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Z. Cohen · D. Shinhar · E. Kurzbart · R. Finaly · A. J. Mares

Laparoscopic and thoracoscopic surgery in children and adolescents: A 3-year experience

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Abstract Our initial experience over the last 3 years with laparoscopic and thoracoscopic surgery in children and adolescents is reported. Between September 1992 and August 1995, a total of 215 laparoscopic and thoracoscopic procedures were performed: 32 appendectomies for acute appendicitis, 10 cholecystectomies for symptomatic gallstones, 11 procedures for adnexal pathology, 6 laparoscopies in children with nonpalpable testes, 3 diagnostic laparoscopies, and 153 thoracoscopic sympathectomies in children suffering from primary palmar hyperhidrosis. The post-operative course was uneventful in all cases. In 2 children with acute appendicitis we converted to the open technique due to technical difficulties. We are encouraged by the results of our initial experience. There is no doubt that laparoscopic cholecystectomy, laparoscopic surgery of adnexal pathology, and thoracoscopic sympathectomy, because of their numerous benefits – shorter operative time, hospitalization, and convalescence as well as less post-operative pain and improved cosmetic results – are replacing the open techniques. We are not convinced as yet of the advantages of laparoscopic appendectomy in children; we are presently performing both laparoscopic and conventional techniques and studying the various parameters in order to reach a more definite conclusion. Various other endoscopic surgical procedures will be carefully considered in the near future.

Key words Minimally invasive surgery · Laparoscopy · Thoracoscopy · Children

Introduction

Laparoscopic and thoracoscopic procedures in adult general surgery are used extensively at present. There is no doubt that we have not yet reached the experience in pediatric surgery gained by the general surgeons. Technical problems related to size as well as variations in surgical indications and technique are among the reasons for delayed application in pediatric patients.

More than 20 years ago, Gans published an article dealing with his laparoscopic experience in 16 children aged 1 day to 14 years [5]. The author stated clearly that laparoscopy is indicated only when more simple studies are not definitive and exploratory surgery would therefore be considered. The advantage of this procedure is that it either avoids a laparotomy or establishes the definitive need and plan for operation. In the last few years, several articles were published in the English literature dealing with laparoscopy in children. One of the largest series was that published by Waldschmidt and Schier, describing 215 cases [28]. We now report our overall initial experience gained with this method over a 3-year period.

Materials and methods

From September 1992 to August 1995, 215 laparoscopic and thoracoscopic procedures were performed (Table 1). Thirty-two children with acute appendicitis underwent laparoscopic appendectomy: 20 boys and 12 girls aged 6 to 16 years. Twenty-four had acute or phlegmonous appendicitis, 3 had gangrenous appendicitis, 4 had perforated appendicitis with localized peritonitis, and 1 had a periappendicular abscess. In 2 cases we converted to an open technique due to technical laparoscopic difficulties. The laparoscopic technique was similar to that described by Ure et al. [23], the only variation being the use of bipolar curved scissors for dissection of the mesoappendix.

Ten patients, 3 boys and 7 girls aged 3.5 to 16 years, underwent laparoscopic cholecystectomy for symptomatic gallstones. None had hemolytic or other metabolic diseases, and hence all were considered “idiopathic”. Nine had complained of colicky abdom-

Z. Cohen (✉) · D. Shinhar · E. Kurzbart · R. Finaly · A. J. Mares
Department of Pediatric Surgery,
Soroka Medical Center, Faculty of Health Sciences,
Ben-Gurion University of the Negev,
Beer-Sheva, Israel

Table 1 Results of laparoscopic and thoracoscopic procedures

Procedure	No. of patients	Operative Time (min)	Conversion to open technique	Immediate postoperative complications	Postoperative hospitalization (post op. days)
Appendectomy	32	20–120	2	0	1–9
Cholecystectomy	10	30–70	0	0	1–4
Cystectomy and detorsion of ovary	7	50–100	0	0	1–2
Excision of ovarian dermoid cyst	1	70	0	0	1
Cystectomy	2	40–70	0	0	2
Bilateral gonadectomy	1	60	0	0	3
Non-palpable testis	6	25–40	0	0	1
Diagnostic laparoscopy	3	40–80	0	0	2–5
Sympathectomy	84 ^a	15–40	0	2	1–3

^a The 84 patients underwent 153 thoracoscopic sympathectomies, since most had bilateral procedures

inal pain for a few months and on abdominal ultrasonography (US) gallstones were detected. A 16-year-old girl presented with obstructive jaundice due to a common bile duct (CBD) stone. The stone was removed by endoscopic retrograde cholangiopancreatography (ERCP) and a papillotomy was performed at the same time. The cholecystectomy was later performed laparoscopically. The operative technique was similar to that described by Holcomb et al. [9,10] except for the intraoperative cholangiography, which we do not perform routinely.

Eleven girls ranging from 10 to 15 years underwent laparoscopic procedures due to adnexal pathology. A 14-year-old diabetic girl with XO/XY gonadal dysgenesis underwent bilateral laparoscopic removal of her streak gonads. In a 16-year-old girl with a 2-month history of abdominal pain, US revealed a mixed cystic and solid lesion of the right ovary; laparoscopic removal of a dermoid cyst was performed. In 7 patients torsion of an ovary due to cysts was suspected clinically, and in 4 was clearly diagnosed by US. Due to a high index of suspicion, early laparoscopic detorsion and cystectomy was performed and all ovaries were salvaged. Two patients underwent cystectomy of huge simple cysts (7 and 10 cm in diameter).

The laparoscopic technique in adnexal torsion is as follows: with the patient under general anesthesia, a nasogastric tube and bladder catheter are introduced. The patient is placed supine in Trendelenburg position. A CO₂ pneumoperitoneum is established through a Veress needle in the lower margin of the umbilicus to a pressure of 14 mmHg. Three 10-mm trocars are introduced, one at the lower border of the umbilicus, the second in the left lower abdomen, and the third in the right lower abdomen. The first step is to untwist the torsion and assess the viability of the organ. In all our patients the adnexa regained good perfusion and was spared. The second step was to aspirate the cyst content, followed by cystectomy. In 5 patients a Penrose drain was left in Douglas' pouch and removed within 24 h post-surgery.

Six boys ranging from 1.5 to 17 years of age underwent laparoscopy for a unilateral impalpable testis. The 1.5-year-old infant had an atrophic intra-abdominal testis and an orchiectomy was performed laparoscopically. In 3 patients the vas and vessels were seen entering the internal ring; inguinal exploration revealed a blind ending of the vas in all cases and the possible diagnosis of antenatal torsion could be entertained. In 2 additional patients no evidence of an intra-abdominal gonad or vas deferens was seen, thus classifying them as unilateral testicular agenesis. The laparoscopic technique was similar to that described by Elder [3] and Heiss and Shandling [7].

Diagnostic laparoscopy was performed in 3 patients, 2 of whom had severe, recurrent abdominal pain requiring several admissions over a short period. The 3rd, a 7-year-old girl, was suspected to have mesenteric lymphadenopathy on US and com-

puted tomography (CT). The laparoscopic findings in all cases were negative.

One hundred and fifty-three thoracoscopic upper thoracic sympathectomies were performed in 84 patients (54 females and 30 males 1.8:1) aged 5 to 18 years. Fifteen underwent bilateral non-simultaneous thoracoscopic sympathectomies, while 15 underwent unilateral procedures and are on the waiting list for sympathectomy of the contralateral side. During the last year, we began performing bilateral simultaneous sympathectomies, and thus, 54 additional patients underwent bilateral sympathectomy, bringing the total to 153 upper thoracic sympathectomies. The operation is performed with the patient under general anesthesia using an ordinary endotracheal tube. The patient is placed supine, slightly elevated at the shoulder with the arms extended laterally. An open pneumothorax is created through a 10-mm midaxillary incision in the 5th intercostal space, through which a 10-mm trocar is placed and an operating thoracoscope with the built-in working channel is introduced. CO₂ is insufflated up to a pressure of 10 mmHg. The sympathetic chain is easily identified, coagulated, and resected at the level of T₂ and T₃.

Results

Table 1 summarizes the results of the various procedures. The operative time for laparoscopic appendectomy ranged between 20 and 120 min. In 2 patients laparoscopy was stopped because of technical problems and converted to the open technique. Twenty-four children were discharged 1 to 3 days post-surgery while 8 were discharged after 6 to 9 days upon completion of prolonged IV antibiotic treatment. The postoperative course in all patients was uneventful.

In the 10 children who underwent laparoscopic cholecystectomy, the operative time ranged between 30 and 70 min. Nine patients were discharged 24 to 48 h post-surgery and 1 on the 4th postoperative day. All patients who underwent laparoscopy for adnexal pathology had an uneventful postoperative course and were discharged 1 to 2 days post-surgery. The juvenile diabetic with mixed gonadal dysgenesis underwent bilateral gonadectomy and was discharged on the 3rd postoperative day.

The laparoscopic procedures performed in the patients with non-palpable testes lasted 25 to 40 min, including the groin exploration in 3. The postoperative course was uneventful and all were discharged on the 1st postoperative day. After the diagnostic laparoscopies performed in 3 patients were negative, an incidental appendectomy was performed in 2.

One hundred and fifty-three thoracoscopic upper thoracic sympathectomies were performed in 84 patients. Two developed pneumothoraces that were relieved by intercostal drainage; 79 were discharged on the 1st postoperative day, 3 on the 2nd and 2 on the 3rd. The postoperative follow-up period ranged from 1 to 23 months. Eighty-one (97%) patients were completely satisfied with the outcome of the operation. Two were unsatisfied, claiming only minimal improvement; 1 is moderately satisfied, complaining of excessive dryness of the palms.

Discussion

Various laparoscopic procedures have been reported to be effective and safe in the pediatric population, appendectomy being most frequently performed [6, 23–25]. Our impression from our present experience is that laparoscopic appendectomy has little or no advantage over the conventional open technique. The operative time is usually longer. The postoperative course, intensity of pain, and types of analgesics required are not significantly different. The length of hospitalization is approximately the same. However, we are continuing to perform both techniques in order to reach a more definite conclusion.

Laparoscopic cholecystectomy has become the standard approach in treating cholelithiasis in adults. In the last 4 years, a few reports have been published advocating the use of the technique in children [9, 10, 16, 19, 21, 27]. Our experience shows that laparoscopic cholecystectomy is equally compatible and suitable in children and can be performed without complications. The majority were discharged 1–2 days postoperatively and were able to return to normal activity within a few more days. The placement of the ports in the teenage group is similar to that in adults. In younger children with a small abdominal cavity, the telescope camera is introduced through an infraumbilical cutdown technique under direct vision. The other three ports are placed in accordance with the patient's age and body size [9, 10]. It is of utmost importance to control the cystic duct as early as possible to prevent egress of small stones into the CBD. The entire length of the cystic duct must be well defined and visualized before being clipped. We have not found it necessary to perform routine intraoperative cholangiography as suggested by others [9, 10]. The only patient with jaundice and a dilated CBD underwent papillotomy and removal of a CBD stone by ERCP prior to cholecystectomy.

Although minimally invasive surgical procedures were introduced in pediatric surgery during the last few years, laparoscopy was rarely reported in connection with juvenile adnexal pathology [8, 11, 20, 22]. Our experience in the treatment of uterine adnexal torsion shows that detorsion and cystectomy can easily be performed by this method, although operative time is longer compared to the open technique. In this series the differential diagnosis of torsion was entertained in all patients due to a high index of suspicion based on our previous experience [13, 17], followed by the immediate use of US and laparoscopy. All adnexae were detorsed and salvaged. Four additional cases of adnexal pathology were treated electively by a laparoscopic approach with good results.

Approximately 15% to 20% of undescended testes have been reported to be impalpable [18]. Various diagnostic procedures have been used to confirm the presence or absence of the testicle, but none were conclusive [4]. Laparoscopy for impalpable testes was described 20 years ago [2, 14]. Recently, several additional publications have advocated its use [3, 7, 26]. The findings in 3 of our cases showed that the vas and vessels entered the internal ring, and an atrophic or vanishing testis was confirmed during inguinal exploration. In 2 boys the vas deferens and gonad were not identified, and they were considered to have testicular agenesis. One boy underwent an orchiectomy due to an atrophic intra-abdominal testis. There is no doubt that laparoscopy is a valuable diagnostic tool in cases of true impalpable testes. It allows good intra-abdominal visualization and the assessment of testicular presence, size, and position as well as the status of the vas deferens and vessels. Furthermore, it helps to decide whether or not to convert immediately to the conventional "open" inguinal approach.

The use of diagnostic laparoscopy should be limited and considered only when other noninvasive studies are inconclusive. It can supplement other imaging studies. In the 7-year-old girl suspected on CT scan of having mesenteric lymphadenopathy, the diagnostic laparoscopy proved to be completely negative.

A variety of reports over the last 30 years have dealt with idiopathic palmar hyperhidrosis and its surgical approaches in the adult population, but relatively few involved children [1, 12, 15], although symptoms are evident from early childhood. Early surgery for severe palmar hyperhidrosis will save a child many years of psychological, social, and physical discomfort. With the advent of minimally invasive surgery, the use of thoracoscopy seemed very logical. The thoracoscopic procedure is easy to perform as one becomes familiar with the equipment and technique, and provides an excellent view of the operative field and sympathetic chain. Since our previous report [1], we have introduced several improvements in our technique. We presently perform the procedure bilaterally during the same session. Also, only one 10-mm port of entry is used on each side rather than the previously described three ports. This has been made

possible by using the 10-mm operating thoracoscope with a 5-mm working channel (Jarit, USA), through which a 45-cm-long grasping forceps is introduced and attached to an electrocoagulation device. The double-lumen endotracheal tube, which can be difficult to insert and localize and is not suitable for smaller children, has been changed to an ordinary one. CO₂ is insufflated to a pressure of 10 mmHg with no ill effects, allowing good exposure of the 2nd and 3rd thoracic ganglia, which are coagulated and ablated.

The procedure is short, easy, and very gratifying. The postoperative course is mild, and most patients are discharged the following day and return to school and normal activities in 2–3 days. Satisfaction is almost universal, and immediate postoperative complications are almost nil. We had no case of Horner's syndrome. Compensatory sweating, mainly localized to the trunk, is the main long-term complaint and has been reported by approximately 25% of our patients. However, it does not decrease satisfaction from the palmar anhidrosis achieved. We are considering reducing and limiting the ganglionectomy to only one ganglion in an attempt to further reduce the occurrence of postoperative compensatory sweating. Interestingly, some patients describe a decrease in plantar sweating, which is a part of this syndrome, following upper thoracic sympathectomy. This is a subjective "fringe benefit" and has no sound physiological basis.

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