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Laparoscopic Versus Open Appendectomy for Complicated Appendicitis in Pediatric age group

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ORIGINAL ARTICLE

Laparoscopic Versus Open Appendectomy for Complicated Appendicitis in Pediatric age group

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Abstract

Background: ***In the pediatric age range, the most prevalent abdominal ailment needing surgery is acute appendicitis. The lifetime risk of acquiring appendicitis is 1 in 14 (7%).***

Aim and objectives: ***To assess the intraoperative and postoperative Results of open and laparoscopic appendectomy for complicated appendicitis in pediatrics.***

Patients and methods: ***This was prospective research conducted on 40 pediatric patients with complicated appendicitis presented to emergency clinics of the Pediatric Surgery Department at Al-Azhar University.***

Results: ***No statistically substantial variation was observed between the two groups in terms of age and gender ($p>0.05$). No substantial variation was found between the two groups regarding ultrasound findings ($p>0.05$). Operative time was substantially greater in the laparoscopic appendectomy group compared to the open appendectomy group ($p<0.001$). In addition, The open appendectomy group saw a considerably greater rate of drain placement than the laparoscopic appendectomy group ($p<0.001$). Compared to the laparoscopic appendectomy group, the open appendectomy group saw a considerably greater rate of hospital stay recovery ($p<0.001$). Additionally, the group that underwent open appendectomy had a considerably longer hospital stay than the group that underwent laparoscopic appendectomy ($p<0.001$). In comparison to the laparoscopic appendectomy group, the open appendectomy group experienced substantially more wound infections and ileus ($p=0.001$ and $p=0.022$, respectively).***

Conclusion: ***We conclude that With modest and less severe postoperative consequences compared to open surgery, laparoscopic surgery has shown to be the preferred method for treating difficult appendicitis in younger children***

Keywords: Laparoscopic appendectomy; Open appendectomy; Complicated Appendicitis; Pediatric age group

1. Introduction

In the pediatric age range, the most prevalent abdominal ailment needing surgery is acute appendicitis. The lifetime risk of acquiring appendicitis is 1 in 14 (7%).[1]

The frequency of acute appendicitis varies according to age group, with rates as low as one to six cases per 10,000 children under four and as high as 19 to 28 cases per 10,000 children under fourteen.[2]

Acute appendicitis can range from mild inflammation to severe perforation. The pathology begins with a blockage of the appendix lumen caused by a variety of factors such as fecal debris (fecalith), lymphoid hyperplasia, foreign substances, or parasites.[3]

Surgical treatment for appendicitis has always involved an open appendectomy; this was the case when McBurney first published his method in 1893. (McBurney, 1893) Approximately a century later, in 1983, German gynecologist Semm carried out the first laparoscopic appendectomy.[4]

For complex appendicitis, laparoscopic appendectomy offers several benefits, such as improved abdominal visualization, a lower risk of surgical site infection, a shorter hospital stay, less pain following surgery, a quicker return to physical activity, and a notable increase in patient and family satisfaction with improved cosmetic outcomes.[5]

Wound infection and intra-abdominal abscess are the most frequent consequences.[6]

This research aimed to compare the intraoperative and postoperative Results of open and laparoscopic appendectomy for complicated appendicitis in pediatrics.

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2. Patients and methods

This prospective study involved forty young patients who arrived at the pediatric surgery department's emergency clinics at Al-Azhar University with severe appendicitis.

Inclusion criteria: Age: less than 14 years old, Sex: both, Cases of complicated appendicitis who underwent ultrasound examination, which showed ultrasonographic features that included the appendiceal wall diameter, peri appendiceal fat inflammation,

Free abdominal fluid, abscess, conglomerate, appendicolith and lymphadenitis. 7

Exclusion criteria: Instances of intense, straightforward, 14 years of age or older, Individuals who have undergone significant abdominal surgery in the past, and those who are not suitable for laparoscopy appendectomy.

Randomization

This study was carried out on 40 pediatric patients complaining of appendicitis who were divided into two equal groups: Group A: 20 patients underwent open appendectomy. Group B: 20 patients underwent laparoscopic appendectomy.

Ethical Consideration

The Ethical Research Committee of Al-Azhar University gave its approval to the project. The patient and family were given a thorough explanation of the study's methods and objectives. Written informed permission was acquired prior to patient recruitment in the research—the family's unwillingness to approve an appendectomy using any method.

Methods

Every patient was exposed to the following:

Full history taking (individual history, family background, the complaint's duration, current historical context, previous medical records, prior surgical experience, a history of drug sensitivity, When, how, and how long stomach discomfort and fever last), Physical examinations, General examination, Local examination (Abdominal tenderness, localization of the pain, rebound tenderness, Psoas sign, Obturator internus sign and Rovsing sign), modified scores, Investigational Studies (Laboratory and Radiological) and Ultrasound examination for complicated Appendicitis.

Ultrasound examination [7]

Ultrasonographic features that were standardly examined included the appendiceal wall diameter, peri appendiceal fat inflammation, free abdominal fluid, abscess, conglomerate, appendicolith and lymphadenitis. Therefore, the appendiceal diameter was measured from the outer wall to the outer wall. Appendiceal wall edema was defined as an obliteration of the layers. Periappendiceal fat inflammation was diagnosed when an increased echogenicity of the periappendiceal tissue was observed. Free abdominal fluid was defined as both simple and complex localized fluid, whether in direct proximity to the appendix or not.

In contrast, an abscess was diagnosed when a walled-off accumulation of peri appendiceal fluid was identified. A conglomerate is defined as an appendix grouped with or indistinguishable from other intestinal structures. An appendicolith was diagnosed when an intraluminal hyperechogenic focus with an acoustic shadow was identified. Lymphadenitis was defined as sonographically detectable lymph nodes.

Pre-operative preparations

Six hours before the procedure, the patient should fast and maintain hydration and electrolyte balance. Broad-spectrum antibiotics should also be administered.

Operative techniques

Open Appendectomy technique

The conventional Open technique through transverse Lanz's incision or McBurney's incision was done. The abdominal wall was the direction of muscle splitting. Using two curved mosquito forceps, the peritoneum was grasped, and the abdomen was penetrated. Gently dissecting fingers was done. Once the cecum was located, interloop adhesions were removed, and the pus chamber was drained. The front teeth were held in place. Suppose the cecum's extraction proved challenging. Attachments could be incised inferior and lateral under direct vision. Meso appendix was held with Babcock forceps. Kocher forceps were used to crush the appendix at its base, advancing the forceps a few millimeters distally after crushing it 5 mm above the cecum. The appendix was removed with a knife just in front of the forceps after a double ligation was completed at the crushed part using absorbable sutures. The appendix might be split close to its base, and the distal appendix may be dissected retrogradely if removal proves to be still difficult. After performing irrigation and suction, the wound was bandaged in layers using absorbable sutures. The skin was sutured shut using non-absorbable threads.

Laparoscopic Appendectomy

The procedure involved a three-trocar, two-handed laparoscopic appendectomy. Following the acquisition of pneumoperitoneum, the abdomen was examined before a 5-mm port for a laparoscopic camera was inserted through a semicircular incision to the top edge of the umbilicus. Under direct vision, two working ports were inserted: one 5 mm in the suprapubic area at the midline and the other 5 mm, or 10 mm if endocarps were to be used, in the left lower quadrant at the level of the iliac spine. The patient was placed in an accommodating Trendelenburg posture. Purulent fluid was aspirated if detected. Following the appendix's formation, the mesoappendix was fully retracted by grasping it

close to its tip and moving it toward the abdominal wall. The mesoappendix was meticulously divided using hook diathermy, starting from the distal end of the artery and working its way toward the cecal base. The appendix might be tractioned. The appendix was sharply split between them after the base was ligated, either by intracorporeal sutures, endocarps using a clip applier, or laparoscopic pre-tied loop sutures in young children. The pus cavity was drained, and interloop adhesions loosened. If necessary, irrigation or suction was done. Hemostasis in the operating area was examined.

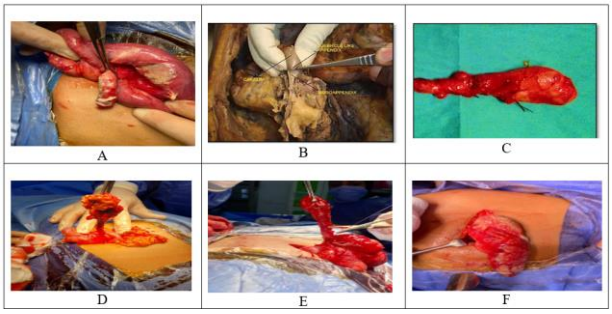

Figure 1. Showing open appendectomy a) the caecum, as viewed from its apex, with its tubercle-like appendix b) the Appendix with full visible diverticula, c) suppurative appendicitis, d) suppurative appendix with omental adhesion, e) suppurative appendix with tie suture over healthy base, suppurative appendix with tie suture over healthy base.

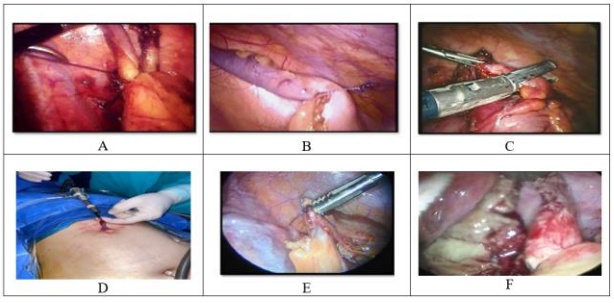

Figure 2. Showing laparoscopic appendectomy, A) demonstrating the ligation of the appendix's base using two applications of a homemade, 2/0 vicryl endo-loop With B) sliding knot, C) Stapling technique of laparoscopic appendectomy, D) extraction of appendix from umbilical port, E) the appendicular stump after appendectomy, F) Gangrenous appendicit.

Postoperative care

Intravenous antibiotics (a third- or fourth-generation cephalosporin at a dosage of 100 mg/kg/day) were administered to all patients. 7.5 mg/kg of metronidazole every eight hours, along with 15 mg/kg of paracetamol every six hours for analgesia. As soon as the patients could bear it, oral intake was initiated after the restoration of bowel function. Usually, the drain was cleared in 48 to 72 hours. In the event that the patient's abdomen was relaxed and did not swell. Following 24 hours of fecundity, the patients were released to resume a regular diet and showed a return of their white blood cell count to normal.

Outcome Measurements and Follow-up

The patient was followed up after one week, one month and three months of operation with routine periodic assessment. In follow-up visits, the patient was assessed for any complications, time of recovery, postoperative pain, and wound complications in both groups.

3. Results

The mean age was 10.15± 2.80 years in open appendectomy group and 10.60± 1.96 years in laparoscopic appendectomy group. There were 70% males and 30% females in open appendectomy group while there were 70% males and 30% females in laparoscopic appendectomy group. No statistically significant difference was observed between the two groups regarding age, and gender (p>0.05) Table 1

Table 1. Features of the two analyzed populations' demographics.

VARIABLE		GROUP (A) OPEN APPENDECTOMY GROUP (N=20)		GROUP (B) LAPAROSCOPIC APPENDECTOMY GROUP (N=20)		TEST VALUE	P-VALUE
		No.	%	No.	%		
GENDER	Male	14	70.0%	14	70.0%	X^2= 0.00	>0.999
	Female	6	30.0%	6	30.0%		(NS)
AGE (YEARS)	Mean± SD	10.15± 2.80		10.60± 1.96		T = 0.590	0.559 (NS)
	Range	5 - 14		5 - 14			

P value >0.05: Not significant (NS), SD: Standard deviation, X2: Chi-Square Test, T: Student T Test

In open appendectomy group, all patients had signs of inflamed appendix and inflamed L.Ns, all of them had fluid collection and 85% patients had omental reaction while in laparoscopic appendectomy group, all patients had signs of inflamed appendix and inflamed L.Ns, all of them

had fluid collection and 70% patients had omental reaction. No significant difference was found between the two groups regarding Ultrasound findings (p>0.05) Table 2

Table 2. Ultrasound findings among the two studied groups.

ULTRASOUND FINDINGS		GROUP (A) OPEN APPENDECTOMY GROUP (N=20)		GROUP (B) LAPAROSCOPIC APPENDECTOMY GROUP (N=20)		CHI-SQUARE TEST	
		No.	%	No.	%	Test value (X^2)	P-value
SIGNS OF INFLAMED APPENDIX	No	0	0%	0	0%	-	-
	Yes	20	100%	20	100%		
FLUID COLLECTION	No	0	0%	0	0%	-	-
	Yes	20	100%	20	100%		
OMENTAL REACTION	No	3	15.0%	6	30.0%	1.290	0.256 (NS)
	Yes	17	85.0%	14	70.0%		
INFLAMED LNS	No	0	0%	0	0%	-	-
	Yes	20	100%	20	100%		

P value >0.05: Not significant (NS), P value <0.05 is statistically significant (S), p<0.01 is highly significant (HS). X2: Chi-Square Test

In open appendectomy group, most cases (75%) had omental adhesion and 55% of them shows s free fluid collection, 75% of them had perforated appendix while 25% of them had suppurative appendix. The median operative time was 1 hour with all of them needed drain insertion. In laparoscopic appendectomy group, most cases (65%) had omental adhesion and 65% of them showed free fluid collection, 65% of them had perforated appendix while 15% of them had suppurative appendix. The median operative time was 1.45 hours with 50% of them needed drain insertion. Three cases (15%) were converted to open appendectomy; as one case due to cecal perforation, the second case due to bleeding while the third case due to excessive adhesions with difficult dissection.

Operative time was significantly higher in laparoscopic appendectomy group compared to open appendectomy group (p<0.001). In addition, Drain insertion was significantly higher in open appendectomy group compared to laparoscopic appendectomy group (p<0.001). No statistically significant difference was observed between the two groups regarding omental adhesion, free fluid collection and gross appearance of appendix (p>0.05) Table 3

Table 3. Operative finding among the two studied groups.

VARIABLE		GROUP (A) OPEN APPENDECTOMY GROUP (N=20)		GROUP (B) LAPAROSCOPIC APPENDECTOMY GROUP (N=20)		TEST VALUE	P-VALUE
		No.	%	No.	%		
OMENTAL ADHESION	No	5	25.0%	7	35.0%	X^2= 0.476	0.490 (NS)
	Yes	15	75.0%	13	65.0%		
FREE FLUID COLLECTION	p	9	45.0%	7	35.0%	X^2= 0.417	0.519 (NS)
	s	11	55.0%	13	65.0%		
GROSS APPEARANCE OF APPENDIX	No	0	0.0%	4	20.0%	X^2= 4.444	0.1083 (NS)
	Perforated	5	75.0%	12	60.0%		
	Suppurative	15	25.0%	4	20.0%		
OPERATIVE TIME (HOURS)	Mean± SD	1.03± 0.28		1.02± 0.04		Z_{MWU} = 4.683	<0.001 (HS)
	Median (IQR)	1 (0.88- 1)		2 (1.5- 2.5)			
	Range	40 min. – 1.5 hrs.		30 min – 1hrs			
DRAIN INSERTION	No	0	0.0%	10	50.0%	X^2= 13.33	<0.001 (HS)
	Yes	20	100.0%	10	50.0%		
CONVERSION TO OPEN	No	-		17	85.0%	-	-
	Yes	-		3	15.0%		

P value >0.05: Not substantial (NS), P value <0.05 is statistically substantial (S), p<0.01 is highly substantial (HS). , SD: Standard deviation, X2: Chi-Square Test, ZMWU: Mann-Whitney U Test

In open appendectomy group, the median regain of hospital stay was 3 days, median of drain removal was 4 days and median hospital stay was 5 days. In laparoscopic appendectomy group, the median regain of hospital stay was 1 day, median of drain removal was 1 day and median hospital stay was two days. Regain of hospital stay was significantly higher in open appendectomy group compared to laparoscopic appendectomy group (p<0.001). Furthermore, hospital stay was significantly higher in open appendectomy group compared to laparoscopic appendectomy group (p<0.001) Table 4

Table 4. Postoperative finding among the two studied groups.

		GROUP (A) OPEN APPENDECTOMY GROUP (N=20)	GROUP (B) LAPAROSCOPIC APPENDECTOMY GROUP (N=20)	MANN-WHITNEY U TEST	
				Test value	P-value
REGAIN OF HOSPITAL STAY (DAYS)	Mean± SD	3.10± 0.72	1.5± 0.92	Z_{MWU} = 4.420	<0.001 (HS)
	Median (IQR)	3 (3- 4)	1 (1- 2)		
	Range	2 – 4	0.5 - 4		
DRAIN REMOVAL (DAYS)	Mean± SD	4.15± 0.75	1.5± 1.91	Z_{MWU} = 4.460	<0.001 (HS)
	Median (IQR)	4 (4- 5)	1 (0- 2)		
	Range	3 – 5	0 - 7		
HOSPITAL STAY (DAYS)	Mean± SD	5.20± 0.83	3.15± 2.16	Z_{MWU} = 4.022	<0.001 (HS)
	Median (IQR)	5 (5- 6)	2 (2- 4)		
	Range	4 – 7	1 - 10		

In open appendectomy group, 65% of patients had wound infections, 55% of them reported ileus, 30% of them had collection and 25% patients needed readmission while in laparoscopic appendectomy group, 15% of patients had Wound infections, 20% of them reported ileus, 10% of them had collection and 5% patients needed readmission. Wound infections, and ileus were significantly higher in open appendectomy group compared to laparoscopic appendectomy group (p=0.001, & p=0.022 respectively) Table 5

Table 5. Complications among the two studied groups.

		GROUP (A) OPEN APPENDECTOMY GROUP (N=20)		GROUP (B) LAPAROSCOPIC APPENDECTOMY GROUP (N=20)		CHI-SQUARE TEST	
		No.	%	No.	%	Test value (X^2)	P-value
WOUND INFECTIONS	No	7	35.0%	17	85.0%	10.417	0.001 (HS)
	Yes	13	65.0%	3	15.0%		
ILEUS	No	9	45.0%	16	80.0%	5.227	0.022 (S)
	Yes	11	55.0%	4	20.0%		
COLLECTION	No	14	70.0%	18	90.0%	2.50	0.235^{FET} (NS)
	Yes	6	30.0%	2	10.0%		
READMISSION	No	15	75.0%	19	95.0%	3.137	0.182^{FET} (NS)
	Yes	5	25.0%	1	5.0%		

P value >0.05: Not significant (NS), P value <0.05 is statistically significant (S), p<0.01 is highly significant (HS). X2: Chi-Square Test, FET: Fischer Exact Test

4. Discussion

Our research revealed that the mean age was 10.15± 2.80 years in the open appendectomy group and 10.60± 1.96 years in the laparoscopic appendectomy group. There were 70% males and 30% females in the open appendectomy group, while there were 70% males and 30% females in the laparoscopic appendectomy group. No statistically significant difference was observed between the two groups regarding age and gender (p>0.05)

In agreement with our findings, Seqsaqa et al. aimed to assess the intraoperative and

postoperative outcomes of LA versus OA in complicated appendicitis in children. Their research was conducted on 60 patients; 30 of them were managed with OA, and the other 30 were managed with LA. They found that the mean age was 8.93 ± 2.12 years in the open appendectomy group and 9.13 ± 1.94 years in the laparoscopic appendectomy group. There were 16 (53.3%) females and 14 (46.7%) males in the open appendectomy group, while there were 18 (60%) males and 12 (40%) females in the laparoscopic appendectomy group. Regarding age and gender, there was no statistically substantial variation between the two groups (p>0.05). [8]

In our study, we found that in the open appendectomy group, all patients had signs of the inflamed appendix and inflamed L.Ns, all of them had a fluid collection, and 85% of patients had an omental reaction. In contrast, in the laparoscopic appendectomy group, all patients had signs of an inflamed appendix and inflamed L.Ns; all of them had a fluid collection, and 70% of patients had an omental reaction. No significant difference was found between the two groups regarding Ultrasound findings (p>0.05)

Our results are consistent with Khirallah et al., who reported that in the laparoscopic appendectomy group, ultrasound detected the inflamed appendix in 100 cases and free fluid in the pelvis and right iliac fossa in 50 cases. In the open appendectomy group, ultrasound detected the inflamed appendix in 95 cases and free fluid in the pelvis and right iliac fossa in 70 cases. No substantial variation was found between the two groups regarding ultrasound findings (p>0.05). [9]

Also, our results are consistent with those of Elofsson et al., who found that no substantial variation was found between the two groups regarding ultrasound findings (p>0.05). [10]

In our study, we found that in the open appendectomy group, most cases (75%) had omental adhesion, 55% showed free fluid collection, and 60% had a suppurative appendix. The median operative time was 1 hour, with all of them needing drain insertion. In the laparoscopic appendectomy group, most cases (65%) had omental adhesion and, 65% of them showed free fluid collection, 45% of them had perforated appendix. The median operative time was 2 hours, with 50% of them needing drain insertion. Three cases (15%) were converted to open appendectomy. Operative time was substantially greater in the laparoscopic appendectomy group compared to the open appendectomy group (p<0.001). In addition, drain insertion was substantially greater in the open appendectomy group compared to the laparoscopic appendectomy group (p<0.001). No statistically substantial variation was noted between the two groups in terms of omental adhesion, free fluid collection, and gross appearance of the appendix (p>0.05).

Also, our results are consistent with those of Murali et al., where 182 patients were split up into 102 people who had an LA and 80 patients who had an OA. They discovered that the laparoscopic group's surgical stay was longer than the open group's, and this difference was statistically substantial. (p<0.0001). [11]

In our study, we found that in the open appendectomy group, the median regain of hospital stay was 3 days, median of drain removal was 4 days, and median hospital stay was 5 days. In the laparoscopic appendectomy group, the median regain of hospital stay was 1 day, median of drain removal was 1 day, and median hospital stay was two days. Regain of hospital stay was significantly higher in the open appendectomy group compared to the laparoscopic appendectomy group (p<0.001). Furthermore, hospital stay was significantly higher in the open appendectomy group compared to the laparoscopic appendectomy group (p<0.001)

Ikeda et al. sought to determine if LA may be used in place of traditional OA in kids with severe appendicitis. They found that, compared to open appendectomy, laparoscopic appendectomy resulted in a much shorter hospital stay (p<0.001). [12]

In our study, we found that in the open appendectomy group, 65% of patients had wound infections, 55% of them reported ileus, 30% of them had a collection, and 25% of patients needed readmission, while in the laparoscopic appendectomy group, 15% of patients had Wound infections, 20% of them reported ileus, none of them had a collection and 5% patients needed readmission. Wound infections, ileus and collection were significantly higher in the OA group compared to the LA group (p=0.001, p=0.022 & p=0.02, respectively)

Our results, consistent with Lee et al., reported that in the open appendectomy group, 86 patients had wound infections and 112 patients needed readmission. In contrast, in the laparoscopic appendectomy group, 201 patients had wound infections, and 186 patients needed readmission. Wound infections were significantly higher in the OA group compared to the LA group.[13]

5. *Conclusion*

We conclude that with modest and less severe postoperative consequences compared to open surgery, laparoscopic surgery has shown to be the preferred method for treating difficult appendicitis in younger children.

Disclosure

The authors have no financial interest to declare in relation to the content of this article.

Authorship

All authors have a substantial contribution to the article

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Conflicts of interest

There are no conflicts of interest.

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