PEDiatric LAPARoscopic SURGERY

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Abstract

The first case of laparoscopy in pediatric surgery was reported by Stephen Gans in 1971, in his landmark publication, “Advances in Endoscopy of Infants and Children,” as a peritoneoscopy. The term peritoneoscopy was soon replaced by Pediatric Laparoscopy. The availability of smaller instruments expanded the role and applications of laparoscopy and thoracoscopy in very small infants and newborns. Initially, application of laparoscopy in children was for diagnostic purposes. Pediatric surgeons were initially slower to adopt laparoscopic techniques than surgeons for adults. This was due to several limiting factors, including the lack of availability of child or adolescent-size instrumentation, surgical learning curves, and limited case volumes for complex procedures. In recent years, however, there have been marked advances in instrumentation, techniques, and training. Minimally invasive approaches have become the standard of care for operations involving the thoracic and abdominal cavities for all ages, including newborn congenital anomalies. As with adult procedures, pediatric laparoscopy offers advantages of fewer major wound-associated complications, less incisional pain, a shorter recovery, and improved cosmesis. Laparoscopy in children and adolescents bears marked similarities to adult procedures, but experience with adult surgery does not sufficiently translate to safe surgery in pediatric patients. Pediatric procedures must be performed with a full understanding of the relevant anatomic and physiologic differences between the pediatric and adult populations.

Keywords: Laparoscopy, pediatric, surgery

Introduction

Pediatric laparoscopy has been first described in 1923 by Kelling but its use has increased since last decade [1]. A laparoscopic approach offers several advantages over an open procedures; potentially reduces the surgical stress and fluid shifts that may accompany it; in addition there is less need for postoperative analgesia, reduction of postoperative respiratory and wound complications; shortens postoperative convalescence , including an intensive care unit stay; rapid return to normal diet and decreased overall hospital stay.[2]

Laparoscopic procedures in children can be done for number of indications and anesthesia for these procedures poses certain challenges which increase manifolds as the patients are children. [3]

Principles

Laparoscopic surgery involves insertion of a telescope for visualisation, and additional ports for therapeutic instrumentation under general anesthesia (fig.1).
Initially, adequate illumination and clear images were obtainable only with relatively large telescopes, but in the past few years good quality pediatric telescopes as little as 2 mm in diameter have become available [4]. The telescope is usually inserted through the umbilicus, resulting in an invisible scar [5]. The image is transmitted to one or more television monitors. The number of instrumentation ports needed is related to the complexity of the therapeutic procedure—for example, one or two for laparoscopic clipping of varicocele, four for laparoscopic fundoplication. The laparoscopic instruments are designed for the same purposes as those used in open surgery: tissue holding, dissection, retraction, hemostasis, suturing, etc. These days, most pediatric laparoscopic instruments measure 2–5 mm in diameter (fig.2).

A 10 mm trocar is only needed for complex items such as stapling devices. Technological innovations such as ultrasonically activated (harmonic) scalpel and laser have greatly facilitated laparoscopic dissection and hemostasis. A pneumoperitoneum is usually required for laparoscopy. Insufflation of carbon dioxide is limited to a pressure of 8–15 mm Hg in children to minimise diaphragmatic splinting [6]. Gasless laparoscopy is achievable by lifting the abdominal wall with special retractors or subcutaneous wiring, but the modification is not widely practised. For renal/adrenal surgery, a retroperitoneal approach can be adopted by opening up the perirenal space with blunt dissection (fig.3). [7]

Thoracoscopic surgery for chest pathology is the equivalent of laparoscopic surgery for abdominal diseases and entails single lung ventilation. This requires close cooperation between surgeon and anesthetist. [2, 8]

Advantages of pediatric laparoscopy

There is growing evidence that laparoscopy has more advantages and benefits to offer children than was earlier presumed to be the case [9-10]. These benefits have been widely reported and significantly outweigh any concerns regarding the technical difficulties which are largely overcome with increasing experience and further developments in the laparoscopic equipment [1]. The advantages of laparoscopy are:

- Reduced wound size
- Reduced wound trauma
- Less wound infection
- Less incisional hernia
- Less wound dehiscence
- Less wound pain
- Early mobilisation
- Less bleeding
- Less heat loss from tissue
- Wider field of vision
- Less postoperative adhesions
- Less postoperative ileus
- Earlier return to usual activities
- Earlier commencement of chemotherapy
- Less respiratory complications
- Less risk of thromboembolism
- Reduction in nerve entrapment

**Disadvantages of pediatric laparoscopy**

Apart from longer operating times, expensive consumables, and a large capital cost, laparoscopic surgery has inherent limitations for the surgeon. These include a two dimensional visual image, a loss of touch sensation, difficulty in controlling bleeding (limited suction, no manual pressure), limitation in the number and directions of instruments, difficulty in suturing. As a result, new skills have to be acquired. Fortunately, intensive, well structured training courses are now readily available [11]. Nevertheless, there is a learning curve and laparoscopic skills have to be maintained and improved. This presents a bigger challenge to pediatric surgeons than to adult surgeons, who have a regular procedure such as laparoscopic cholecystectomy to refine their laparoscopic skills. For laparoscopic cholecystectomy [12]. The learning curve ranges from 10 to 75 procedures. For laparoscopic fundoplication in children, proficiency could be achieved after 25 procedures [13]. In a series of laparoscopic pyloromyotomy, good results were achieved after 23 procedures, but these were associated with seven complications (30%), six of which required reoperation [14]. A potentially high complication rate in the early part of the learning curve is one of the most uncomfortable facts the surgeon will have to face, especially when this is judged against the excellent results of many pediatric procedures achieved by open surgery [15]. A recent survey that high the increasing popularity of laparoscopic surgery suggests that many pediatric surgeons are early in their learning curve.

Most complications of pediatric laparoscopic surgery are technique related. Hemorrhage is a dreaded complication because intraperitoneal bleeding is more difficult to control laparoscopically and children respond poorly to haemodynamic disturbances [17]. Inadvertent visceral injury during trocar insertion is another feared complication. The use of an open technique for the insertion of the first trocar and placement of subsequent trocars under direct vision minimises unintentional major vessel and visceral injuries. New designs of trocars with safety mechanisms further reduce such risks. Diathermy injury can lead to intestinal perforation.14 complications related to port sites include postoperative herniation of intra-abdominal contents, which can occur even through small port sizes [18]. Technical limitations could result in failure of the procedure, which might be recognised either intraoperatively or postoperatively. Conversion to open surgery is often described as a complication and a criterion to define the learning curve of laparoscopic surgery. In fact, it is much better for surgeons not to regard conversion of a laparoscopic procedure to open surgery as a complication, but rather as an attempt to prevent complications. Safety of the patient is far more important than the ego of the surgeon. Rarely, complications arise from CO2 insufflation for pneumoperitoneum during laparoscopy [19]. These include gas embolism, cardiovascular compromise, hypercapnia. The risks are minimised by the use of low pressure CO2 insufflation in children [20]. Slight increases in end tidal CO2 and peak airway pressures might be detectable intraoperatively. This can usually be compensated for by slight hyperventilation. Overall, in large centres, a low complication rate (1–2%) of laparoscopic surgery in children can be achieved. Despite the perceived technical difficulties of working in a restricted space in small infants, laparoscopic surgery has been carried out successfully in neonates as small as 1.3 kg body weight with no added complications. [21]

**Laparoscopic procedures in children**

Some surgical procedures that have been safely and efficiently accomplished through laparoscopic approach in children are enumerated in anatomical and regional groups below. [10-11]

**1- Upper gastrointestinal tract**

- Ladd’s procedure for intestinal malrotation
- Pyloromyotomy
- Fundoplication (fig.4)
- Reduction of intussusception
- Gastrostomy tube insertion
- Jejunostomy
- Heller myotomy
- Treatment of duodenal atresia
- Treatment of Jejunal atresia
- Intestinal duplication cyst
- Torsion of appendix epiplioicae
- Adhesiolysis
- Mesenteric cyst resection
- Resection of Meckel’s diverticulum
- Inflammatory bowel
- Repair of post-traumatic gastric perforation
- Repair of post-traumatic duodenal perforation

2- Lower gastrointestinal tract

- Appendicectomy (fig.5)
- Antegrade continence enema
- Laparoscopy assisted endorectal pullthrough procedure

3- Abdominal wall defects

- Epi gastric hernia repair
- Umbilical hernia repair
- Inguinal hernia repair (fig.6)
- Femoral hernia repair

4- Solid Intra-abdominal organs

- Splenectomy (fig.7)
- Deroofing of liver cyst
- Laparoscopic Kasai portoenterostomy
- Pancreatic biopsy
- Liver biopsy
- Abdominal cystic masses
- Adrenal gland biopsy
- Adrenal gland excision
- Excision of intra-abdominal neuroblastoma
- Excision of hepatoblastoma
- Excision of intra-abdominal extralobar pulmonary sequestration
- Partial pancreatectomy
- Splenic cyst resection
- Cholecystectomy (fig.8)
5- Gynecologic
- Ovarian cystectomy
- Ovarian detorsion (fig. 9)
- Oophorectomy
- Diagnostic laparoscopy for chronic abdominal pain

6- Urology
- Laparoscopy for impalpable testis
- Fowler Stephen’s stage 1 orchidopexy
- Ligation of varicocele
- Renal biopsy
- Ureteral implantation,
- Mitrofanoff appendicovesicostomy,
- Bladder augmentation
- Pyeloplasty
- Nephroureterectomy
- Heminephrectomy
- Placement of dialysis catheter

Conclusion
Laparoscopic surgery is becoming the standard of care for many pediatric conditions. There is an increased demand from referring physicians as well as the public for laparoscopic minimally invasive surgery. It is the responsibility of surgeons to ensure that these procedures are as safe as possible for their patients. Careful preparation and training are the cornerstones of successful outcomes. The willingness to convert to an open procedure when faced with significant difficulty should not be regarded as failure on the part of the surgeon, but rather as an exercise in good surgical judgment. The possibility of converting to an open procedure should always be explained to the parents and patient and informed consent should be obtained with specific reference to the possibility of conversion. There are many new and advanced laparoscopic procedures in pediatric surgery, some still controversial. As new procedures are implemented, we will need to learn more about their potential complications and how to avoid them. Rapid recognition of complications and the appropriate treatment of these problems can minimize their impact.

Références
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