International Journal of Pediatrics and Adolescent Medicine 7 (2020) 70–73

HOSTED BY

Contents lists available at ScienceDirect

International Journal of Pediatrics and Adolescent Medicine

journal homepage: http://www.elsevier.com/locate/ijpam

Original Article

Pediatric appendectomy in developing countries: How does it differ from international experience?

Rezkalla Akkary [a, *], Smart Zeidan [b], Reva Matta [b], Chantal Lakis [c], Nabil Diab [b]

[a] Pediatric Surgery and Urology, 20A avenue de la liberté, Colmar, 68000, France
[b] Faculty of Medicine, University of Balamand, Lebanon
[c] American University of Beirut, Lebanon

ARTICLE INFO

Article history:
Received 20 May 2019
Accepted 25 June 2019
Available online 2 July 2019

ABSTRACT

Introduction: A review of the English literature indicates the faint superiority of laparoscopic (LA) over open appendectomy (OA) in the pediatric population; however, a developing-country's experience in the field is not available yet. This study presents our experience in LA versus OA over the last 7 years in one university hospital in Lebanon and compares our results to the international ones.
Method: A single center retrospective study was done including all patients aged less than 15 years who underwent appendectomy. A description of each operative technique is presented. Patients' characteristics, intraoperative finding, operative timing (OT), length of stay (LOS) and short term postoperative complications including surgical site infection (SSI) rate, intra-abdominal abscess formation (IAA) rate and reoperation rate were all studied. Statistical analysis was done using Chi-square or Fisher's exact test, as for continuous, Student's t test was used or one-way ANOVA in case of more than 2 categories.
Result: Appendectomy was performed in 84 patients. 52 patients underwent OA through a Rocky Davis incision, and 32 patients underwent a LA. We found an advantage of LA over OA in reducing SSI, otherwise both approaches were similar.
Conclusion: In accordance with international results, in our experience, LA is superior to OA only with regards to SSI.

1. Introduction

Acute appendicitis is one of the most common causes for hospitalization in pediatrics and adolescents [1]. Approximately 30% of appendicitis cases in the pediatric population are complicated [2]. Open appendectomy (OA) was originally described by McBurney [3]. Since the introduction of laparoscopy, this appendectomy was progressively increasingly carried out by the minimal invasive approach, which was first introduced by Semm in 1983 [4].

In the adult population, it was demonstrated that there is a benefit of laparoscopic appendectomy (LA) compared to OA in reducing the incidence of surgical site infection (SSI) and length of hospital stay (LOS). However, LA was associated with higher rates of intra-abdominal abscesses (IAA), longer operative timing, and higher costs than OA [5].

In the pediatric population, it was found that in complicated appendicitis (CA), LA was superior to OA in reducing postoperative complications, wound infections, and LOS, but it was associated with an increased risk of IAA and increased operative timing (OT). No evidence of statistically significant difference was seen between the two approaches [5].

In this article, we present our experience in appendectomy in Lebanon, a developing low-to-middle-income country. We analyzed the differences between OA and LA approaches according to our experience, and we compared our results with those of international ones.

2. Material and method

A single-center, retrospective study was carried out. The medical charts of patients below the age of 15 years who underwent appendectomy during the 7-year period (2010–2016) in one

* Corresponding author.
E-mail address: r.akkary@gmail.com (R. Akkary).
Peer review under responsibility of King Faisal Specialist Hospital & Research Centre (General Organization), Saudi Arabia.

https://doi.org/10.1016/j.ijpam.2019.06.006

Table 1
Patients' characteristics in the laparoscopic appendectomy and open appendectomy groups.

		LAP (32 patients)	Open (52 patients)	*P* value
Gender	Female	14	14	.11
		43.8%	26.9%	
	Male	18	38	
		56.3%	73.1%	
Age (year)	Mean (SD)	10.1 (3.2)	9.5 (3.7)	.49
BMI (kg/m^2)	Mean (SD)	20 (5.8)	18.5 (3.1)	.19
Duration of symptoms (days)	Mean (SD)	0.5 (0.8)	0.5 (0.8)	.69
Intraoperative grading	Normal	01	0	.15
		3.1%		
	nCA	19	24	
		59.4%	46.2%	
	CA	12	28	
		37.5%	53.9%	

university hospital were reviewed. We divided the patients into two groups: group 1 included all the patients who underwent OA, and group 2 included all the patients who underwent LA. No interval appendectomies were performed. Three surgeons were involved. All the OAs were performed by one surgeon (A). All the LAs were carried out by one of the other two surgeons (B, C). The choice of surgical approach depended only on the on-call surgeon's experience. Abdominal ultrasound was a first-line imaging modality. In cases when the diagnosis was still questionable, an attenuated-dose -abdomino-pelvic CT scan with intravenous contrast injection was performed. In cases of persistence of doubt, patients were either admitted for close monitoring or discharged with a re-evaluation appointment reserved after 12 h – the choice depended on the ease of access to the hospital. Once the diagnosis of acute appendicitis was made, all patients were started on IV antibiotics. In the absence of signs and symptoms of peritonitis, and in patients who were diagnosed after midnight, the operation would be performed the next day; otherwise, the case was labeled as urgent. Operative time (OT) was calculated from the induction of anesthesia until closure of the wound.

In the OA approach, a rocky Davis incision was made with the muscle-sparing approach. Cultures were taken from peritoneal fluid. The cecum was delivered outside the wound, and double ligation of appendicular base was done. Appendectomy was routinely followed by coagulation of the appendicular stump mucosa. Peritoneal toileting was always done. The abdominal wall was closed in layers with profuse wound irrigation. The subcutaneous tissue was closed by 2–3 separate sutures, and the skin was closed by either several separate sutures over an antibiotic-impregnated mesh – bactigras – in cases of gross contamination or by subcuticular running suture, otherwise. Bactigras usage is an off-label usage, and not supported by research evidence. Daily dressing changing started on the second operative day if indicated. In cases where a mesh was used, it was progressively retrieved to allow for secondary healing to take place.

In the LA, after insertion of a Foley catheter in the bladder, a trans-umbilical 10 mm trocar was inserted by the OA technique and one 5 mm trocar by the LLQ. After inspection of the peritoneal cavity using a 30-degree camera, a third 5 mm trocar was inserted either in the RUQ or in the suprapubic area – both under direct vision. Aspiration of the intraperitoneal fluid was performed in this position and then in the Trendelenburg position, with the patient's right side elevated; double ligation of the appendicular base was always done intracorporally, and the appendix was extracted through the umbilical trocar or through an endo-bag. No direct contact was made between the abdominal wall and the appendix. The appendicular stump was coagulated.

Normal appendix was labeled when minimal clear fluid was found in the peritoneal cavity associated with negative culture results and confirmed by pathological analysis. Noncomplicated appendicitis (nCA) was defined as the presence of an inflammatory nongangrenous nonperforated appendix, with nonpurulent intraperitoneal liquid. All other more severe cases were labeled as CA. The diagnosis was confirmed by pathological analysis. The cases of appendiceal plastron and the appendiceal abscesses were operated in the acute state.

A drain was inserted if there was a gross contamination of the peritoneal cavity. It drains the cul-de-sac de Douglas along with/without the right paracolic gutter and exiting through an RLQ stab incision. If another one is needed – in cases of generalized peritonitis – it usually drains the left paracolic gutter and exists through an LLQ stab wound. All patients resumed feeding and started ambulation 24 h postoperatively.

All patients underwent our hospital's antibiotics protocol, which involves administering intravenous antibiotics for 3 days. In simple nCA, no more antibiotics were given. In complicated cases, however, administration of antibiotics for a total of 5 days was prescribed. Patients with generalized peritonitis were given antibiotics for 7 days. In cases of nCA, the choice was augmentin. In cases of CA, the choice was ceftriaxone/gentamicin, and metronidazole. An antibiotic regimen was adapted according to each patient's evolution and with regard to peritoneal culture results. A switch toward antibiotics perOS was made as soon as the patient resumed his/her peristaltism.

OT, LOS, SSI (adjusted to BMI), IAA, and reoperation rate were compared in both groups. BMI was not matched to patient age. Our results were compared to those reported in the literature.

Descriptive and bivariate analyses were carried out using SPSS© version 20. P values of less than 0.05 were considered statistically significant. P values for categorical data were calculated using chi-square or Fisher's exact test, and those for continuous data were calculated with Student's *t*-test or one-way ANOVA in case of more than 2 categories.

3. Results

Eighty-four patients were included. All patients were operated within 24 h of surgical consultation.

Table 2
Comparison of the two groups regarding LOS, OT, incidence of IAA, and re-intervention rate.

Criterion	Group 1	Group 2	*P* value
LOS (days)	4.6±2.6	4.41±2.51	0.74
OT (minutes)	75.1±31.99	85±29.58	0.16
OT in CA	75±36.79	85.91±32.77	0.39
OT in nCA	75.21±26.35	85.79±28.73	0.21
IAA	1	3	0.15
Re-intervention rate	1	1	1

Table 3
Prevalence of surgical site infections in each group with regard to BMI and severity of disease.

Approach	SSI		Total	P value	SSI prevalence in each group according to BMI				SSI prevalence in each group according to disease severity, irrespective of BMI				
						SSI		*P* value					
	No	Yes				No	Yes		Severity	No SSI	Yes	Total	*P* Value
Open	24	14	38	0.05	Not Obese	22	10	.26	nCA	10	6	16	.94
					Obese	1	2		CA	14	8	22	
LAP	23	4	27		Not Obese	18	3	1	nCA	14	3	17	1
					Obese	4	1		CA	9	1	10	

We found that both groups were similar with regard to gender, age, duration of symptoms, and BMI. Moreover, the distribution of CA and nCA cases between the two groups was similar as shown in Table 1.

OT in both groups was similar. Even when adjusting for CA and nCA, there was no difference between the groups. The same was applied to LOS.

Out the 84 patients studied, 4 (4.8%) developed deep intra-abdominal abscesses postoperatively. The incidence of deep abscess formation was 3 times higher after LA versus OA; however, this was not statistically significant.

The re-intervention rate (re-operation or by interventional radiology) was also found to be similar; however, the etiology differed. In the OA group, the reason was small bowel obstruction due to adhesions, while it was IAA in the LA group as summarized in Table 2.

OA was associated with statistically significant higher rate of SSI compared to LA. However, higher BMI was not a risk factor. The results are summarized in Table 3.

No per-/postoperative bleeding was encountered; no bowel injury and no conversion occurred.

4. Discussion

Appendicitis is one of the most common causes of abdominal pain, with lifetime risk of approximately 8% [6]. It was first approached by McBurney's incision; then with the advent of laparoscopy, the minimally invasive approach in the early 1980s started to be utilized. Currently, with more experience and advancement in minimally invasive surgeries, single trocar appendectomy is also being performed [7].

When studying the OT, Aziz et al. found no difference between OA and LA, although they did not differentiate between CA and nCA cases [12]. Others had found that a longer OT was associated with the LA approach [15], especially in CA cases [5]. In our setting, OT was similar between the groups even when considering the complication level. This is possibly because the OAs were performed frequently by surgeons during training, while in laparoscopy cases, less tolerance was noted and a senior surgeon rapidly interfered taking into consideration the training curve.

Regarding LOS, international results are contradictory. While some studies that demonstrated LA have a significantly shorter LOS than OA, for both CA and NCA [5,9–11], other studies showed no difference [15] as in our series. The reason underlying the shorter LOS in laparoscopic surgery is that it has a faster recovery, faster mobilization, less ileus, and less pain [12]. Although this is evident in prolonged and complex surgeries, in appendectomies, patients have a very fast recovery regardless of the approach, and their stay is determined by the duration of intravenous antibiotics needed [13]. In our series, the prolonged and probably excessive antibiotic protocols that we use might be a reason for similar LOS in the two groups. Another factor for a long LOS in both groups was the presence of drainage, which might delay patient mobilization, delay the peristaltism, and prolong the duration of pain and the need for painkillers.

In a Cochrane review of LA versus OA surgery for suspected appendicitis, a higher incidence of intra-abdominal abscess was described following laparoscopy, with OR = 2.48 (95% [CI] 1.45–4.21) [16]. Although, in our practice, the rate of IAA was higher in LA, it was not statistically significant. This might be due to our aggressive lavage in cases of peritonitis.

When studying the rate of SSI post-appendectomy, one meta-analysis showed that LA is associated with a statistically significant less incidence of SSI than OA [12,15]. However, this advantage was later proven to be only in cases of CA [5]. In our series, there was a significantly less incidence of SSI in LA that in OA, with no influence of severity degree. This is most likely related to the degree of wound contamination during the surgery.

BMI is not an independent factor for the development of SSI post-appendectomy. This finding is contradictory to those reported in many studies in the adult population, where elevated BMI was a bad prognostic factor [17], knowing that in the adult population this might be associated with comorbidities – such as hypertension, insulin resistance, diabetes, and dyslipidemia – that could contribute to higher infectious complications.

An important limitation to our study is the small patient number. Because of the subtle differences in the outcome and complications between all the approaches, the gold standard technique and the superiority are not established yet [8], spotlighting the importance of studying a large population [13].

5. Conclusion

In a low-to-middle-income country, in the pediatric age group, LA seems to be superior to OA only in terms of reducing SSI. This is similar to the findings concluded in other international studies. Despite this and because of the absence of large randomized clinical trials, it is difficult to define the gold standard technique to manage appendicitis.

Abbreviations

OA: open appendectomy; LA: laparoscopic appendectomy; CA: complicated appendicitis, nCA: noncomplicated appendicitis; IAA: intra-abdominal abscess; SSI: surgical site infection; LOS: length of hospital stay, OT: operative time.

Conflicts of interest

There is no conflict of interest to be declared by any of the authors.

Ethical approval

This is a retrospective study. No informed consent was needed. No unethical actions were undertaken. The variable techniques is dependent on surgeon experience.

References

[1] Gosemann Jan-Hendrik, Lange A, Zeidler J, Dingemann J Blaser C, Ure BM, Lacher M. Appendectomy in the pediatric population—a German nationwide cohort analysis. Langenbeck's Arch Surg 26 april 2016.

[2] Eileen M, Duggan Andre P, Marshall Katrina L, Blakely Martin L. A systematic review and individual patient data meta-analysis of published randomized clinical trials comparing early versus interval appendectomy for children with perforated Appendicitis. Pediatr Surg Int 9 May 2016.

[3] McBurney C. The incision made in the abdominal wall in the cases of appendicitis, with a description of a new method of operating. Ann Surg 1894;20:38–43.

[4] Semm K. Endoscopic appendectomy. Endoscopy 1983;15:59–64.

[5] Markar Sheraz R, Blackburn Simon, Cobb Richard, Karthikesalingam Alan, Evans Jessica, Kinross James, Faiz Omar. Laparoscopic versus open appendectomy for complicated and uncomplicated appendicitis in children. J Gastrointest Surg 2012;16:1993–2004.

[6] Addiss DG, Shaffer N, Fowler S, Tauxe RV. The epidemiology of appendicitis and appendectomy in the United States. Am J Epidemiol 1990;132:910–25.

[7] Kim SJ, Choi BJ, Lee SC. Novel approach of single-port laparoscopic appendectomy as a solo surgery: a prospective cohort study. Int J Surg 2015 Sep;21:1–7.

[8] Sozutek A, Colak T, Dirlik M, Ocal K, Turkmenoglu O, Dag A. A prospective randomized comparison of single-port laparoscopic procedure with open and standard 3-port laparoscopic procedures in the treatment of acute appendicitis. Surg Laparosc Endosc Percutaneous Tech 2013 Feb;23(1):74–8.

[9] Canty TG, Collins D, Losasso B, Lynch F, Brown C. Laparoscopic appendectomy for simple and perforated appendicitis in children: the procedure of choice? J Pediatr Surg 2000;35:1582–5.

[10] Ikeda H, Ishimaru Y, Takayasu H, Okamura K, Kisaki Y, Fujino J. Laparoscopic versus open appendectomy in children with uncomplicated and complicated appendicitis. J Pediatr Surg 2004;39:1680–5.

[11] Li P, Xu Q, Ji Z, Gao Y, Zhang X, Duan Y, Guo Z, Zheng B, Guo X, Wu X. Comparison of surgical stress between laparoscopic and open appendectomy in children. J Pediatr Surg 2005;40:1279–83.

[12] Aziz Omer, Athanasiou Thanos, Darzi Ara. Laparoscopic versus open appendectomy in children a meta-analysis. Ann Surg 2006;243(17–27).

[13] Nataraja Ramesh M, Loukogeorgakis Stavros P, Haddad Munther J. The incidence of intraabdominal abscess formation following laparoscopic appendicectomy in children: a systematic review and meta-analysis. J Laparoendosc Adv Surg Tech 2013;23. Number 9.

[15] van Rossem CC, Bolmers MDM, Bemelman WA. On behalf of the Snapshot Appendicitis Collaborative Study Group, Prospective nationwide outcome audit of surgery for suspected acute appendicitis. BJS 2016;103:144–51.

[16] Sauerland S, Jaschinkski T, Neugebauer EA. Laparoscopic *versus* open surgery for suspected appendicitis. Cochrane Database Syst Rev 2010;10:CD001546.

[17] Hawn MT, Bian J, Leeth RR. Impact of obesity on resource utilization for general surgical procedures. Ann Surg 2005;241:821–8.