

Two-Port Versus Three-Port Laparoscopic Appendectomy in Children with Uncomplicated Appendicitis

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ABSTRACT

Background/Objective: Laparoscopic appendectomy is commonly performed through a 3-port technique. We compared our experience of 2-port laparoscopically assisted appendectomy with 3-port LA (laparoscopic appendectomy) in uncomplicated appendicitis in terms of efficacy, safety, and cost.

Methods: We evaluated 86 children ages 3 to 12 years with uncomplicated appendicitis undergoing laparoscopic appendectomy (2-port, n = 45; 3-port, n = 41) during a 4.5-year period. The technique depends on the surgeon's preference and the position of the appendix. We excluded all children (2-port, n = 8; 3-port, n = 15) with complicated appendicitis.

Results: There were no differences at the time of presentation in age, gender, weight, duration of symptoms, or severity of disease for both techniques of laparoscopic appendectomy. In 2-port laparoscopically assisted appendectomy, the operative (40 vs. 68 minutes, $P < .05$) and anesthesia (67 vs. 96 minutes, $P < .05$) times were shorter. The average postoperative stay (2.5 days in 2-port vs. 3.3 days in 3-port) and analgesia requirement were also less in 2-port laparoscopically assisted appendectomy. Two children (3-port laparoscopic appendectomy) required conversion to open appendectomy. There were no postoperative complications in either group. The extra cost of endo-loops with 1 port and the 1-day hospital stay was saved by using 2-port laparoscopically assisted appendectomy.

Conclusion: We concluded that 2-port laparoscopically assisted appendectomy is a safe and effective alternative for the management of uncomplicated appendicitis. When successful, the overall cost is less with 2-port laparoscopic appendectomy because it is quicker to perform, requires less anesthesia time and no endo-loops, endo-clips, or endo-GIA, and results in a shorter hospital stay and less postoperative analgesia.

INTRODUCTION

ACUTE APPENDICITIS is the most common pediatric surgical emergency. Initially, laparoscopic appendectomy in children remained confined to a few enthusiasts. More recently, the idea has been gradually popularized. With the advances in miniaturized instruments, laparoscopic appendectomy is now performed routinely in many centers. Although there is no standard technique for laparoscopic appendectomy

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in children, different methods have been described in the literature.^{1-5,6} We compared a 2-port laparoscopically assisted appendectomy versus a 3-port laparoscopic appendectomy in this review.

METHODS

During a period of 4.5 years (January 1997–May 2001), all children admitted to King Khalid University Hospital, Riyadh, Saudi Arabia, and given a diagnosis of uncomplicated appendicitis who underwent laparoscopic appendectomy were reviewed. We evaluated the patients (2-port, n = 45; 3-port, n = 41) with uncomplicated appendicitis in this review. Patients with complicated appendicitis were excluded from this review (2-port, n = 8; 3-port, n = 15). All demographic data, diagnostics studies, and data for duration of symptoms, operative and anesthesia times, hospital stay, postoperative analgesia requirement, and complications were collected. All children received one dose of preoperative antibiotic prophylaxis (cefuroxime 30 mg/kg with metronidazole 7.5 mg/kg). An additional three doses were given postoperatively. All children were instructed to void before surgery.

Laparoscopic appendectomy was performed with the child under general endotracheal anesthesia with assisted ventilation and muscle relaxation. A modified Hasson technique⁷ was used to gain access for the primary port. A 1-cm incision was made in the lower umbilical fold, cutting the skin and subcutaneous tissue to expose the avascular plane between the umbilical base and the subcutaneous fat. Dissection was continued until the linea alba was clear. Two forceps were applied to the linea alba, and the abdomen was entered by cutting the linea alba with its underlying peritoneum between the forceps. Single 2-0 or 3-0 VicrylTM purse-string sutures (Ethicon) were applied to prevent gas leakage and cannula dislodgment. A 3.5- to 10-mm cannula (depending on the weight of the patient) was introduced under direct vision to start insufflation to a pressure of 6 to 10 mm Hg. The peritoneal cavity was inspected. The second cannula was inserted along the right midclavicular line at the level of the umbilicus or higher, depending on the location of the appendix, through which a nontoothed dissecting endo-forceps was introduced. The choice of laparoscopic appendectomy technique depended on the mobility of the appendix and cecum, the length, position, and condition of the appendix, and the surgeon's preference. When we decided on a 2-port laparoscopically as-

TABLE 1. DEMOGRAPHIC AND CLINICAL DETAILS

<i>Characteristics</i>	<i>Two-port LA n = 45</i>	<i>Three-port LA n = 41</i>
Age (ys)	9.3	9.2
Weight (kg)	29.78	32.29
Sex:		
males	26	21
females	19	20
Duration of abdominal pain (hs)	19.2	25.5
Fever at presentation		
Yes	25	21
No	20	20
White cell counts (per mm ³)		
<11,000	6	10
11,000–15,000	18	14
>15,000	21	17
Histopathology		
Acute	19	19
Suppurative	20	17
Chronic	0	1
Normal	6	4

Chi-square test was used; all variables had a *P* value above 0.05 (not significant).
LA, laparoscopic appendectomy.

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TABLE 2. OUTCOME

	Two-port LA n = 44	Three-port LA n = 41	P value
Operative time (min)	40.7	68.9	
Anesthesia time (min)	67.1	98.4	Significant <.05
Hospital stay (d)	2.5	3.3	Significant <.05
Meperidine used			Significant <.05
One dose only	10	11	
Two doses	3	3	
More than two doses	0	1	
Complications	None	None	
Conversion to open due to subserosal position	Nil	2	

LA, laparoscopic appendectomy.

sisted appendectomy, the appendix was extracted from the abdomen with a suitable grasping forceps. The pneumoperitoneum was deflated and a formal appendectomy performed extracorporeally. In a 3-port laparoscopic appendectomy, the mesoappendix was coagulated or clipped with monopolar coagulation, ultrasonic activated endo-shears (UltraSonic™ Auto-suture; US Surgical Corporation), or 5-mm clips. Three ligatures were applied by using endo-loops (Vicryl) at the base of the appendix. The rest of the procedure was completed intracorporeally. Meperidine (1 mg/kg intramuscularly) was used as postoperative analgesia as needed. We performed a chi-square test with Microsoft™ Excel.

RESULTS

We evaluated 86 children (ages 3 to 12 years) with uncomplicated appendicitis who underwent laparoscopic appendectomy between January 1997 and May 2001 in King Khalid University Hospital, King Saud University, Riyadh, Saudi Arabia. Forty-five children underwent a 2-port laparoscopically assisted appendectomy and 41 had a 3-port laparoscopic appendectomy performed. The demographic data, clinical and histopathologic details, and outcome results are summarized in Tables 1 and 2. There were no differences at presentation in age, gender, weight, duration of symptoms, or severity of disease (fever, leukocytosis,

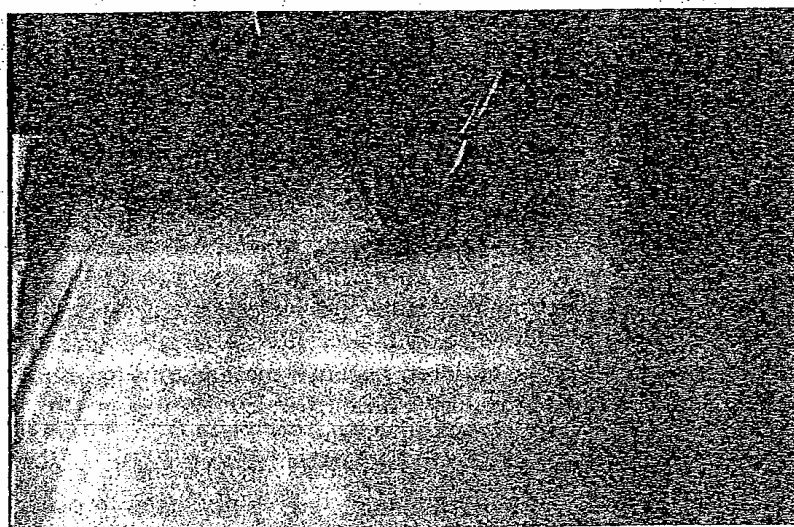


FIG. 1. Two-port laparoscopic appendectomy with extracorporeal appendectomy.

histopathology) between groups. Regarding the operative and anesthesia times, the 2-port laparoscopically assisted appendectomy was significantly shorter (40 vs. 68 minutes and 67 vs. 96 minutes, respectively; $P < .05$). The average hospital stay of children with laparoscopically assisted appendectomy was significantly shorter in comparison to the 3-port laparoscopic appendectomy (2.5 days vs. 3.3 days, $P < .05$). The postoperative analgesia requirement was also less in the 2-port laparoscopic appendectomy, but this difference was not significant ($P > .05$). The incidence of a histological normal appendix was 11.7% (2-port, $n = 6$; 3-port, $n = 4$). There were no complications in either group. Conversion to open appendectomy was required in two children with a 3-port laparoscopic appendectomy because of a very adherent subserosal and retrocecal appendix. The extra costs of endo-loops with 1 port (\$128) and the 1-day hospital charges (approximately \$266–\$400) was saved in each patient with 2-port laparoscopically assisted appendectomy. The operative times in 2-port laparoscopically assisted appendectomy and 3-port laparoscopic appendectomy were reduced to 15 minutes and 45 minutes, respectively, in each of the last 20 cases.

DISCUSSION

Laparoscopic appendectomy has many potential benefits for children. Although there is no standard technique for performing laparoscopic appendectomy in children, different methods have been described. As experience is gained with different techniques, the operative times, conversion to open procedures, and postoperative complications are gradually decreasing.

The operative time for the 2-port laparoscopically assisted appendectomy is significantly shorter than that for a 3-port laparoscopic appendectomy. The time for location and removal of the appendix is short in the 2-port laparoscopically assisted appendectomy. The use of endo-loops and dissection of the mesentery with cautery or clips takes some extra time. This is comparable with other series.¹⁻⁴ Valla et al.¹ reported 184 cases of umbilical one-puncture laparoscopically assisted appendectomy in children. Their mean operative time was 15 minutes. Valla and Steyaert⁸ reported their 6-year experience from Lenval Children's Hospital, Nice, France, in which 1200 (80%) of 1500 children underwent an extracorporeal appendectomy. They concluded that this method is simple, cheaper, quicker, and safe and offers a better cosmetic result. Their average operative time was 23 minutes for uncomplicated appendicitis. In our last 20 cases with 2-port laparoscopically assisted appendectomy, the operative time decreased to 15 minutes. Valla and Steyaert⁸ reported that a single-port laparoscopically assisted appendectomy was impossible in 7% of cases because of the retrocecal position of the appendix or a very adherent posterior wall. They also observed that the quality of bowel exploration and peritoneal lavage was not as good as for a 2- or 3-port laparoscopic appendectomy.

In a recent report of laparoscopically assisted appendectomy with microlaparoscopic instruments in 13 children, the authors used three 2-mm trocars and a separate 1-cm incision in the right iliac fossa for removal of the appendix.⁹ Four wounds (three trocars and one open incision) might not be superior to a single- or 2-port laparoscopically assisted appendectomy. In cases of complicated appendicitis, the operative times were even longer in laparoscopic appendectomy, as was observed by others.^{8,10} Complicated appendicitis was not evaluated in this paper, as the number of children was too small to draw any conclusions.

The conversion rate from laparoscopic appendectomy to open appendectomy (for technical problems such as malposition or perforation of the appendix, appendiceal abscess, or bleeding) is reported to be between 0.08% and 20% in the literature.^{1-4,8,11,12} Not many reports are available to compare the rate of conversion with 2- or 3-port laparoscopic appendectomy in children. In our cases, two (1.7%) cases were converted to open in the 3-port laparoscopic appendectomy because of a retrocecal subserosal appendix that was very adherent to the posterior wall. The conversion rate will decrease as surgeons pass the learning curve. This conversion rate is higher for adults than for children because the anatomy is more favorable in children. The rate of removal of a normal appendix was 11.7% in our review (2-port, $n = 6$; 3-port, $n = 4$). The incidence is reported as between 8% and 30% in the literature.¹⁻⁴

The requirement of postoperative analgesia is also a controversial issue in children. Because it is very difficult to assess pain in children, especially the younger ones, only a few prospective randomized trials have been done in children to compare open versus laparoscopic appendectomy.^{10,13,14} These studies show that laparoscopic appendectomy is certainly less painful and results in faster recovery and a shorter hospi-

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tal stay.^{10,14,15} Another study shows no difference in the postoperative analgesia requirement.¹³ In our series, the 2-port laparoscopically assisted appendectomy required less postoperative analgesia versus the 3-port laparoscopic appendectomy, but this difference was not statistically significant. A controlled study is required to compare these groups.

We had no complications in any case of uncomplicated appendicitis. Valla and Steyaert⁸ reported a low complication rate (0.7%) in simple appendicitis (n = 1260) in their 6-year review. Shalaby et al.⁴ reported a higher complication rate in the 3-port laparoscopic appendectomy using endo-loops (12.5%) in comparison to using an extracorporeal technique (8%) or endo-GIA (0%). Horwitz et al.¹⁶ reported that the morbidity of laparoscopic appendectomy in perforated appendicitis is as high as 56%, even with a 3-port laparoscopic appendectomy. They advised against laparoscopic appendectomy in children with complicated appendicitis. Canty, et al.¹⁴ reported that the 3-port laparoscopic appendectomy had a low complication rate (0.07%) in uncomplicated appendicitis but a higher rate (6%) in complicated appendicitis. However, this has been eliminated with more experience. First, we thought that 2-port laparoscopically assisted appendectomy was better to avoid in cases of perforated appendicitis with generalized peritonitis; however, we recently treated complicated appendicitis in a few cases without any problem. A multicenter prospective comparative study was conducted by the French group of endosurgery (GECI) for 2 years on complicated appendicitis in children.⁸ They reported that the number of cases of intra-abdominal residual abscess was higher in laparoscopic appendectomy versus open appendectomy (10% vs. 4%, $P = .04$). There is no study available to compare the complications in the 2- or 3-port techniques in children.

Finally the teaching value of laparoscopically assisted appendectomy is limited because hemostasis and suturing are done as in conventional appendectomy. Obviously the 3-port laparoscopic appendectomy has more training value. Undoubtedly, most appendectomies are performed in teaching hospitals by junior trainee surgeons. These junior surgeons are not trained in laparoscopy, and so it is necessary for the attending surgeon to be personally involved in laparoscopic appendectomy. In some settings, this is difficult because of their busy schedules, including teaching, research, and administrative work. However, all the laparoscopic appendectomies were done either by the attending or under an attending's supervision.

The cost of laparoscopic appendectomy is balanced when we counted all expenses. The use of reusable materials lowers the cost today. Laparoscopy is cost-effective for appendectomy, fundoplication, and cholecystectomy in children, as reported by Luke et al.¹⁷ The use of three endo-loops (\$32 each in Saudi Arabia) for ligation of the appendix is an extra cost in cases of 3-port laparoscopic appendectomy. As the hospital stay in cases of the 2-port laparoscopically assisted appendectomy is also less, more savings are achieved (\$266-\$400 per day; average cost from private hospitals). The cost is even more if an endo-GIA used. In one recent study, the endo-GIA cost was more than three times the cost of the endo-loop technique and six times the cost of the extracorporeal laparoscopically assisted appendectomy technique.⁴

CONCLUSION

The 2-port laparoscopically assisted appendectomy combines the advantages of open and laparoscopic techniques. Laparoscopy allows identification of the position of the appendix and the nature of the disease, complete inspection of the abdominal cavity, and diagnosis of the associated pathology with a minimal requirement for additional equipment. We conclude that 2-port laparoscopically assisted appendectomy is a safe, effective, and easy method to remove the appendix in uncomplicated appendicitis. When successful, the overall cost is less in 2-port laparoscopic appendectomy because it is quicker to perform, requires less anesthesia time and no endo-loop, endo-clips, or endo-GIA, and results in a shorter hospital stay and less postoperative analgesia.

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