Diabetic patients were given regular insulin based on blood glucose check every 6 hours. Vital signs are measured regularly. Patients were encouraged to walk in the 1st Post-operative day.WBCs and CRP will be checked every 24 hours starting from postoperative day 1.Oral intake will be introduced as soon as it would be tolerated and when bowel function become adequate without any signs of stump leakage.Wound care every 24 Hours.Recording the amount and nature of drain bag content every 24 hours and be changed every 24 hours and removed when it contains less than 30 ml/ 24 Hours.

Hospital stay and patient discharge:

1) Hospital stay ranged between 2 to 8 days .The patient were discharged when both oral intake and physical activity had recovered sufficiently, body temperature, WBCs, CRP start to decrease , no further complaint from pain. Ultrasonography had been done and accepted. The patient will be given telephone number for contact when need.

Postoperative complications:

1- Intra abdominal collection occurred in 2 cases through open appendectomy compared to 1 case in laparoscopic appendectomy that all had been managed by conserve treatment.

2-Wound dehiscence occurred in 1 case through open appendectomy compared to no cases in laparoscopic appendectomy that was managed by secondary suture technique after become completely clean.

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3-Paralytic ileus occurred in 2 cases through open appendectomy compared to no cases in laparoscopic appendectomy that managed by conserve ttt(NPO, Fluids, ryle, urinary catheter).

Follow-up:

1-All patients had followed up every week for at least 30 days after discharge.

2- Follow up was carried out in outpatient clinic to check their general condition , local examination, drain if the patient was discharged with it, change wound dressings, check wound problems wither surgical site occurrences (wound infection, wound dehiscence, seroma, drain and stitches removal.

Statistical analysis:

Data analyzed using Microsoft Excel software then imported into Statistical Package for the Social Sciences (SPSS version 20.0) software for analysis. According to the type of data qualitative represent as number and percentage , quantitative continues group represent by mean±SD. Differences between quantitative independent multiple by ANOVA or Kruskal Wallis,. P value was set at <0.05 for significant results &<0.001 for high significant result.

RESULTS

Age was distributed as 33.15±10.04 and 27.69±8.18 respectively between open group and lab group with no significant difference between groups also there was no significant difference regard sex and smoking **(Table 1).**

No significant difference between groups and all patients had pain rigidity, Tenderness and Rebound tenderness **(Table 2).** Lap group was significantly shorter than Open group regard operation time **(Figure 3)**.

Regarding intra-operation characters, there are no differences between them**(Table 3).** Tear and bleeding were more in Open group but not significantly and only one case from Lab group need conversion to open **(Table 4).**

Regardingdrain character**,**there are no differences between them **(Table 5).**Overall complication was significantly associated with Open group **(Table 6).**

There are no differences between groups in US investigation **(Table 7).**Satisfaction was significantly associated with Lab group**(Table 8).**

Table1: Demographic data distribution between studied groups

			Open group	Lab Group	t/ X^2	P
Age			**33.15±10.04**	**27.69±8.18**	**1.519**	**0.142**
Sex	**Female**	**N**	**6**	**7**		
		%	**46.2%**	**53.8%**		
	Male	**N**	**7**	**6**	**0.15**	**0.69**
		%	**53.8%**	**46.2%**		
Special habit	**No**	**N**	**10**	**8**		
		%	**76.9%**	**61.5%**		
	Smoker	**N**	**3**	**5**	**0.72**	**0.39**
		%	**23.1%**	**38.5%**		
Total		**N**	**13**	**13**		
		%	**100.0%**	**100.0%**		

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Table2: clinical characters distribution between studied groups

			Group		X^2	P
			Open Group	Lab Group		
Pain	No	N	0	0		
		%	0.0%	0.0%		
	Yes	N	13	13	0.00	1.00
		%	100.0%	100.0%		
anorexia	No	N	3	4		
		%	23.1%	30.8%		
	Yes	N	10	9	0.19	0.65
		%	76.9%	69.2%		
nausea	No	N	3	5		
		%	23.1%	38.5%		
	Yes	N	10	8	0.72	0.39
		%	76.9%	61.5%		
vomiting	No	N	9	8		
		%	69.2%	61.5%		
	Yes	N	4	5	0.17	0.68
		%	30.8%	38.5%		
Fever	No	N	2	5		
		%	15.4%	38.5%		
	Yes	N	11	8	1.75	0.18
		%	84.6%	61.5%		
Dysuria	No	N	10	10		
		%	76.9%	76.9%		
	Yes	N	3	3	0.00	1.00
		%	23.1%	23.1%		
Tenderness	No	N	0	0		
		%	0.0%	0.0%	0.00	1.00
	Yes	N	13	13		
		%	100.0%	100.0%		
Rebound tenderness	No	N	0	0		
		%	0.0%	0.0%	0.00	1.00
	Yes	N	13	13		
		%	100.0%	100.0%		
guarding	No	N	8	5		
		%	61.5%	38.5%		
	Yes	N	5	8	1.38	0.23
		%	38.5%	61.5%		
Rigidity	No	N	12	12		
		%	92.3%	92.3%	0.0	1.0
	Yes	N	1	1		
		%	7.7%	7.7%		
Rovsing sign	No	N	9	10		
		%	69.2%	76.9%		
	Yes	N	4	3	0.19	0.65
		%	30.8%	23.1%		
Psoas sign	No	N	8	7		
		%	61.5%	53.8%		

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	Yes	N	5	6	0.15	0.69
		%	38.5%	46.2%		
Zachary sign	No	N	9	11		
		%	69.2%	84.6%		
	Yes	N	4	2	0.86	0.35
		%	30.8%	15.4%		
Total		N	13	13		
		%	100.0%	100.0%		

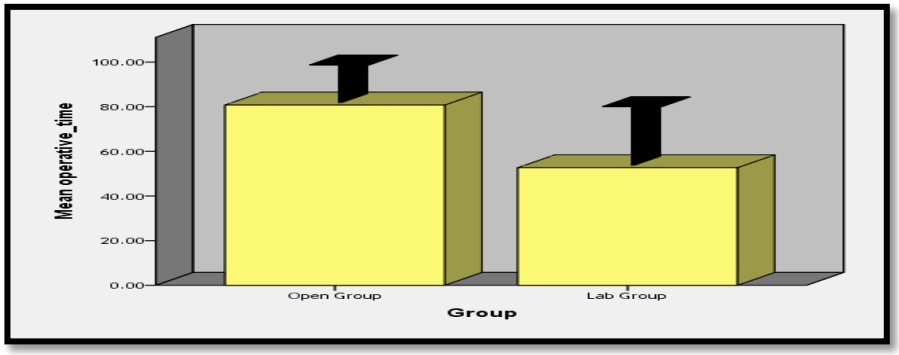

Figure (3): Operation time distribution between studied groups

Table 3: Intra-operation characters distribution between studied groups

			Group		X^2	P
			Open Group	Lab Group		
Normal		N	0	0	0.0	1.0
		%	0.0%	0.0%		
Inflamed		N	0	0	0.0	1.0
		%	0.0%	0.0%		
Perforated		N	6	3	1.52	0.21
		%	46.2%	23.1%		
Gangrenous		N	1	5	3.46	0.063
		%	7.7%	38.5%		
Appendicular abscess		N	6	5	0.42	0.58
		%	46.2%	38.5%		
Position appendix	Pelvic	N	4	3		
		%	30.8%	23.1%		
	Retrocecal	N	9	10	0.19	0.65
		%	69.2%	76.9%		
Total		N	13	13		
		%	100.0%	100.0%		

Table 4: Complication distribution between studied groups

			Group		X^2	P
			Open Group	Lab Group		
Serosal tear	No	N	9	11		
		%	69.2%	84.6%		
	Yes	N	4	2	0.86	0.35
		%	30.8%	15.4%		
Bleeding	No	N	10	12		
		%	76.9%	92.3%		

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	Yes	N	3	1	1.18	0.27
		%	23.1%	7.7%		
Adhesion	No	N	8	9		
		%	61.5%	69.2%	0.17	0.68
	Yes	N	5	4		
		%	38.5%	30.8%		
Cecal mass	No	N	13	13		
		%	100.0%	100.0%	0.00	1.0
	Yes	N	0	0		
		%	0.0%	0.0%		
Ovarian cyst	No	N	11	11		
		%	84.6%	84.6%		
	Yes	N	2	2	0.00	1.0
		%	15.4%	15.4%		
Total		N	13	13		
		%	100.0%	100.0%		

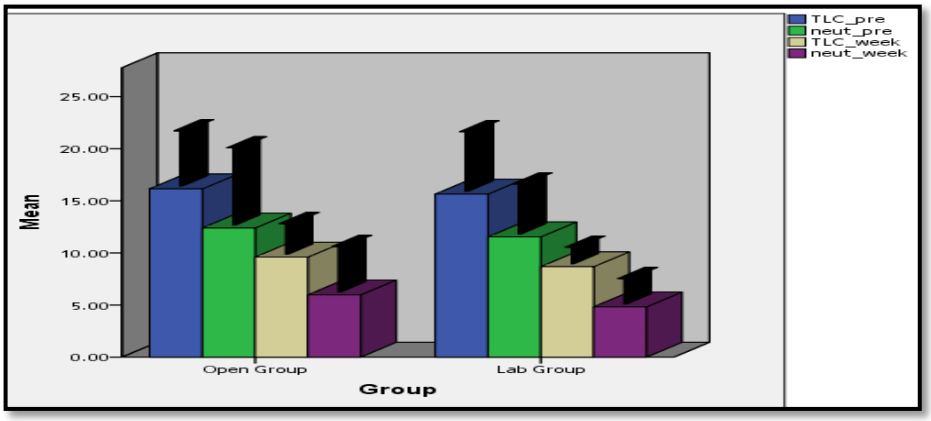

Figure (4): TLC and Neutrophil distribution pre and after one week between studied groups

Table 5: Drain character between studied groups

			Open Group	Lab Group	t/ X^2	P
Drains			75.0±27.68	69.23±23.15	0.556	0.583
Nature	Non	N	9	12		
		%	69.2%	92.3%		
	Infected	N	4	1	2.22	0.13
		%	30.8%	7.7%		
Total		N	13	13		
		%	100.0%	100.0%		

Table 6: Complication distribution between studied groups

			Group		X^2	P
			Open Group	Lab Group		
Complications	No	N	5	11		
		%	38.5%	84.6%		
	Incisional hernia	N	1	1		

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		%	7.7%	7.7%		
	Intra-abdominal collection	N	2	1		
		%	15.4%	7.7%		
	Paralytic ileus.	N	2	0	7.58	0.18
		%	15.4%	0.0%		
	Wound dehiscence	N	1	0		
		%	7.7%	0.0%		
	Wound infection	N	2	0		
		%	15.4%	0.0%		
Overall Complicated	Not	N	5	11	5.82	0.015*
		%	38.5%	84.6%		
	Complicated	N	8	2		
		%	61.5%	15.4%		
Total		N	13	13		
		%	100.0%	100.0%		

Table 7: US Investigation between studied groups

			Group		X^2	P
			Open Group	Lab Group		
US week	Free	N	7	9		
		%	53.8%	69.2%		
	Finding	N	6	4	0.65	0.42
		%	46.2%	30.8%		
Total		N	13	13		
		%	100.0%	100.0%		

Table8: Patient satisfaction distribution between studied groups

			Group		X^2	P
			Open Group	Lab Group		
Patient satisfaction	Not satisfied	N	8	2		
		%	61.5%	15.4%		
	Satisfied	N	5	11	5.85	0.016*
		%	38.5%	84.6%		
Total		N	13	13		
		%	100.0%	100.0%		

DISCUSSION

Approximately 6% of the population develop appendicitis in their life time, with peak incidence between the ages of 10 and 30 years, thus making appendectomy the most frequently performed abdominal operation **(4).**

Open appendectomy has been the treatment of choice for more than a century. Laparoscopic appendectomy has been shown to be feasible and safe in randomized comparisons with open appendectomy in many studies **(5).**

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Perforated appendicitis is associated with increased morbidity rates. The surgical management of CA generally requires a larger abdominal incision and longer operating time, with increased surgical stress to patients, compared with surgery for uncomplicated appendicitis **(6).**

The effectiveness of the laparoscopic approach for CA has been extensively studied. However, the role of laparoscopy in CA is still undefined due to lack of high-level evidence (e.g., randomized controlled trials). The present randomized controlled trial addressed the issue as to whether LA for CA effectively reduces the incidence of postoperative complications and improves various measures of postoperative recovery in adults in comparison with OA **(7).**

Several studies have shown the efficacy and safety of laparoscopic appendectomy as well as the advantages such as reduced hospital stay, earlier recovery, less intra-abdominal adhesions and a better cosmetic outcome. However, unlike laparoscopic cholecystectomy, laparoscopic appendectomy has not yet gained popularity. Laparoscopic cholecystectomy is now considered a standard method of performing cholecystectomy and has mostly replaced the old method throughout the world, while appendectomy has yet to achieve such popularity **(8).**

This prospective randomized study was done in the surgical emergency unit of Zagazig University Hospitals. This study was carried 26 cases suffering from complicated acute appendicitis (perforated, gangrenous, causing intra- abdominal abscess, or peritonitis), open appendectomy OA "group A" was the procedure in 13 patients and laparoscopic appendectomy LA "group B" was in 13 patients).

This study included all cases of complicated acute appendicitis (perforated, gangrenous, causing intra- abdominal abscess, or peritonitis) above 18 years old. Age was distributed as 33.15±10.04 and 27.69±8.18 respectively between open group and lap group with no significant difference between groups also there was no significant difference regarding sex and smoking as a special habit.

In our study, the most common presenting symptoms was pain in the right iliac fossa in all patients of both groups associated with anorexia in 10 (76.9%) cases in OA, 9 (69.2%) cases in LA group. Nausea in 10 (76.9%) cases of OA group, 8 (61.5%) cases in LA group.Vomiting in 4 (30.8%) cases in OA group, 5 (38.5%) cases in LA group.Fever in 11 (84.6%) cases in OA group, 8 (61.5%) cases in LA group. Dysuria in 3 (23.1%) cases in both groups equally.

In this study, the most common presenting signs was localized tenderness and rebound tenderness which were found in all patients of both groups with muscle guarding in 5 (38.5%) in OA group, 8 (61.5%) in LA group associated with rigidity found in only one case (7.7%) of both groups equally.

Rovsing's sign was positive in 4 (30.8%) cases f OA group. 3 (23.1%) in LA group. Psoas sign in 5 (38.5%) in OA group, 6 (46.2%) in LA group. Zachary sign in 4 (30.8%) in OA group. 2 (15.4%) in LA group. No significant difference between groups regarding signs nor symptoms.

In our study, we found preoperatively that there was increase in total leucocytic count (> 12 $x10^3$ /mm^3) with mean values 16.14±2.69 and 15.64±2.90 in OA group and LA respectively and increase in neutrophil percentage with mean values

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12.39±3.75 in OA group and 11.53±2.45 in LA group. CRP was 60.61±17.03 and 46.92±17.44 in OA group and LA group respectively.

One week post-operative, there was a decrease in these values in both groups as the mean TLC was 9.60±1.52 in OA group and 8.67±0.84 in LA group. Neutrophil percentage was 5.97±1.89 in OA group and 4.82±1.27 in LA group. While CRP was found to be 17.0±5.89 in OA group and 10.53±3.45 in LA group with no statistically significant difference between two groups regarding pre and post-operative values.

In this study revealed that there was a significant difference regarding operative time with PV (0.005) in OA 80.76±8.62, in LA group 53.38±15.52 minutes. So, a shorter operative time was in LA group than OA group. This is consistent with study made by **Horvath et al.(9)** where the mean operative time was (64.5 and 60 mins) in OA and LA groups respectively. Some studies reported a longer and some a shorter operative time for LA than for OA **Garg et al.(10) and Clavien et al.(11)**. These heterogeneous results might be explained by different laparoscopic skill levels in the authors. What we found in our study population is that in the presence of perforation the operative times were synchronously extended in both groups.

Operative time was significantly longer with LA than with OA (84.6 ± 34.57 and 63.5 ± 20.76)respectivelyin **Yoshiro et al.(12).** While two studies done by **Alfredo et al.(13)and Kehagiaset al.(14)**there was no difference in the operative time between the laparoscopic group and open group .This may be related to the experience of the surgeon as the operative time decreased successively throughout this work with increase in the learning curve.

Regarding the intra-operative characters distribution between studied groups, there was no significant difference between two groups as we found perforated appendix in 9 cases; 6 (46.2 %) cases of OA group and 3 (23.1%) in LA group. Gangrenous appendix in 6 cases; 1 (7.7%) in OA group and 5 (38.5%) in LA group.Appendicular abscess formation in 11 cases totally; 6 (46.2%) in OA group and 5 (38.5%) in LA group.

The site of the appendix was pelvic in 7 cases; 4 (30.8%) in OA group and 3 (23.1%) in LA group. Retrocecal appendix in 19 cases totally; 9 (69.2%) in OA group and 10 (76.2%) in LA group.

In all patients in the OA and in the LA group a drain was inserted for a median time about 75.0±27.68, 69.23±23.15 hrs respectively. 4 cases out of 13 in the OA group had infected drain content (30.8%). But, only one case in the LA group (7.7%) had infected drain content.

Post-operative complications were discussed including incisional hernia, wound dehiscence, surgical site infection (SSI), paralytic ileus (PI) and intra-abdominal abscess / collection (IAA). Overall there were significantly less post-operative complications with LA than OA. In the OA group, 8 (61.5%) cases out of 13 cases had complications; 2 (15.4%) had SSI, 2 had PI, 2 had IAA, 1 patient had wound dehiscence and another one had incisional hernia. Where in LA group, only 2 (15.4%) cases were complicated. One of them had IAA and the other had incisional hernia.

Suppression of wound infection and reduction in the hospital stay have been emphasized as major benefits of LA for CA **(15).**

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Consistent with other studies SSI occurred more often in the OA group (**16)** reaching statistical significance in our study population. The main reasons for the significantly larger number of SSI in the OA group might be the direct trauma to the wound and the fact that during LA the specimen is removed using an endobag**(9).**

In order to perform the resection during OA the inflamed appendix has to be luxated out of the abdomen, which may contribute to contamination of the surrounding tissue. Furthermore, the laparoscopic approach creates a far smaller operative trauma than does OA. None of the patients had to be re-operated due to SSI, but were manageable with antibiotics and bedside wound treatment **(9).**

In our study **2 (15.4%)** cases exclusively had SSI in OA group. This is consistent with study by **Horvath et al.(9)**where there was higher incidence of SSI in OA but not in LA group. But in study made by **Yoshiro et al.(12)**surprisingly, the rate of incisional SSI was not reduced in the LA group. He explained that disadvantages of OA may have been overestimated because of potential bias concerning disease severity, antibiotics, analgesics, or surgeons in previous retrospective studies. An explanation for the relatively higher (but not significant) rate of incisional SSI in LA than in OA may be that the incidence of wound infection was effectively suppressed in the OA group to a level lower (7.7 %) than we expected compared with data in previous reports (**17)**.

The wound protection system applied in all cases in OA may have contributed to the inhibition of incisional SSI in that group. On the other hand, no protective device against contaminated fluid or irrigation with saline could be applied to the small trocar wounds in LA, except for an endoscopic bag to extract the resected specimen **(18).**

It is plausible that LA for perforated appendicitis should result in a decreased incidence of IAA because the abdominal cavity can be better visualized and a more thorough washout can be performed. However, a higher incidence of IAA formation following the use of laparoscopy has been reported **Yeomet al.(19)**, which possibly has hampered LA being adopted as a standard procedure for CA.

Also in **Yoshiro et al.(12)**showed that the rates of organ/space SSI, with or without stump leakage, were similar between the study groups, with a comparable incidence of reoperation.

In **Horvath et al.(9)**two and ten patients developed postoperative IAA in the OA and the LA group, respectively ($p = 0.002$). But in this study, 2 (15.4%) cases developed IAA in OA and only one patient (7.7%) in LA group had IAA.

In our study, PI was also exclusively found in OA group as 2 (15.4%) patients had PI (acute abdominal pain, nausea, vomiting). This is consistent with **Horvath et al.(9)**who found more PI in the OA than in the LA group (5 vs. 1 patient).

Patients in both groups were urged to walk as early as possible after surgery in accordance with the same postoperative program for recovery of physical activity. So, patients had LA were more satisfied than OA group (84.6% and 38.5%) respectively.

CONCLUSION

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LA constitutes a safe and feasible procedure for the treatment of CA. In the case of CA, endobags and endostapler should be used or the appendiceal stump should be inverted after applying Roeder knots.

Furthermore, local irrigation in supine position should be performed carefully in order to further minimize the occurrence of IAA in LA. While a distinguishing benefit of LA was not validated in this clinical trial. A further study would be needed to clarify the effectiveness of LA for CA.

No Conflict of interest.

REFERENCES:

1- **Wang, D., Dong, T., Shao, Y., Gu, T., Xu, Y., and Jiang, Y.,(2019):**Laparoscopy versus open appendectomy for elderly patients, a meta-analysis and systematic review. BMC Surg 19, 54.

2- **Talha, A., El-Haddad, H., Ghazal, A., and Shehata , G.,(2020):** Laparoscopic versus open appendectomy for perforated appendicitis in adults: randomized clinicaltrial. SurgEndosc 34, 907–914.

3- **Athanasiou C, Lockwood S and Markides GA (2017):** Systematic review and meta- analysis of laparoscopic versus open appendicectomy in adults with complicated appendicitis: an update of the literature. World J Surg 41(12):3083–3099**.**

4- **Kumar B, Samad A, Khanzada T and Shaikh A (2008): "**Superiority of Laproscopic appendectomy over open appendectomy the Hyderabad experience" Rawal Med J., 33: 165-8.

5- **Shaikh A, Sangrasi A and Shaikh G (2009):** "Clinical Outcomes of Laparoscopic Versus Open Appendectomy" JSLS, 13(4): 574- 580.

6- **Lin HF, Lai HS, Lai IR (2014):** Laparoscopic treatment of perforated appendicitis. World J Gastroenterol 21(20):14338–14.

7- **Vahdad MR, Troebs RB, Nissen M, Burkhardt LB, Hardwig S, Cernaianu G (2013):** Laparoscopic appendectomy for perforated appendicitis in children has complication rates comparable with those of open appendectomy. J PediatrSurg 48:555–561.

8- **Guller U, Hervey S and Purves H (2004):** "Laparoscopic versus open appendectomy: outcomes comparison based on a large administrative database" Ann Surg., 239:43-52.

9- **Horvath P, Lange J, Bachmann R, Struller F, Ko¨nigsrainer A, Zdichavsky M (2016):** Comparison of clinical outcome of laparoscopic versus open appendectomy for complicated appendicitis. SurgEndosc (2016).

10- **Garg CP, Vaidya BB, Chengalath MM (2009):** Efficacy of laparoscopy in complicated appendicitis. Int J Surg 7:250–252.

11- **Clavien PA, Barkun J, de Oliveira ML, Vauthey JN, Dindo D, Schulick RD, de Santiban˜es E, Pekolj J, Slankamenac K, Bassi C, Graf R, Vonlanthen R, Padbury R, Cameron JL, Makuuchi M (2009):** The Clavien-Dindo classification of surgical complications: five-year experience. Ann Surg 250:187–19**.**

ISSN 2515-8260 Volume 08, Issue 04, 2021

12- **Yoshiro Taguchi, Shunichiro Komatsu, Eiji Sakamoto, Shinji Norimizu, Yuji Shingu and Hiroshi Hasegawa (2016):** Laparoscopic versus open surgery for complicated appendicitis in adults: a randomized controlled trial. SurgEndosc (2016) 30:1705- 12.

13- **Alfredo M, Carbonell D, Justin M, Amy E, Kristi L and Harold T (2004):** "Outcomes of laparoscopic versus open appendectomy" the Carolinas laparoscopic and advanced surgery program, department of general surgery, 70:759-766.

14- **Kehagias I, Karamanakos S and Kalfarentzos F (2008):** "Laparoscopic versus open appendectomy: which way to go?" World J Gastroenterol., 14: 4909.

15- **Tiwari MM, Reynoso JF, Tsang AW, Oleynikov D (2011):** Comparison of outcomes of laparoscopic and open appendectomy in management of uncomplicated and complicated appendicitis. Ann Surg 254:927–932.

16- **Zdichavsky M, Go¨gele H, Blank G, Kraulich M, Meile T, von Feilitzsch M, Wichmann D, Ko¨nigsrainer A (2013):** Histological characterization of appendectomy specimens with intraoperative appearance of vascular injection. SurgEndosc 27:849–853.

17- **Markides G, Subar D, Riyad K (2010):** Laparoscopic versus open appendectomy in adults with complicated appendicitis: systematic review and meta-analysis. World J Surg 34:2026–2040.

18- **Edwards JP, Ho AL, Tee MC, Dixon E, Ball CG (2012):** Wound protectors reduce surgical site infection: a meta-analysis of randomized controlled trials. Ann Surg 256:53–5

19- **Yeom S, Kim MS, Park S, Son T, Jung YY, Lee SA, Chang YS, Kim DH, Han JK (2014):** Comparison of the outcomes of laparoscopic and open approaches in the treatment of periappendiceal abscess diagnosed by radiologic investigation. J LaparoendoscAdvSurg Tech A 24:762–769.