

Laparoscopic vascular relocation procedures in the treatment of hydronephrosis due to aberrant vessels compression in children

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Abstract

Introduction. Congenital hydronephrosis, can be caused by intrinsic and / or extrinsic uretero-pelvic obstruction. Regardless of the type of obstruction, pyeloplasty remains the traditional surgical procedure for hydronephrosis in children, though procedures that aim to relocate the vascular pedicle, commonly known as "vascular hitch", were described for hydronephrosis associated with aberrant renal vessels. Because of the development of minimally invasive surgery, this surgical technique gained its maximum utility in laparoscopy. We describe our experience with laparoscopic technique of relocating the aberrant vessels, in children with PUJO.

Materials and method. Between January 2007–February 2015, a total of 35 patients, were operated by a laparoscopic technique for hydronephrosis. In this group, we studied eight patients (five boys and three girls), with a mean age of 9.7 years (range 4e17), diagnosed with vascular compression of the pelviureteric junction, who underwent laparoscopic relocation of the aberrant vessels. Surgical indication was based on an intermittent lumbar pain associated with evidence of pelviureteric obstruction (ultrasound / urography / DTPA scintigraphy).

Results. The laparoscopic surgical technique involved dissection and mobilization of the lower pole vessels, freeing the junction and suspension of the vascular pedicle on the anterior pelvic wall. None of the patients required ureteral stenting, but a lumbar drain was held in place for 48 hours. In a single case we practiced the suspension of the pelvis to the psoas muscle, in a girl who had a simultaneous pelvic bifidity, and developed a troublesome postoperative course, caused by inefficient drainage of the renal pelvis, so the final solution was a uretero-calycostomy and ureteral stenting. The main outcome variables measured were relief of pain, improvement of the value of the urinary tract distension on ultrasound and of the renal function on scintigraphy, performed 3 and 6 months after surgery. Average operating time was 110 minutes. All patients were discharged on the fourth postoperative day, except for one patient, who was hospitalized for 21 days. All of the patients remained free of symptoms after six months. They showed no obstruction signs on ultrasound, with improvement of the renal appearance.

Conclusions. Vascular relocation procedures are simple, requiring less operative time than pyeloplasty. Their advantages are maintaining the integrity of the urinary tract, without anastomosis or ureteral stenting. Controversy remains regarding patency of the pelviureteric junction.

Keywords: congenital hydronephrosis, pelviureteric junction obstruction (PUJO), ureterovascular hydronephrosis, vascular hitch

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Introduction

Congenital hydronephrosis, common disorder in pediatric pathology, also known as pyeloureteral junction obstruction (PUJO), can be caused by both intrinsic and extrinsic obstruction. Aberrant renal vessels (lower pole vessels) are the most frequent etiology for extrinsic obstruction, known as ureterovascular hydronephrosis.

This reality has been recognized and addressed since the early surgical treatment of hydronephrosis. J. C. Anderson established the most popular surgical procedure for the treatment of congenital hydronephrosis, known as "dismembered pyeloplasty". Although he noted that the operation described with W. Hynes [1] can be applied in all cases, regardless of cause, he lists, among the other surgical techniques, nephroplasty or nephroplication, as an alternative surgical solution for ureterovascular hydronephrosis.[2]

Surgical solutions, developed over time, followed all the same objective, namely, the release of the pyeloureteral junction from the vascular compression. The first to imagine a surgical technique by which he achieved this goal was Hamilton Stewart, who, in 1937, performed the first nephroplication or nephroplasty, published in the British Journal of Surgery in 1947. [3] The operation aimed cranio-caudal plication of the kidney, with changing of the relative position of the vascular pedicle and pyeloureteral junction with its subsequent release. The good results of this surgery, imposed it as a therapeutic solution for a long time, being used and adapted by many surgeons. [4]

Another surgical technique, addressing the same etiological forms of hydronephrosis was imagined and created by Hellstrom, who supported the vessels by sutures passed through the perivascular connective tissue [5, 6]. Over time, this surgical correction presented various changes, so what is mainly used today is a modification of the technique imagined by Hellstrom. It was developed by Chapman in 1954, and consists of performing a tunnel of pelvic wall in which the vascular pedicle is enclosed, thus nullifying the effect of vascular clamp.[7]

Although initially used with good results, then neglected, these surgical techniques have been brought back to practice by adult-urolologists, because of the development of minimally invasive surgery. Known as the "vascular hitch" this surgical technique has found its maximum utility in laparoscopy. [8]

The purpose of this article is to present the clinical and imaging characteristics of this form of hydrone-

phrosis, and highlight the applicability of laparoscopic vascular relocation techniques, as an alternative solution to laparoscopic pyeloplasty in children.

Materials and methods

This study involves the analysis of patients diagnosed with hydronephrosis secondary to pure extrinsic vascular obstruction who underwent laparoscopic vascular relocation procedures in the Clinic of Pediatric Surgery of Emergency Hospital for Children "Marie Curie", Bucharest, between January 2007 and February 2015.

We included in the study - of a total of 35 patients, aged two months to 17 years (average age 5.6 years), who underwent laparoscopic surgery for hydronephrosis - eight patients who were diagnosed with pure extrinsic obstruction of the pyeloureteral junction due to a lower vascular pedicle and were addressed with a laparoscopic repositioning of the vascular pedicle.

Age of those eight patients was between four to 17 years, with a mean value of 9.1. Gender distribution of patients, less important in terms of pathology, was in favor of male patients (five/three).

None of those eight patients had a prenatal diagnosis.

Age of the patients at the moment of diagnosis was between three and 17, with an average value of 8.5. The moment of diagnosing hydronephrosis, was relatively late, partially due to the absence of changes on ultrasound imaging (in the pre- and immediate postnatal period), and the non-specific, less noisy symptoms developed later in life.

Patients presented because of subtle symptoms, such as intermittent, colicky lumbar pain episodes, augmented by increased fluid intake (three patients, aged over ten years), repeated urinary tract infection (two patients) or as a result of routine ultrasound examinations (three patients). For a complete diagnosis, every patient followed ultrasound, scintigraphy and retrograde studies, which showed hydronephrosis, obstructed drainage and a normal caliber ureter.

In our study we have not recorded the development of high blood pressure secondary to hydronephrosis.

Development of hydronephrosis in the context of a pre-existing renal malformation, was identified in one patient. The malformative association - bifid pelvis, junctional vascular obstruction - influenced the choice of the surgical procedure.

Surgical indication was established by evidence of

pelviureteric obstruction and the presence of symptoms, both presenting in the study group in an intermittent way. Criteria used were the classic ones used for the surgical indication in hydronephrosis, the particular form of vascular compression being diagnosed intraoperative (table 1).

Table 1 Criteria used for surgical indication in hydronephrosis

Criteria	Elements
Symptomatology	Intermittent, colicky lumbar pain episodes, augmented by increased fluid intake Repeated urinary tract infection
Ultrasound	Pelvic dilatation (antero-posterior pelvis diameter > 3 cm) Calyceal clubbing Reduction of the renal parenchyma Absence of ureteral dilatation
Urography/Uro-CT DTPA Scintigraphy	Pelviureteric obstruction with less than 40 % of differential renal function

Pelvis dilatation was the most frequent found criteria in the study group, with values ranging from 3.2 to 4.8 cm, with an average of 4.2 cm, in comparison to the calyceal appearance, which showed only moderate dilatation. Degree of pyelocalyceal dilatation is variable, depending on the hydration status, and it correlates with the intermittent lumbar pain syndrome.

Regarding the renal function – a relative function over 40% on the affected side was found in patients' renal scintigraphy and had a non-obstructive response to the administration of furosemide.

Imaging explorations allowed a firm diagnosis of hydronephrosis (fig. 1), and also raised suspicion of vascular obstruction form in four cases. Elements suggestive of ureterovascular hydronephrosis were aberrant vessels located close to the lower renal pole, identified by Doppler ultrasonography, and the tortuous appearance of the subjunctional ureter (fig. 2).



Fig. 1 Urography showing hydronephrosis (grade III), obstructed drainage and a normal caliber ureter with a sharp cut-off.



Fig. 2 Uro-CT showing pyeloureteral obstruction with pyelocalyceal dilatation; tortuous appearance of the subjunctional ureter

However determining that the cause of the pyeloureteral obstruction are aberrant lower pole vessels, was most frequently an intraoperative process.

Results

Laparoscopic surgical procedure, realized in a transperitoneal manner in all eight cases, aimed the suppression of the vascular obstruction of the pyeloureteral junction, by relocating the vessels, as in the Chapman modification of Hellstrom technique (seven cases), or by suspending the pelvis to the psoas muscle (one case), surgical correction method required in the patient with a bifid pelvis, because of the pelvis anatomy and a voluminous vascular pedicle.

The operative technique

Preoperative preparation consisted in administration of a diet based on liquids starting on the day before surgery, in order to minimize intestinal distension which might impede the creation of a comfortable work space.

Laparoscopic transperitoneal approach was performed in all seven cases. Position of the patient on the operating table is in a lateral semidecubitus; surgeon is situated on the opposite side of the lesion and on his left side the cameraman is situated. Optical trocar, usually a five mm trocar, is placed at the umbilicus, in an open manner; the two working ports are placed supra-umbilically and the other in a pararectal, subumbilical position, enabling thus a triangulation for easily handling the instruments, and performing intraoperative gestures.

All interventions were performed in a transperitoneal manner; after a preliminary intraperitoneal exploration, dissection of the pyeloureteral junction was achieved, identifying the lower polar vascular pedicle as

the cause of the obstruction (fig. 3). Vascular dissection and release of the compression, as well as testing pyeloureteral permeability by administration of a diuretic and visualizing the peristaltic movements, allowed the establishment of the suitable surgical technique.

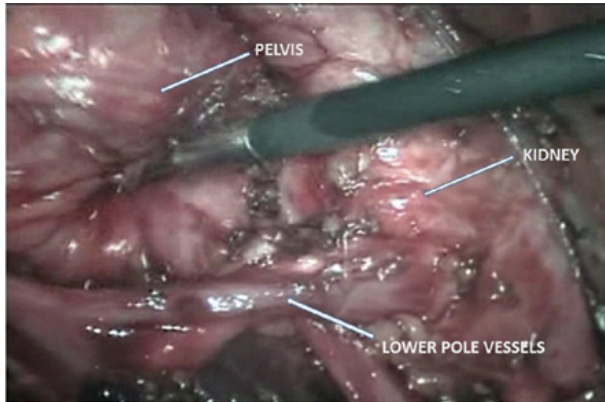


Fig. 3 Intraoperative aspect: important pelvis dilatation due to lower pole vessels compression

Suppression is achieved by elevation of the mobilized vessels and invagination in a pelvic tunnel realized on the anterior pelvic wall by a series of Lembert sutures (fig. 4).

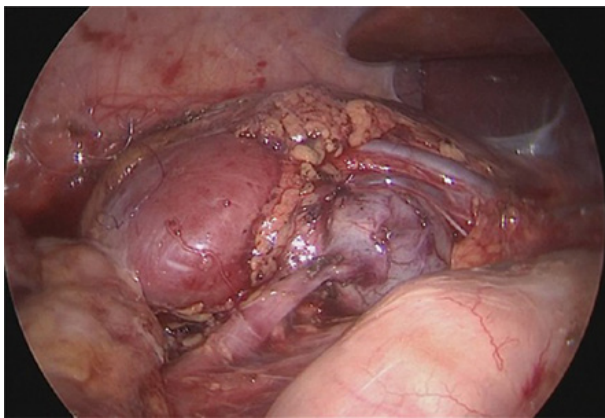


Fig. 4. Operative technique – Suspension of the lower pole vessels on the anterior face of the pelvis

In case of a pelvic malformation, a low volume or intrarenal pelvis, pelvis suspension to the psoas muscle can be achieved, thus relocating the pyeloureteral junction from the vascular clamp. [9]

In all cases, lumbar drainage was performed, and it was maintained for 48 hours. As our intervention preserved the integrity of the urinary tract, ureteral stenting was not accomplished.

Duration of surgery was an average 110 minutes, with a range between 65 and 145 minutes.

In the group of patients operated by this laparo-

scopic approach, there was no conversion.

There was a single complex evolution – in the patient with the hydronephrosis associated with a bifid pelvis, where, after practicing the “psoas-hitch” procedure, there was an inefficient drainage of the renal pelvis, so the final solution was a uretero-calycostomy, with a favorable postoperative course.

Postoperative course was unproblematic in seven of the eight cases, patients' hospitalization was on average four days, excepting one patient, who, due to the reintervention, was hospitalized for 21 days.

Long-term evolution was favorable in all patients, their status being analyzed clinically, biologically and by imaging techniques after three and six months. All of the patients were free of symptoms after the surgery; no urinary tract infection was recorded after surgical correction. Ultrasonography showed remission of the urinary obstructive signs with no calyceal dilatation and reduction of the pelvis ectasia. Scintigraphy performed six months after surgery revealed a normal value of relative renal function (>40%), in all cases.

Discussions

In the literature, there are few published series of pediatric patients diagnosed with extrinsic hydronephrosis due to aberrant vessels, approached by laparoscopic vascular relocation procedures. [10-12]. They all report a reduced number of patients, with the largest group (19 patients) being described by Singh et al.[11] A large series was described by Pesce et al, who reported 61 children, who were treated by open vascular relocation in a period of 25 years. [13]

Regarding vascular obstruction hydronephrosis, it is known that it is a form that is most often diagnosed in older children and adults. Incidence of this etiological form in our group of patients operated for hydronephrosis is about 23%, proving that it has a relatively low incidence in the pediatric population compared to the older children and adult population where it reaches over 50%.[11, 14] In a series of older, symptomatic children, Cain et al. reported an incidence of 58 % for extrinsic hydronephrosis.[14]

Another aspect to be mentioned is the average age in the group of patients - 9.1 years - high value compared to the average age of the group of patients with intrinsic obstruction form (5.6 years), similar results being described in the literature [10, 11]. Antenatal diagnosis of the disease was absent in all patients. The diagnosis was established either in the presence of in-

intermittent lumbar symptomatology in children over 10 years, or in the context of urinary tract infection and routine imaging investigations in younger children.

Clinical and imaging diagnosis is based on symptoms and on the intermittent nature of pyelocaliceal dilatation. There are discrepancies between important pyelocaliceal dilatation and low renal functional impairment, due to the partial, intermittent nature of obstruction. Surgical indication was established despite of the relative values of over 40% of renal functionality. Clinical and imaging aspects of extrinsic pyeloureteral obstruction have been described by Rigas et al, highlighting the preservation of a good renal function.[15]

Simultaneously renal malformation is an important aspect to consider. Concomitant ipsilateral pathology and anatomical particularities (intrarenal pelvis) may influence the election of the surgical procedure and postoperative outcome.

The surgical dispute, regarding the surgical correction of hydronephrosis secondary to vascular obstruction persists. Hynes-Anderson pyeloplasty remains a reliable surgical solution, although both on classical and laparoscopic surgery, "unconventional" surgical methods of vascular relocation is gaining more ground. [11, 13]

Indications of this technique, are the cases of uretero-vascular hydronephrosis, having a considerable renal pelvis dilatation and an extrarenal pelvis with a permeable pyeloureteral junction. The most important element in establishing the surgical indication is the exclusion of concomitant intrinsic obstruction; if one cannot appreciate a correct pyeloureteral transit, it is preferable to practice pyeloplasty. [12, 16, 17]

Advantages of this procedure remain the integrity of the urinary system and the low degree of difficulty, having similar postoperative results as pyeloplasty. Complications are rare and avoidable in terms of a judicious surgical indication.

Conclusions

With the development of minimally invasive surgical techniques, vascular relocation procedures tend to become the surgical technique of choice in this aetiology of hydronephrosis, with similar results to pyeloplasty.

The most important aspect of this intervention remains the exclusion of intrinsic pelviureteric obstruction.

The technique of laparoscopic transposition of crossing renal vessels, having a medium degree of difficulty, may be the starting point in the laparoscopic approach of renal pathology.

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