

Port exteriorization appendectomy in children: an alternative to the conventional laparoscopic technique?

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Introduction Laparoscopic appendectomy is usually performed using an intracorporeal approach. The conventional procedure uses three ports. The port exteriorization appendectomy uses two trocars to perform the entire procedure and can be considered an efficient alternative to the conventional approach, especially in case of nonavailability of adequate material. We report our experience using port exteriorization appendectomy with the aim of evaluating this technique and determining its feasibility for all grades of appendicitis.

Patients and methods Between May 2013 and January 2014, 193 appendectomies were performed in our department; in 50 cases (26%), a port exteriorization appendectomy was performed. Technical challenges, complications, and postoperative recovery were determined and analyzed.

Introduction

Appendectomy is one of the most common surgical procedures. There are various surgical techniques to perform appendectomy, ranging from the open technique, first described by Mac Burney in 1894 and that has been the gold standard for the management of acute appendicitis for more than a century, to the standard three-port laparoscopic approach described by Semm in 1983 [1].

Port exteriorization appendectomy offers the advantages of both approaches: good laparoscopic visualization and a safe extracorporeal appendectomy.

First reported by Valla *et al.* [2] and then by others such as Ohno *et al.* [3], initially, this technique was only used in cases of uncomplicated appendicitis.

The aim of this study was to evaluate the feasibility and efficiency of port exteriorization appendectomy for both complicated and uncomplicated appendicitis.

Different variables were documented and collected: mean operative time, conversion rate, hospital stay, complications, and patients' satisfaction.

Patients and methods

Between May 2013 and January 2014, 193 appendectomies were performed in our department. In 50 cases (26%), the surgery was performed using the port exteriorization technique. The choice of the technique was made according to the surgeon's ability to perform the laparoscopic appendectomy; only one surgeon used this approach during an emergency shift throughout this period.

Conclusion Port exteriorization appendectomy can be considered a safe and economical approach to perform pediatric appendectomy when conditions are favorable. It allows minimizing minimally invasive surgery even further, enabling a low level of invasiveness and resulting in postoperative pain. *Ann Pediatr Surg* 12:10–13 © 2016 Annals of Pediatric Surgery.

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All the patients admitted for appendicitis when this surgeon was on call were included; we excluded patients with a preoperative diagnosis of appendicular abscesses or appendicular phlegmon.

All the children's parents were informed preoperatively about the procedure, the possibility of adding a third trocar, and the possibility and risk of conversion to an open surgery.

All data were prospectively collected and compiled using Excel software (Microsoft, Redmond, Washington, USA). Tests for statistical significance included the χ^2 -test and Fisher's exact test as well as logistic regression from the SPSS statistical program (SPSS Inc., Chicago, Illinois, USA).

Differences were considered significant at a *P* value less than 0.05.

Description of the procedure

Under general anesthesia, the patient was placed in a supine position. The surgeon stood on the left side of the patient and the first assistant on the right side with a personal screen at the opposite side of the surgeon. A 5 mm semicircular incision was made at the upper edge of the umbilicus. The fascia was exposed and incised.

A 5 mm port for a laparoscopic camera was then introduced. After pneumoperitoneum insufflation, a 10 mm working port was introduced under laparoscopic visual control in the right lower quadrant of the abdomen.

The appendix was isolated, grasped, and mobilized, enabling its extraction with the mesoappendix outside

the abdomen (Fig. 1). The rest of the surgery was similar to open appendectomy. When it was impossible to pull out the appendix, a 5 mm working port was introduced under visual control at the left lower quadrant of the abdomen.

The appendix was then mobilized by dividing inflammatory adhesions and the mesoappendix was coagulated using a monopolar hook, and then the appendix, free of its mesoappendix, was extracted out of the abdomen through the 10 mm port. After appendectomy, the ceco-appendicular junction was moved back into the abdomen. Visual control of hemostasis and the length of the remaining appendicular stump were performed.

After extraction of trocars under visual control, the fascia of the two-port incision and the skin were opposed with delayed absorbable sutures.

Postoperative care

During the procedure, all the patients received a single dose of cefotaxime (30 mg/kg). Imidazole (15 mg/kg) and aminoside (5 mg/kg) were also administered once a complicated form of the appendicitis was found.

Progressive feeding was started 4 h after surgery.

Postoperative antibiotherapy was performed according to a local protocol established after a prospective study in our hospital with the aim of identifying the microbiological profile of acute appendicitis in children in our area [4].

In cases of noncomplicated appendicitis (catarrhal or phlegmonous without perforation), no postoperative antibiotherapy was necessary and the patient was discharged the day after.

In cases of complicated appendicitis (gangrenous, local peritonitis), a 3-day intravenous antibiotherapy was administered by adapted oral antibiotics for 10 days.

Postoperative follow-up

Clinical control was performed 2 weeks after surgery, and then 1 and 3 months later.

Results

During the study period, a total of 193 appendectomies were performed in our department; 26% of the patients (30 boys and 20 girls) were managed using the port exteriorization technique. The surgery was performed by the same senior surgeon.

All Preoperative, perioperative, and postoperative data were prospectively collected. The mean age of the patients was 10.5 years; the median age was 11 years, with a range between 4 and 14 years.

In 76% of the cases (group 1), the appendicitis was noncomplicated (38 cases); it was inflammatory in eight cases or phlegmonous in 30 cases.

In 24% of the cases (group 2), the appendicitis was complicated (12 cases); it was gangrenous in seven cases and local peritonitis was found in five cases (Table 1).

Preoperative features

Symptoms started 1.79 days before surgery on average in group 1 and 2 days in group 2.

The mean values of blood leukocytes and C-reactive protein were significantly lower in the patients in group 1 than in those in group 2 ($P = 0.03$ and 0.015) (Table 1)

All the patients underwent an abdominal ultrasound; the appendix was visualized in 90% of the cases.

Operative features

The mean operative time was 39 min (10–95 min).

In group 1, the mean operative time was 34 min: 25 min for inflammatory appendicitis and 37 min in phlegmonous cases.

In group 2, the mean operative time was 60 min: 65 min for gangrenous appendicitis and 55 min for local peritonitis. The difference between the two groups was statistically significant ($P = 0.002$). None of the patients required a conversion to laparotomy during surgery. In three cases (6%), we had to include a third 5 mm operative trocar: two cases of local peritonitis with necrotizing retrocecal appendix and one case for subhepatic appendix.

Postoperative features

Oral fluid was started 4 h after surgery. All the patients had an analgesic prescription of paracetamol (60 mg/kg/day) and a bolus of nalbuphine (0.2/mg/kg/day) when needed.

There was no need for antibiotic prescription after surgery in group 1, but the patients in group 2 had an intravenous prescription of cefotaxime 100 mg/kg/day and metronidazole (30 mg/kg/day) for 3 days and gentamicin 3 mg/kg/day for 48 h.

Figure 1



Exteriorization of the appendix through a 10 mm trocar.

Table 1 Differences between cases of uncomplicated and complicated appendicitis

	Uncomplicated appendicitis	Complicated appendicitis	P
Number of cases	38	12	
Start of symptoms (days)	1.44	2	0.3
Leukocytes (mm ³)	12.879	17.792	0.001
CRP (mg/l)	20.30	46.62	0.003
Mean operative time (min)	34	55	0.002
Hospital stay (days)	1	3	0.004
Conversion to laparotomy	0	0	
Wound infection	0	0	
Intra-abdominal abscess	0	0	
Readmission	0	0	

CRP, C-reactive protein.

Table 2 Comparison between conventional laparoscopy and port exteriorization appendectomy

Mean operative time	Uncomplicated case	Complicated case	P
Conventional laparoscopy			
53 min	50 min	72 min	0.025
PEA			
39 min	34 min	60 min	

PEA, port exteriorization appendectomy.

The patients were discharged the day after the surgery in group 1.

The patients were discharged 3 days after surgery on average in group 2 with a prescription of an oral antibiotic, according to the bacteriological results, to collect a total of 10 days antibiotherapy [4]. The patients achieved clinical control after 2 weeks, and 1 and 3 months. Pathologic examination indicated acute appendicitis in all cases. No cases of wound infection or postappendectomy intra-abdominal abscesses were reported. None of the patients was readmitted for intestinal obstruction.

Discussion

Although criticized because of the technical difficulty and cost, the three-port 'in' technique has been practiced widely and remains the gold standard among the techniques of laparoscopic appendectomy because of its significant advantages [3]. However, it needs a complete surgical laparoscopy set in addition to a trained surgeon.

It is clear that the advantages of laparoscopic appendectomy over an open approach include decreased pain, fewer postoperative complications, decreased length of hospitalization, improved intra-abdominal visualization, and better cosmetic results.

Studies support that laparoscopic procedures reduce the inflammatory cascade by reducing the expression of proinflammatory cytokines. Those cytokines may be responsible for an increase in systemic inflammatory response and perioperative morbidity and mortality [5].

Three laparoscopic ports are traditionally required to complete a laparoscopic appendectomy. In the minimally invasive surgery area, pediatric surgeons continue to focus on alternative technical solutions to minimize scarring of the patient.

The minimally invasive approach leads to a significant reduction in the postoperative cytokines and this approach results in less surgical trauma in children compared with the use of open surgery [5].

The nonavailability of adequate material (such the endoloops in our case) represents an obstacle in performing laparoscopic appendectomy, which encouraged us to look for an alternative technique combining the advantages of both open and laparoscopic appendectomy, which was in our practice the port exteriorization technique.

This technique, performed predominantly using two ports and occasionally three ports, gained popularity initially in pediatric practice [6,7] and later in surgeries on adults as well [8,9].

Several studies report the trans umbilical one trocar laparoscopic appendectomy (TULA) as a valuable technique in the management of acute appendicitis.

Ding *et al.* [10] reported in a systematic review and meta-analysis that trans umbilical one TULA was associated with a higher conversion rate and perhaps greater surgical difficulty and hospitalization costs than the conventional laparoscopic appendectomy. According to Carter *et al.* [11], TULA resulted in more pain and longer operative time without improving short-term recovery or complications compared with the three-port laparoscopic appendectomy. In a precedent study carried out in our department, the mean operative time for conventional laparoscopic appendectomy was 53 min. Compared with the port exteriorization group, there was a statistically significant difference. The operative time was significantly shorter ($P = 0.025$) in the two-port technique for both uncomplicated and complicated appendicitis (Table 2). This difference may be explained by the fact that in the two-port technique, the appendectomy was performed outside the abdomen, allowing an easier manipulation of the appendix.

Compared with the trans umbilical one TULA, the port exteriorization technique offers better triangulation and avoids collisions between laparoscope and instruments; it can also be considered a transition step before the TULA [12].

Few studies are available on port exteriorization appendectomy [6,9,12–16] and only three previous studies have focused on a pediatric population [6,13,17].

Table 3 Summary of similar pediatric studies

	Pediatric cases	Uncomplicated appendicitis	Complicated appendicitis	Operative time (min)	Use of third trocar	Conversion rate	Complication	Hospital stay (days)
This study	50	76%	24%	39	6%	0	0	2
Golebiewski <i>et al.</i> [13]	27	63%	37%	39	–	–	11.1%	–
Valioulis <i>et al.</i> [6]	38	81.5	15.8	19	23.6%	5.2%	5.2%	–
El-Gohary and El-Marsafawy [17]	13	46.2	53.8	34	–	0	0	2.4

Our study has a double interesting point, represented by the concerned population (pediatric) and the fact that procedure was used for both uncomplicated and complicated appendicitis.

The mean operative time in the published studies ranged from 19 to 64 min. In the pediatric studies, the operative time ranged from 19 [6] to 39 min [13].

The rate of complications in pediatric studies ranged from 5.2 to 11.1% [7].

In our study, similar to the study of El-Gohary and El-Marsafawy [17], none of the patients developed local wound infection or intra-abdominal abscesses (Table 3).

The limitations of our study include the nonsignificant number of cases and the lack of a reliable comparison between port exteriorization appendectomy and the conventional laparoscopic technique and the open technique. The nonfeasibility of this scientific comparison in our department is because of the fact that the open technique is most of the time performed by residents and not all the surgeons practice laparoscopy regularly.

Conclusion

The port exteriorization appendectomy technique for acute appendicitis in children can be performed as safely and efficiently as the open technique, with a lower cost than the complete laparoscopic approach. This method can be recommended as an alternative to open appendectomy or the conventional laparoscopic technique, and can be considered a transition step before the one-trocar laparoscopic-assisted appendectomy.

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Conflicts of interest

There are no conflicts of interest.

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