



Benefits of Retroperitoneoscopic Surgery in Pediatric Urology

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Abstract

Purpose of Review The aim of this review is to find out the benefits of retroperitoneoscopy for the most common urological diseases in children.

Recent Findings The emergence of minimally invasive surgery about 20 years ago revolutionized pediatric urology. In this context, laparoscopy and later retroperitoneoscopy were developed and applied to a wide spectrum of urological diseases. Both approaches have since presented benefits and disadvantages that have been documented in various series. The main indications of retroperitoneoscopy are presented, from the classical ablative surgery, like total or partial nephrectomy, to more advanced reconstructive surgery. The success rate is similar to open surgery. However, few comparative studies have been conducted.

Summary According to the most recent findings, retroperitoneoscopic surgery in children is feasible and safe if performed by well-trained surgeons. A pediatric urologist would favor the retroperitoneoscopic access to reach the upper urinary tract and the kidney because this is the “natural” way to treat the most common urological pediatric diseases.

Keywords MIS · Retroperitoneoscopy · Laparoscopy · Urology · Children

Introduction

Minimally invasive surgery (MIS) has gained popularity in the last two decades due to numerous advantages and has evolved and made remarkable progress. Compared to the adult population, the application of this approach in the pediatric population was somewhat delayed. However, since its advent, the use of laparoscopy and later retroperitoneoscopy in pediatric urology has revolutionized the diagnosis and treatment of many pediatric urological diseases.

Two approaches of laparoscopy have been described until now: transperitoneal laparoscopy and retroperitoneoscopy. [1] The main problem in pediatric laparoscopic urology is the choice of the most suitable way to reach the urinary tract. Until few years ago, the transperitoneal route was the only route to the kidney and the urinary tract. In the past years, thanks to the report of Gaur et al., Guilleauneau et al., and Valla et al., use of the retroperitoneoscopic approach has

begun also in pediatric surgery [2–5]. In fact, both techniques have been used on children for a wide range of urological procedures such as in inguinal, renal, adrenal, upper, and lower urinary tract surgery. However, few studies have been conducted concerning the benefits of retroperitoneoscopic surgery in pediatric urology [6]. The aim of this paper is to find out the benefits of retroperitoneoscopy in the main frequent urological diseases in children.

Methods

A search on Medline found 69 items between 1998 and 2016 using relevant key search terms (retroperitoneoscopy, urology, children). This report aims to provide a large review of pediatric literature to establish the benefit of retroperitoneoscopic approach among the urological disease in children. No publication date limits were applied. There are no reports in the international literature describing large series of pediatric urologic patients treated using retroperitoneal approach, except for series requiring total nephrectomy, partial nephrectomy, and dismembered pyeloplasty.

In pediatric laparoscopic urology, the problem is the choice of the most suitable way to reach the urinary tract. The transperitoneal route was the only route to the kidney and the urinary tract until a few years ago. In general, surgeons

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prefer the transperitoneal approach at the beginning of their experience in pediatric laparoscopic urology because of the well-known and wide peritoneal working space.

Retroperitoneoscopy follows all the criteria of open renal surgery, respecting integrity of the peritoneal cavity. The procedure is performed with the patient placed in lateral decubitus position. Retroperitoneal access is achieved with the first incision 15 mm long and 1 cm from the lower border of the tip of the 12th rib (Figs. 1 and 2). Gerota's fascia is approached by a muscle-splitting blunt dissection then opened under direct vision, and the first trocar (5 or 10 mm) is introduced directly inside it. A working space is created just by gas insufflation dissection without using balloon, and the first trocar is fixed with a purse-string suture applied around the deep fascia, to ensure an airtight seal. A 5- or 10-mm 0° telescope is inserted through the first trocar. A second 3-mm trocar is inserted posteriorly near the costovertebral angle, while the third (3 mm) is inserted 1 cm above the top of the iliac crest at the anterior axillary line. To avoid transperitoneal insertion of this trocar, the working space is fully developed, and the deep surface of the anterior wall muscles identified before the trocar is inserted. The insufflation pressure is < 12 mmHg, and the flow rate of CO₂ is progressively increased from 1 to 3 L/min.

Total Nephrectomy

Nephrectomy is perhaps the most popular urologic indication for the videosurgical procedure [2]. The aim of a retroperitoneal approach is to strictly adhere to the principles of open surgery for benign lesions and to ensure a high level of cosmesis after the surgical incisions are made.

Retroperitoneal laparoscopic nephrectomy in pediatric urology was reported for the first time by Chandhoke et al. in 1993 who analyzed their experience on 41 patients underwent retroperitoneal laparoscopic nephrectomy with no intraoperative complications (surgical and anesthetic), and no significant blood loss and with only two cases of conversion to open surgery caused by failure to progress due to difficult



Fig. 1 Position of the patient

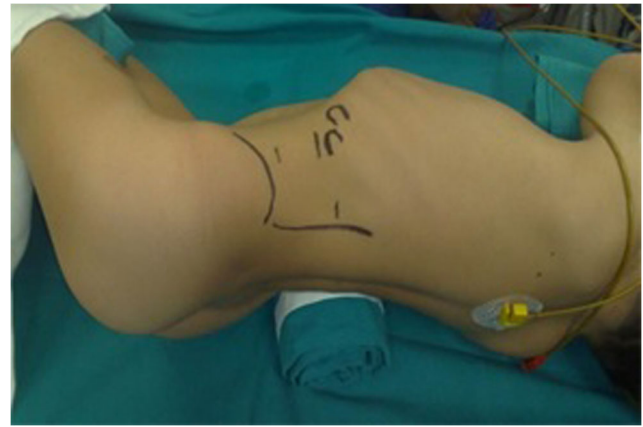


Fig. 2 Introduction points of the trocars

anatomy. Its first mention in adults occurred in 1992 and was by Gaur; today, retroperitoneoscopic nephrectomy is widely used in different centers. The main difficulty of this approach is its limitations of the working space and the need for a good imaging of the anatomy of the retroperitoneal space as described by El-Ghoneimi et al. [7].

Retroperitoneoscopic nephrectomy for benign renal disease in children has been shown to be safe and effective. The operative times were comparable to those for open surgery, but less need for postoperative analgesia and hospitalization was encountered [8, 9].

EL-Ghoneimi et al. found that retroperitoneoscopic nephrectomy was advantageous in the older population of children (median age of 5 years) [10].

Indications for this procedure commonly include exclusive benign diseases such as multicystic or dysplastic kidneys causing renal hypertension, nonfunctioning kidneys associated with obstructive uropathy, xanthogranulomatosis, pyelonephritis, protein-losing nephropathy, and, occasionally, nephrolithiasis or nephropathy causing uncontrollable hypertension [2, 6].

As for reflux nephropathy, Esposito et al. suggest that it is mandatory to perform transperitoneoscopic nephrectomy rather than a retroperitoneoscopic nephrectomy in case of VUR, because this approach permits a complete ureterectomy near the bladder dome, avoiding leaving a residual distal ureteral stump [11, 12]. In fact in their series, they noted that with retroperitoneoscopy, it is possible to remove the ureter only until it crosses the iliac vessels, leaving in place the last 5–6 cm of the ureter. For this reason, in case of nephrectomy for VUR, it is necessary to perform this procedure transperitoneally in order to remove the entire ureter as near the bladder as possible [11, 13]

Partial Nephrectomy

Partial nephrectomy using the videosurgical approach for benign pathologies has been often reported in infants. The

indications are renal duplication and a poorly functioning, chronically infected upper-pole segment. The retroperitoneal approach seems preferable for this procedure [2].

Jordan and Winslow firstly reported laparoscopic partial nephrectomy in 1993, and since then, it has gained wide acceptance, mainly due to the large working space [14]. The first report of a pediatric retroperitoneal laparoscopic heminephrectomy was published by Miyazato et al. in 2000 [15]. Both procedures in children are considered complex techniques with limited diffusion among pediatric surgeons and pediatric urologists [16, 17]. For this reason, scanty reports exist in the international literature about the use of laparoscopy and retroperitoneoscopy in children to perform partial nephrectomy. In particular, very few comparative series comparing the results of laparoscopic partial nephrectomy with retroperitoneoscopic partial nephrectomy have been reported like those by Castellan M et al. in 2006 and Marszalek M et al. in 2011 who compared the transperitoneal and retroperitoneal approach for heminephrectomy [16].

In the recent years, thanks to the use of new hemostatic and synthesis devices that permit faster and safer procedures, the technique seems to be easier to perform.

As for retroperitoneoscopic approach, direct access to the renal vessels without violating the peritoneal cavity is the main advantage of the lateral and prone retroperitoneal method.

Borzi and Yeung also advocated that the lateral position in retroperitoneoscopy is indicated in the case of ectopic kidneys [1].

It is important to note that in the case of duplex kidney, a ureteral catheter was placed preoperatively by cystoscopy in the ureter of healthy moiety in order to facilitate its recognition and avoid any inadvertent injury. In the majority of children, the dissection of parenchyma was made with the aid of specific [1].

Esposito et al. compared laparoscopic and retroperitoneoscopic approaches regarding partial nephrectomy in the pediatric population. The authors found significant statistical differences between the two approaches regarding operative time, hospitalization (longer in the retroperitoneal approach), and a higher complication rate in retroperitoneal approach. For this reason, the procedure must be performed only by pediatric urologists with a solid experience in laparoscopy and retroperitoneoscopy [16].

Dismembered Pyeloplasty

Ureteropelvic junction obstruction (UPJO) is the most common disorder of the upper urinary tract in children. As a result of progress in diagnostic ultrasound, hydronephrosis can nowadays even be identified prenatally.

The surgical correction of UPJO has been a urological challenge for more than one century [18]. Open dismembered pyeloplasty according to Anderson-Hynes (AHP) has been the gold standard treatment for ureteropelvic junction obstruction in children for several years. However, during the last

decades, the management has been revolutionized with introduction of laparoscopy with comparable results and less morbid outcomes [19, 20].

The first laparoscopic pyeloplasty for children was described by Schuessler [21] and Kavoussi [22].

Since then, suturing techniques together with improved visualization of the structures have developed rapidly. As a result, a number of larger centers have introduced the laparoscopic technique because of its minimal invasiveness.

The laparoscopic Anderson-Hynes procedure can be performed in two different ways: transperitoneal and retroperitoneal [23]. In the transperitoneal approach, the operative space is large, the operative marking is distinct, and the operative field is better lighted due to peritoneum reflection. On the other side, this approach may disturb other intraperitoneal organs, such as stomach and intestines, which can result in complications. In particular, urine leakage caused by the operation may lead to some serious consequences.

For the retroperitoneal approach, although the operative field is less clear, it involves fewer intraperitoneal organs, and urine leakage is easy to handle [24]. In our opinion, retroperitoneal approach is more suitable for urological surgery, since it makes a direct access to the target lesion and causes less injury. The advantages of this approach would be even more obvious when the operator is skillful in establishing the retroperitoneal space and familiar with its topographical features [18].

Various authors presented their experiences using different techniques (dismembered and non-dismembered pyeloplasty) with success rates of more than 90%. Casale et al. reported on 26 children who underwent both a dismembered and non-dismembered laparoscopic transperitoneal pyeloplasty. The non-dismembered pyeloplasty was performed by Heineke–Mikulicz technique with a poor success rate of 43%. Therefore, a dismembered laparoscopic pyeloplasty was recommended in children without a crossing vessel [25].

Yeung et al. reported their initial experience in 2001 with retroperitoneal dismembered pyeloplasty in 13 patients; one required open conversion [26].

El-Ghoneimi et al. in 2003 well described the retroperitoneal approach in their experience with the technique of dismembered laparoscopic pyeloplasty via a retroperitoneal approach in 22 children in a period of 3 years. They conclude that the procedure is difficult to learn and the duration still too long for pediatric pyeloplasty, but cosmetically, there is no doubt that with the 3-mm ports, the results of retroperitoneoscopic approach are better than open surgery scars.

According to their experience, the retroperitoneal laparoscopic dismembered pyeloplasty represents an attractive alternative to conventional open pyeloplasty, but it is technically challenging, although with practice and technical adaptation to improve suturing, retroperitoneal laparoscopic dismembered pyeloplasty may be completed in the same time as conventional open pyeloplasty. Surgical robotics may facilitate

suturing in such a limited working space [10]. In fact, Robotic pyeloplasty is likely to emerge as the new minimally invasive standard of care whenever robotic technology is available, because its precise suturing and shorter learning curve represent unique attractive features. For both laparoscopy and robotics, the technique can be tailored to the specific case according to intraoperative findings and personal surgical experience [27].

Discussion

Retroperitoneoscopic surgery in children is feasible and safe if performed by well-trained surgeons. Between transperitoneal and retroperitoneal approach, the choice should be made according to each case; however, in our opinion, pure pediatric urologist would favor the retroperitoneoscopic access to reach the upper urinary tract and the kidney, because this is the “natural” way even if it is more difficult to learn at the beginning.

Operative urological minimal access surgery has recently expanded its range of indications due to improved laparoscopic technology and an increased interest in minimally invasive therapeutics. In other words, the indications have evolved from diagnostic procedures 20 years ago, than to ablative procedures 10 years ago, and now to reconstructive surgery [3].

Nowadays, minimally invasive surgery for pediatric nephrectomies is established as routine practice. Transperitoneal and retroperitoneal are the two approaches for performing either total or partial nephrectomy. During transperitoneal laparoscopy, the surgeon must mobilize the hepatic flexure of the colon in order to expose the right kidney, and the splenic flexure to expose the left kidney. This approach is easier compared to retroperitoneoscopy, since it allows plenty of space, but it has an inherent risk of adhesion formation or intestinal perforation.

Faster access and easier dissection of the parenchyma can be achieved with the retroperitoneal approach [1].

As for the repair of ureteropelvic junction obstruction, the retroperitoneal approach is now an acceptable method. The cosmetic result is superior in retroperitoneoscopy, and the need for reoperation is also reduced in comparison with the transperitoneal approach [1].

In conclusion, it is possible to state that retroperitoneoscopy is the technique of choice for reaching the urinary tract in children, as it can be performed safely and effectively in children. Still, this procedure is more challenging and requires excellent imaging of the retroperitoneal space, especially when partial nephrectomies are involved.

Retroperitoneoscopic approach offers several potential advantages. The main advantage is its more direct and rapid exposure without peritoneal cavity transgression and without dissection and handling of intraperitoneal structures which could be injured during these maneuvers.

The working space is not obscured by intestinal loops; therefore, the risk of postoperative paralytic ileus, shoulder pain, omental evisceration, and intestinal adhesions is eliminated.

The retroperitoneal approach can be performed even after previous transperitoneal surgery [3]. The direction of future development for videosurgery in pediatric urology will surely be the robotic technology that, with the precise control of surgical manipulation, will allow advanced surgical procedures with less complications.

Compliance with Ethical Standards

Conflicts of Interest M. Cerulo, M. Escolino, F. Turrà, A. Roberti, A. Farina, and C. Esposito each declare no potential conflicts of interest.

Human and Animal Rights and Informed Consent This article does not contain any studies with human or animal subjects performed by any of the authors.

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