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Laparoscopic Appendectomy Versus Open Appendectomy in Pediatric Patients

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Background: Appendicitis is a common cause of acute abdominal pain in children. Surgical removal of the appendix by either OA or LA is the treatment of choice. Over last two decades, LA has failed to be considered superior over OA in adults and children.

Methods: A retrospective chart review of 1883 pediatric patients (≤14 years) diagnosed with acute appendicitis that underwent LA or OA at King Abdulaziz Medical City, Riyadh,

Results: A total of 1883 pediatric patients underwent appendectomy (65% male, mean age ten years old). OA surgical approach was performed in 1673 (88.8%) patients with a mean age of 10 ± 2.4. LA was performed in 210 (11.2%) with a mean age of 10.28 ± 2.5.

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Abstract- ***Objective:*** The aim of the present study was to assess the advantages of laparoscopic appendectomy (LA) compared with open appendectomy (OA) in children, regarding outcomes, operative time, length of hospital stay, antibiotic use, and available variables.

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Methods: A retrospective chart review of 1883 pediatric patients (≤ 14 years) diagnosed with acute appendicitis that underwent LA or OA at King Abdulaziz Medical City, Riyadh, Saudi Arabia, between 1998-2014.

Results: A total of 1883 pediatric patients underwent appendectomy (65% male, mean age ten years old). OA surgical approach was performed in 1673 (88.8%) patients with a mean age of 10 ± 2.4. LA was performed in 210 (11.2%) with a mean age of 10.28 ± 2.5.The rates of complication were 3.2% and 5.7% for OA and LA, respectively, with no statistically significant difference (p-value = 0.057). The length of hospital stay was significantly different between OA(3.19 ± 2.3 days) and LA (3.81 ± 2.4 days) (p-value <0.001).The LA approach has a significantly longer operative time of 73.2 ±25.3 min compared with the OA approach (53.1 ± 24 min)(p-value <0.001). The LA approach has significantly increased over the study time from 0% use in 1998 to 42% use in 2014.

Conclusions: The LA and OA approach used in the pediatric population show similar risk for post-appendectomy complications. LA is associated with longer operative time, which might contribute to the higher cost. LA has the same need for antibiotics as OA. Our findings show that LA is not superior to OA in children, although further studies including randomized controlled trials and meta-analysis are required.

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I. Introduction

Appendicitis is a common cause of acute abdominal pain in children. Surgical removal of the appendix by laparoscopic appendectomy (LA) or open appendectomy (OA) approaches is the standard treatment in acute appendicitis(AA).Surgical intervention has a lower rate of post-appendectomy complications than that seen with antibiotic therapy alone (1). LA has shown advantages over OA in many aspects, such as shorter hospital stay, decreased recovery time with a faster return to normal daily activities, less postoperative pain, shorter postoperative ileus, better cosmetic results, lower time for wound healing, and less wound infection (2-8). However, other studies have shownthat LA is associated with longer operative time, increased incidence of an intra-abdominal abscess, and higher cost (7-9). Also, a previous study showed that LA has a shorter operative time in complicated appendicitis (10). One trend analysis demonstrated that LA showed a higher risk for complication compared with OA in uncomplicated appendicitis (11). In contrast, other studies havereported that OA has a shorter hospital stay and lower cost (12,13).LA is not the standard approach to AA management in children (11). This subject remains debatable, especially in pediatric patients in which there is a lack of published studies. The aim of the present study was to assess the advantages of LA compared withOA in children, regarding outcomes, operative time, length of hospital stay, antibiotic use, and other available variables.

II. Methods

a) Study design and setting

The present study was a retrospective chart reviewconducted at King Abdulaziz Medical City (KAMC), Riyadh, Saudi Arabia.

b) Identification of study participants

A total of 1883 pediatric patients (≤ 14 years old) who were diagnosed with acute appendicitis and underwent LA or OA between January 1, 1998, and December 31, 2014,at KAMC were included in the study. Pediatric patients undergoing interval or incidental appendectomy were excluded from the study.

Also, six patients with incomplete data were excluded from the study.

c) Data collection process

Ethical approval for the present study was obtained from the Ethics Review Board of King Abdullah International Medical Research Center (KAIMRC) with research approval No. RC14/078/R. Data were collected by the First (AK), Second (RA), and Third (AKA) co-authors. The patients were categorized into two groups, including LA and OA. Demographic, laboratory, preoperative, intraoperative, and postoperative appendectomy data were extracted during a review of the medical files.

d) Data Analysis

Excel was used for data entry. SPSS version 24 software (IBM Corp., Armonk, New York, USA)was used for data management and analysis. Descriptive statistics were used to describe demographic variables. The chi-square test was used to assess the relationship between each surgical approach and categorical variables by percentages and frequencies (e.g., surgical approach and gender). T-tests were used to assess the difference between the type of surgery and quantitative values by measuring the mean and standard deviation (e.g., surgical approach and age). A p-value of <0.05 was considered statistically significant.

III. Results

A total of 1883 pediatric patients (mean age of 10 years old) that underwent appendectomy were included in the present study. Males accounted for 64.9% of the patients (male: female ratio was 2:1). OA surgical approach was performed in 1673 (88.8%) patients with a mean age of 10 ± 2.4. LA was performed in 210 (11.2%) with a mean age of 10.28 ± 2.5. Conversion of LA to OA was needed for one patient and was included in OA numbers. Additional variables were compared between the two approaches, including gender, WBC count, neutrophil percentage, imagining, operative surgeons, histopathology reports, and rate of complication (Table 1). A statistically significant difference was seen between LA and OA neutrophil percentages, operative surgeons, and histopathology reports (p-value =0.003, <0.001 and <0.001, respectively) (Table 1). The rates of complication were 3.2% for OA and 5.7% for LA, with no statistically significant difference observed between the two surgical approaches (p-value =0.057). The length of hospital stay was significantly longerfor LA (3.81 ± 2.4 days) compared with OA(3.19 ± 2.3 days) (p-value <0.001; Table 2). However, there were no statistically significant differences between the two groups regarding antibiotic consumption during admission (p-value = 0.077). LA demonstrated asignificantly longer operative time (73.2 ±25.3 min)compared with OA (53.1 ± 24 min)(p-value <0.001; Table 2). A significantly higher percentage (30%) of patients that underwent LA used antibioticsupon discharge fora longer period (2.43 ± 2.4 days)compared with OA (p-value s<0.001; Table 2). The LA approach has significantly increased over the study time from 0% use in 1998 to 42% use in 2014 (Figure 1).

IV. Discussion

Since the first use of the laparoscopic appendectomy approach for the management of acute appendicitis by Semm in 1983(14), it has failed to show superiority over the OA approach in adults and children (11,15). In contrast, in acute cholecystitis, the laparoscopic approach has been shownto have well-established superiority over the open approach (16). However, the LA approach is widely preferred by most surgeons and acceptable as the standard of treatment for AA. A technique is preferred over another due to its safety and few complications. In the present study, the overall complication rate was 3.5% and included IAA, wound infection, and bowel obstruction. The complication rate for both LA and OA approaches in children failed to show statistically significant differences, similar to the majority of recent studies (17-19). However, another report claimed that LA showed less complication rate in pediatric appendectomy (20). In the present study, the LA approach did not reduce the need for imagining (abdominal US and CT) for the diagnosis of appendicitis, which is similar to results from another study (17).However,a new trend is to use imagining for the diagnosis of appendicitis to reduce the incidence of a normal appendix (21). Senior surgeons (consultants and associate consultants) prefer the LA approach; instead, junior surgeons (fellows and residents) prefer the OA approach,which might be due to educational reasons. Similar to many previous studies that included meta-analysis, randomized trial, and cohort studies, the LA approach has been shown to have longer operation times (7-9,12). However, a report byAxel Elofsson[18]and his colleagues found no difference between the two techniques (LA and OA) regarding operative time in children. In the present study, approximately half of LA surgeries were performed by junior surgeons,which may contribute to the longer operative times that we observed. The LA technique can have shorter operative times, but this might depend on the surgeon'sexperience (21).

Interestingly, our study and others found that the histopathology reports showed that non-perforated appendix and normal appendix were statistically significant between the two methods (LA and OA), with no statistical difference observed in perforated appendix cases (18). Upon seeing more normal or healthy appendicesduring LA, raises the concern that the LA approach may participate in misdiagnosis of AA.

Furthermore, in the present study, the hospital stay was longer after LA in pediatric patients; however,additional pediatric studies have shown that LA resulted in a shorter hospital stay (17,18,20). The overall hospital stay in our study was longer than most previous studies. One of the main goals of LA is to reduce the use of antibiotics in AA patients, however we did not find an advantage regarding this issue. The present study found a low rate of LA for the management of AA;however, this is no longer the case becausethe medical community is shifting toward minimally invasive techniques and considers the LA approach the standard treatment of AA (see Figure 1).

V. Conclusions

LA and OA demonstratesimilar risk for post-appendectomy complicationsin the pediatric population. LA is associated with longer operation times, which might lead to higher cost. Both LA and OAshow asimilar need for antibiotics post-surgery. LA is not superior to OA in children, although further studies, including a randomized controlled trial and meta-analysis, are required.

VI. Limitations

Our single-center study was a retrospective chart review that was associated with the limited patient information. The large variation between LA and OA cases might affect the results. However most our resultswere constant with most recent studies.

Conflict of interest
None declared

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None

Table 1: Comparison of open and laparoscopic appendectomy in all children

	OA	LA	P-value
Age	10 ± 2.4	10.28 ± 2.5	0.173
Gender (male)	1095 (65.5%)	126 (60%)	0.119
WBC counts	16 ± 4.9	15 ± 5.2	0.259
Neutrophil percentage(%)	79.73 ± 10	77.25 ± 13	<0.01
Complication rate	53 (3.2%)	12 (5.7%)	0.057
Surgeons			<0.01
Senior Surgeons (Associate Consultant and Consultant)	318 (19%)	101 (48%)	<0.01
Junior Surgeon (Fellow and Resident)	1355 (81%)	109 (51.9%)	<0.01
Histopathology reports			<0.01
Non-perforated Acute Appendix	1410 (84.3%)	153 (72.9%)	<0.01
Perforated Appendix	133 (7.9%)	24 (11.4%)	0.086
Normal Appendix	130 (7.8%)	33 (15.7%)	<0.01

Table 2: Operative time, length of hospital stay and antibiotics in children undergoing open or laparoscopic appendectomy

	OA	LA	P-value
Operative time (min)	52.1 ± 24	73.2 ± 25.3	<0.01
Length of hospital stay (days)	3.19 ± 2.3	3.81 ±2.4	<0.01
Duration of antibiotic during admission (days)	2.29 ± 2.1	2.57 ± 2.1	0.077
Antibiotic on discharge	303 (16%)	63 (30%)	<0.01
Duration of antibiotic on discharge (days)	1.87 ±1.9	2.43 ± 2.4	<0.01

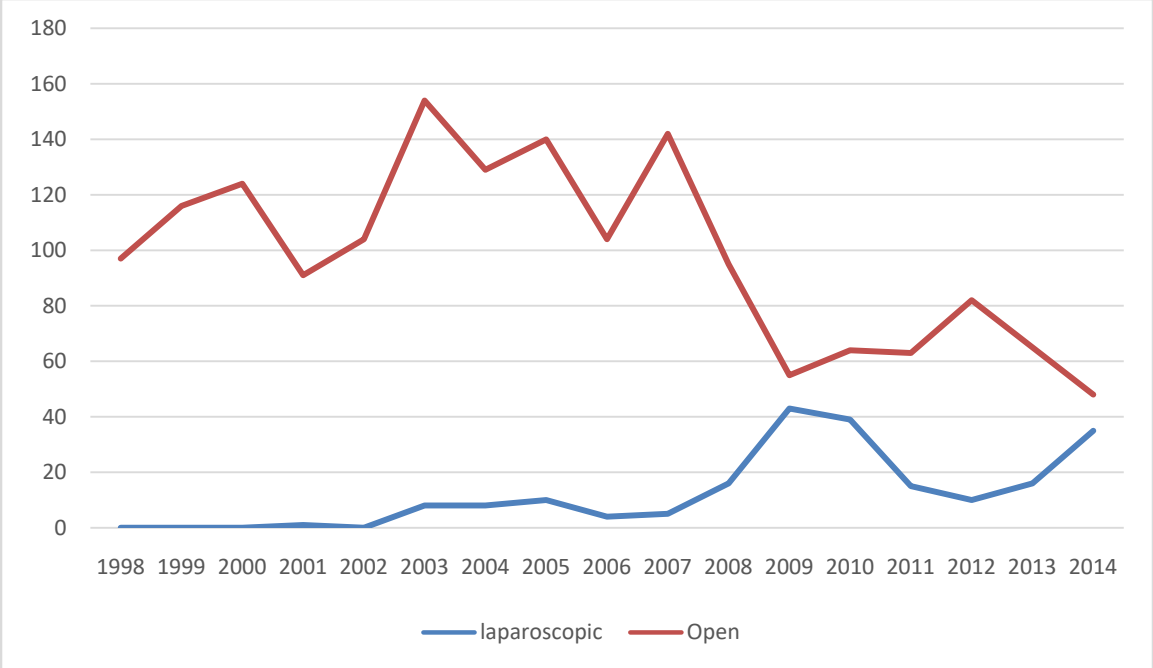

Figure 1: Laparoscopic appendectomy versus open appendectomy cases over time

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