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Pediatric Minimal-Access Surgery: Update 2006

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ABSTRACT

Pediatric patients continue to benefit from the advances made in minimal-access surgery. Improvements in techniques and tools have made minimal-access procedures increasingly available to children. Growing popularity of laparoscopy and thoracoscopy has resulted in greater numbers of patients available for outcomes analysis. Randomized, controlled studies have been difficult to perform because of parent, patient, and physician selection bias.

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pediatric minimal-access surgery,
laparoscopy, thoracoscopy

Abbreviations

MAS—minimal-access surgery
ONF—open Nissen fundoplication
LNF—laparoscopic Nissen fundoplication
LAGB—laparoscopic adjustable gastric banding

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THE FIELD OF minimal-access surgery (MAS) has secured a strong foothold in the discipline of pediatric surgery in a remarkably brief period of time. Barely 20 years ago, laparoscopy was just taking the first few stumbling steps from diagnostics into the world of therapy. Orthopedic surgeons, gastroenterologists, and urologists had long invaded closed spaces with small scopes to remove injured or pathologic tissues. Gynecologists developed the tools and techniques to perform basic operations such as cholecystectomy and tubal ligation. General surgeons took notice of the success of their gynecology colleagues. These first few steps opened the paths to explore additional MAS procedures. Appendectomies were possible, and biopsies could be performed. Fueled by industry, tools of the trade were developed and mass-produced, allowing surgeons to expose, dissect, ligate, cauterize, cut, and remove, replicating the same maneuvers performed during open operations. Stapling techniques used for open surgery became available for MAS, allowing surgeons to create anastomoses. Because most surgeons were more comfortable with sewn anastomoses and some anastomoses seemed better suited to sutures than staples, laparoscopic needle drivers and knot-tying devices were developed. If necessity is the mother of invention, imagination is the second parent.

Pediatric surgeons have been slower to adopt MAS, in part because the patients are smaller, the operations are often performed with minimal incisions, and many of the conditions that require surgery are rare. Nevertheless, several pioneering pediatric surgeons began to perform uncomplicated surgical procedures, demonstrating that children, too, could benefit from MAS techniques. Interest in pediatric MAS became contagious. In the Division of Pediatric Surgery at the Morgan Stanley Children's Hospital of New York Presbyterian, for example, laparoscopic appendectomies were performed in <10% of the cases in 1997; in 2005, >95% of the appendectomies were laparoscopic. Similar trends have been observed in numerous other pediatric surgical services.

Likewise, the breadth of cases now being performed laparoscopically continues to grow. Enthusiastic pediatric MAS proponents have learned how to apply techniques to perform more complex and complicated procedures. Industry recognizes the need to produce versions of their instruments that are shorter and smaller to allow MAS procedures to be offered to the smallest patients. Procedures once inconceivable as MAS operations (eg, repair of esophageal atresia, Kasai procedure) have been performed with successful outcomes.

The following paragraphs present an update of the current status of minimal-access procedures in a variety of areas in the field of pediatric surgery.

EMPHYEMA

Early intervention to evacuate parapneumonic effusions and empyema results in decreased length of hospital stays. Layering fluid may be amenable to thoracentesis or closed drainage. Many patients will have fibropurulent exudate develop in the affected pleural space. Chen et al¹ have shown that >70% of children with late presentation of empyema will eventually come to surgery and that video-assisted thoracoscopy is an effective and successful method of treatment.

GASTROESOPHAGEAL REFLUX DISEASE

Antireflux surgery for gastroesophageal reflux is a common laparoscopic procedure. Comparing open (ONF) and laparoscopic Nissen fundoplication (LNF), Diaz et al² found LNF to have a significantly higher reoperation rate than ONF, although each procedure was successful without reoperation in >85% of the cases 2 years postoperatively. Somme et al³ reviewed 55 funduplications performed in infants over a 1-year span. Operating times were longer with LNF (120 ± 24 minutes) than with ONF (91 ± 21 minutes). Feeds were started >1.5 days sooner after LNF, and time from initiation of feeding to full feeds was not significantly different. Recurrence was significantly more frequent in ONF (14.3%) than LNF (2.6%). Rothenberg⁴ reported a wrap failure rate of 4% in >1000 consecutive LNF procedures compared with failure rates as high as 13% reported for ONF.

HERNIAS

Laparoscopically facilitated repair of inguinal hernias, a common practice in adults, has been performed in sufficient numbers to allow comparison to traditional open repair. Chan et al⁵ assigned consecutive patients with inguinal hernias to undergo either laparoscopic (*N* = 42) or open (*N* = 41) repair. Patients who underwent laparoscopically facilitated repair required fewer postoperative analgesics and had more contralateral hernias detected at surgery (11 vs 0). Five patients in the open-repair group subsequently had contralateral hernias appear. Spurbeck et al⁶ have shown that MAS is a safe technique for inguinal hernia repair, although Gorsler and Schier⁷ have reported a recurrence rate of 2.7% with laparoscopic repair, a figure slightly higher than reported with open repair. Recent laboratory studies demonstrate success using tissue adhesives injected into the hernia sac(s) under laparoscopic guidance.⁸

Routine contralateral groin exploration in a child with a unilateral inguinal hernia at presentation is becoming less common. Laparoscopic evaluation of the contralateral groin is now practiced by 37% of pediatric surgeons, a sixfold increase over a dozen years.⁹

PYLORIC STENOSIS

Pyloromyotomy is a common pediatric surgical procedure. More than a century of experience has demon-

strated the Ramstedt pyloromyotomy to be safe and effective. Technical nuances of the laparoscopic procedure are learned with experience, reflected by Kim et al.¹⁰ A meta-analysis of laparoscopic versus open pyloromyotomy found laparoscopic pyloromyotomy to be associated with a higher complication rate (mucosal perforation, incomplete pyloromyotomy) and similar operating times but shorter recovery times.¹¹

INTESTINAL SURGERY: SMALL INTESTINE

Laparoscopic bowel resection and anastomosis can be performed in children and adolescents for such conditions as Crohn disease, Meckel diverticulum, and duplication cyst.¹² Intestinal malrotation is amenable to correction by MAS, although the presence of volvulus may make the laparoscopic technique less desirable than open laparotomy because most pediatric surgeons will require more time to perform the procedure laparoscopically. Laparoscopic-assisted procedures have also gained popularity, allowing the surgeon to carry out the dissection laparoscopically and then deliver the loops of intestine through a small incision to perform an anastomosis outside of the abdominal cavity.¹³ Pediatric surgeons have used MAS techniques to reduce intussusception.^{14,15}

APPENDICITIS

A recent survey of the members of the American Pediatric Surgical Association revealed that 31% of respondents used a MAS technique to remove the appendix frequently (including "always," 11%), and an additional 29% reported that they used MAS occasionally. Almost 40% rarely or never treated appendicitis laparoscopically.¹⁶ Selected patients with uncomplicated appendicitis may be treated as same-day surgery patients,¹⁷ as may patients for whom antibiotic therapy followed by interval appendectomy is the selected treatment.¹⁸ Ikeda et al¹⁹ confirm that laparoscopic appendectomy shortens hospital stay in uncomplicated appendicitis but not in complicated appendicitis. Operating time was 50% longer with laparoscopic appendectomy, and overall hospital costs were 26% higher in their early experience with the operation.

INTESTINAL SURGERY: COLORECTAL DISORDERS

As with small-bowel abnormalities, colon resections may be conducted by using MAS. For more than a decade, pediatric surgeons have used laparoscopy to assist with endorectal pull-through for Hirschsprung disease.²⁰ Similar techniques are used to perform total colectomy for ulcerative colitis and familial polyposis.²¹ Georgeson et al²² have successfully performed correction of high imperforate anus using laparoscopic assistance.

SPLENIC DISORDERS

Laparoscopic splenectomy allows the patient to have the spleen removed without having the morbidity of a large,

painful incision. Most surgeons perform the procedure with 3 small access ports and a larger port through which the spleen is eventually removed. More than 85% of the spleens removed laparoscopically are removed to treat hematologic disorders.²³ In those children in whom gall bladder disease may be associated, laparoscopic cholecystectomy may be added to the procedure. Open splenic salvage is preferred for treating splenic injuries. Partial splenectomy may be conducted in selected patients, particularly in those who have a solitary nonparasitic splenic cyst.

BILIARY DISEASES

Laparoscopic cholecystectomy is the standard of therapy in patients of all ages. Advances in laparoscopic suturing and stapling devices have made it possible to perform biliary anastomoses for such conditions as biliary atresia and choledochal cyst. Laparoscopy has also been used for guided liver biopsy as well as cholangiography.

GONADAL ABNORMALITIES

Much has been written in support of MAS to treat male children with a nonpalpable testicle. A multicenter analysis of treatment for nonpalpable testicle confirmed improved results and better testicular salvage with laparoscopic techniques.²⁴ Varicocele is now routinely corrected laparoscopically with successful outcomes and low complication rates.²⁵ Ovarian torsion can often be treated laparoscopically with detorsion and pexy, resulting in a salvaged ovary in most instances.²⁶ Templeman et al²⁷ argue in favor of the use of laparoscopy to evaluate and treat ovarian cysts, the most common ovarian mass requiring operative intervention. I have removed twisted paraovarian cysts while performing laparoscopy for chronic abdominal pain.

TUMORS

In addition to gonadal tumors, other masses in the abdomen and chest have been biopsied or removed by using MAS. A multitude of biopsies have been performed for mediastinal, pulmonary, abdominal, and retroperitoneal tumors, with satisfactory results in most. Laparoscopic adrenalectomy is appropriate for selected patients; successful resection of virilizing tumors, pheochromocytomas, and neuroblastoma has been reported.²⁸ Biopsy is appropriate for some tumors, whereas complete resection may be performed on selected neoplasms.²⁹⁻³¹

OBESITY SURGERY

Bariatric surgeons are interested in developing programs for obese adolescents.³² Both laparoscopic gastric bypass and laparoscopic adjustable gastric banding (LAGB) have proven to be effective procedures to help obese and superobese patients lose excess weight in numerous studies.^{33,34} Current opinion calls for patients to be cared

for in multidisciplinary programs that include medical specialists, dieticians, psychologists, exercise therapists, and surgeons.³⁵ Gastric bypass is the most common bariatric procedure performed in the United States, but irreversibility and concern regarding chronic malabsorption have led bariatric surgeons to consider LAGB. At present, few centers are approved for LAGB; Food and Drug Administration–regulated studies are underway at 3 sites to determine the efficacy and applicability of LAGB in adolescents.

CONCLUSIONS

Smaller incisions, shorter hospital stays, and a more rapid return to preoperative activities continue to make MAS appealing to patients. Instruments now available enable surgeons to perform most operations wielding scopes rather than scalpels. Parents regularly reference Internet sites to help them make informed decisions regarding how appropriate MAS might be for their child's condition. Searching the Web for medical information may lead to incomplete or misleading information; thus, Web sites of the American Pediatric Surgical Association (www.eapsa.org) and the International Pediatric Endosurgery Group (www.ipeg.org) provide guidelines for pediatric MAS in several topics.^{36,37}

Still lacking from the pediatric endosurgical literature are controlled studies that compare open and minimal-access procedures. The enthusiasm generated by patients who undergo MAS (and their parents) and the surgeons who perform these operations are hurdles to overcome to obtain truly objective and significant results. Clinical trials organized both at individual institutions and on a multicenter level will be important to validate or challenge the presumed benefits of MAS in children and adolescents.

REFERENCES

- Chen LE, Langer JC, Dillon PA, et al. Management of late-stage parapneumonic empyema. *J Pediatr Surg.* 2002;37:371–374
- Diaz DM, Gibbons TE, Heiss K, Wulkan ML, Ricketts RR, Gold BD. Antireflux surgery outcomes in pediatric gastroesophageal reflux disease. *Am J Gastroenterol.* 2005;100:1844–1852
- Somme S, Rodriguez JA, Kirsch DG, Liu DC. Laparoscopic versus open fundoplication in infants. *Surg Endosc.* 2002;16:54–56
- Rothenberg SS. The first decade's experience with laparoscopic Nissen fundoplication in infants and children. *J Pediatr Surg.* 2005;40:142–146; discussion 147
- Chan KL, Hui WC, Tak PK. Prospective randomized single-center, single-blind comparison of laparoscopic vs open repair of pediatric inguinal hernia. *Surg Endosc.* 2005;19:927–932
- Spurbeck WW, Prasad R, Lobe TE. Two-year experience with minimally invasive herniorrhaphy in children. *Surg Endosc.* 2005;19:551–553
- Gorsler CM, Schier F. Laparoscopic herniorrhaphy in children. *Surg Endosc.* 2003;17:571–573
- Kato Y, Yamataka A, Miyano G, et al. Tissue adhesives for repairing inguinal hernia: a preliminary study. *J Laparoendosc Adv Surg Tech A.* 2005;15:424–428
- Antonoff MB, Kreykes NS, Saltzman DA, Acton RD. American Academy of Pediatrics Section on Surgery hernia survey revisited. *J Pediatr Surg.* 2005;40:1009–1014
- Kim SS, Lau ST, Lee SL, Waldhausen JH. The learning curve associated with laparoscopic pyloromyotomy. *J Laparoendosc Adv Surg Tech A.* 2005;15:474–477
- Hall NJ, Van Der Zee J, Tan HL, Pierro A. Meta-analysis of laparoscopic versus open pyloromyotomy. *Ann Surg.* 2004;240:774–778
- Rothenberg SS. Laparoscopic intestinal resection. *Semin Pediatr Surg.* 2002;11:211–216
- Diamond IR, Langer JC. Laparoscopic-assisted versus open ileocolic resection for adolescent Crohn disease. *J Pediatr Gastroenterol Nutr.* 2001;33:543–547
- Kia KF, Mony VK, Drongowski RA, et al. Laparoscopic vs open surgical approach for intussusception requiring operative intervention. *J Pediatr Surg.* 2005;40:281–284
- Goldstein AM, Cho NL, Mazziotti MV, Zitsman JL. Pneumatically assisted laparoscopic reduction of intussusception. *Pediatr Endosurg Innov Tech.* 2003;7:33–37
- Muehlstedt SG, Pham TQ, Schmeling DJ. The management of pediatric appendicitis: a survey of North American pediatric surgeons. *J Pediatr Surg.* 2004;39:875–879; discussion 875–879
- Grewal H, Sweat J, Vazquez WD. Laparoscopic appendectomy in children can be done as a fast-track or same-day surgery. *JSLs.* 2004;8:151–154
- Gibeily GJ, Ross MN, Manning DB, Wherry DC, Kao TC. Late-presenting appendicitis. *Surg Endosc.* 2003;17:725–729
- 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;39:1680–1685
- Coran AG, Teitlebaum DH. Recent advances in the management of Hirschsprung's disease. *Am J Surg.* 2000;180:382–387
- Georgeson KE. Laparoscopic-assisted total colectomy with pouch reconstruction. *Semin Pediatr Surg.* 2002;11:233–236
- Georgeson KE, Inge TH, Albanese CT. Laparoscopically assisted anorectal pull-through for high imperforate anus: a new technique. *J Pediatr Surg.* 2000;35:927–930; discussion 930–931
- Reddy VS, Phan HH, O'Neill JA, et al. Laparoscopic versus open splenectomy in the pediatric population: a contemporary single-center experience. *Am Surg.* 2001;67:859–863; discussion 863–864
- Baker LA, Docimo SG, Surer I, et al. A multi-institutional analysis of laparoscopic orchidopexy. *BJU Int.* 2001;87:484–489
- Koyle MA, Oottamasathien S, Barqawi A, Rajimwale A, Furness PD 3rd. Laparoscopic Palomo varicocele ligation in children and adolescents: results of 103 cases. *J Urol.* 2004;172(4 pt 2):1749–1752; discussion 1752
- Cass DL. Ovarian torsion. *Semin Pediatr Surg.* 2005;14:86–92
- Templeman C, Fallat ME, Blinchevsky A, Hertweck SP. Non-inflammatory ovarian masses in girls and young women. *Obstet Gynecol.* 2000;96:229–233
- Kadamba P, Habib Z, Rossi L. Experience with laparoscopic adrenalectomy in children. *J Pediatr Surg.* 2004;39:764–767
- Sandoval C, Strom K, Stringel G. Laparoscopy in the management of pediatric intraabdominal tumors. *JSLs.* 2004;8:115–118
- Spurbeck WW, Davidoff AM, Lobe TE, Rao BN, Schropp KP, Shochat SJ. Minimally invasive surgery in pediatric cancer patients. *Ann Surg Oncol.* 2004;11:340–343
- Iwanaka T, Arai M, Yamamoto H, et al. No incidence of port-site recurrence after endosurgical procedure for pediatric malignancies. *Pediatr Surg Int.* 2003;19:200–203
- Allen SR, Lawson L, Garcia V, Inge TH. Attitudes of bariatric

- surgeons concerning adolescent bariatric surgery (ABS). *Obes Surg.* 2005;15:1192–1195
33. Horgan S, Holterman MJ, Jacobsen GR, et al. Laparoscopic adjustable gastric banding for the treatment of adolescent morbid obesity in the United States: a safe alternative to gastric bypass. *J Pediatr Surg.* 2005;40:86–90; discussion 90–91
34. Parikh MS, Shen R, Weiner M, Siegel N, Ren CJ. Laparoscopic bariatric surgery in super-obese patients (BMI>50) is safe and effective: a review of 332 patients. *Obes Surg.* 2005;15:858–863
35. Inge TH, Krebs NF, Garcia VF, et al. Bariatric surgery for severely overweight adolescents: concerns and recommendations. *Pediatrics.* 2004;114:217

IF YOU'VE GOT A PULSE, YOU'RE SICK

“For a nation that spends more than any other on health, the United States certainly doesn’t seem very healthy. Many cancers are on the rise—prostate, breast, skin, and thyroid. We’re fatter than ever. As for diabetes, the number of people who say they have it has doubled in the last 10 years. Now a report says that the English—those smoking, candy-eating, fish-and-chips lovers—are actually healthier than Americans. And they spend half as much on health care. . . . The question of which country is healthier, Dr. Nortin M. Hadler [professor of medicine at the University of North Carolina] and others say, turns out to be a perfect illustration of an issue that has plagued American medicine: the more health problems you look for, the more you find. And Americans, medical researchers say, are avid about looking. The British, doctors say, are different. ‘The UK has a tradition of independent and perhaps more skeptical primary-care practitioners who are probably slower to label and diagnose people and more reluctant to follow guidelines than their US counterparts,’ says Dr. Iona Heath, a general practitioner in London. ‘I have heard it argued that the US believes more in the perfectibility of humanity and the role of science than the Europeans.’ ‘Some people call it disease-mongering,’ says Dr. Lisa Schwartz of Dartmouth Medical School. She once calculated that if everyone had the recommended tests for blood cholesterol, blood sugar, body mass index and diabetes, 75 percent of adults in the United States would be labeled as diseased. And new diseases arise by the minute, she says, her favorite example being ‘restless legs.’ . . . But the lesson for Americans is clear. These days, and especially in the United States, with its screening and testing, ‘we are labeled,’ said Dr. Hadler of North Carolina. ‘I call that medicalized,’ he added. ‘And one of my creeds is that you don’t medicalize people unless it is to their advantage. When you medicalize people, they think they’re sick, and in our culture it’s, ‘Do something, Doc. Don’t just stand there.’ Dr. Hadler has written a book about the problems of medicalization, calling it ‘The Last Well Person: How to Stay Well Despite the Health Care System’ (McGill-Queen’s University Press, 2004). The title refers to a story told by Dr. Clifton K. Meador, director of the Meharry-Vanderbilt Alliance, a cooperative program between the medical schools in Nashville. One day, as Dr. Meador tells it, a doctor-in-training was asked by his professor to define a well person. The resident thought for a moment. A well person, he said, is ‘someone who has not been completely worked up.’ ”

Kolata G. *New York Times*. May 21, 2006.

Submitted by Roger Soll, MD

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