

Our experience with laparoscopic Anderson-Hynes ureteropyeloplasty

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ABSTRACT

Objective. To analyze whether the application of laparoscopic surgery in the treatment of pyeloureteral junction obstruction (PUJO) has been beneficial for pediatric patients.

Materials and methods. Medical records of all patients undergoing PUJO surgery from January 1997 to December 2017 were retrospectively reviewed. Patients with <6-month follow-up and patients undergoing video-assisted surgery were excluded. Open surgery was compared with laparoscopic surgery. The following data were collected: surgical approach, need for and type of urinary diversion, operating time, mean hospital stay, complications, and restenosis rate. Ultrasound and diuretic renogram parameters were also retrieved.

Results. 328 Anderson-Hynes pyeloplasties were analyzed, 142 of which had been performed laparoscopically. Overall success rate was 96.6%, and complication rate was 11.9%. No significant differences were noted between open and laparoscopic surgery.

In 97.5% of surgeries, urine was diverted using an external nephroureteral catheter, a double J stent, or a Salle stent, with significant differences between open and laparoscopic surgery. Mean operating time was significantly longer in laparoscopic surgery. Mean hospital stay was significantly shorter in the laparoscopic surgery group.

Conclusion. Surgical approach does not play a role in PUJO surgery success. Therefore, in our view, laparoscopic surgery should be the technique of choice in pediatric patients.

KEY WORDS: Pyeloureteral junction obstruction; Hydronephrosis; Laparoscopy; Pediatrics.

URETEROPIELOPLASTIA ANDERSON-HYNES LAPAROSCÓPICA EN NIÑOS. NUESTRA EXPERIENCIA

RESUMEN

Objetivo. Analizar si la aplicación de la cirugía laparoscópica en el tratamiento de la estenosis pieloureteral (EPU) han sido beneficiosos para el paciente pediátrico.

Material y método. Hemos revisado de forma retrospectiva las historias clínicas de todos aquellos pacientes intervenidos de EPU desde enero 1997 hasta diciembre 2017. Se excluyeron las que tuvieron seguimiento menor a 6 meses, y las cirugías videoasistidas. Se han comparado la cirugía abierta con la cirugía laparoscópica. Se han recogido los siguientes datos: abordaje quirúrgico, necesidad y tipo de derivación urinaria, tiempo quirúrgico, estancia media, complicaciones, tasa de reestenosis. Los parámetros ecográficos del renograma diurético también han sido recogidos.

Resultados. Se han analizado 328 pieloplastias, 142 se realizaron laparoscópicamente. La tasa de éxito global ha sido del 96,6%, existiendo un 11,9% de complicaciones; sin existir diferencias significativas entre la cirugía abierta y la laparoscópica.

En el 97,5% de las cirugías, la orina se derivó mediante catéter nefroureteral externo, catéter doble J o catéter tipo Salle; existiendo diferencias entre cirugía abierta y laparoscópica. El tiempo quirúrgico medio fue significativamente superior en la cirugía laparoscópica. La estancia media fue menor en el grupo de cirugía laparoscópica de forma significativa.

Conclusión. La vía de abordaje no es un factor que influya en el éxito de la cirugía de la EPU, por ello pensamos que la cirugía laparoscópica es la técnica de elección en pacientes pediátricos.

PALABRAS CLAVE: Estenosis pieloureteral; Hidronefrosis; Laparoscopia; Pediatría.

INTRODUCTION

Pyeloureteral junction obstruction is the most frequent cause of congenital hydronephrosis. Even though treatment is typically conservative, surgery still plays a very important role in cases with clinical, ultrasound, or differential renal function worsening.

Pyeloureteral junction obstruction repairing surgery was first described by Anderson-Hynes in 1949. It estab-

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Date of submission: January 2020 Date of acceptance: April 2020

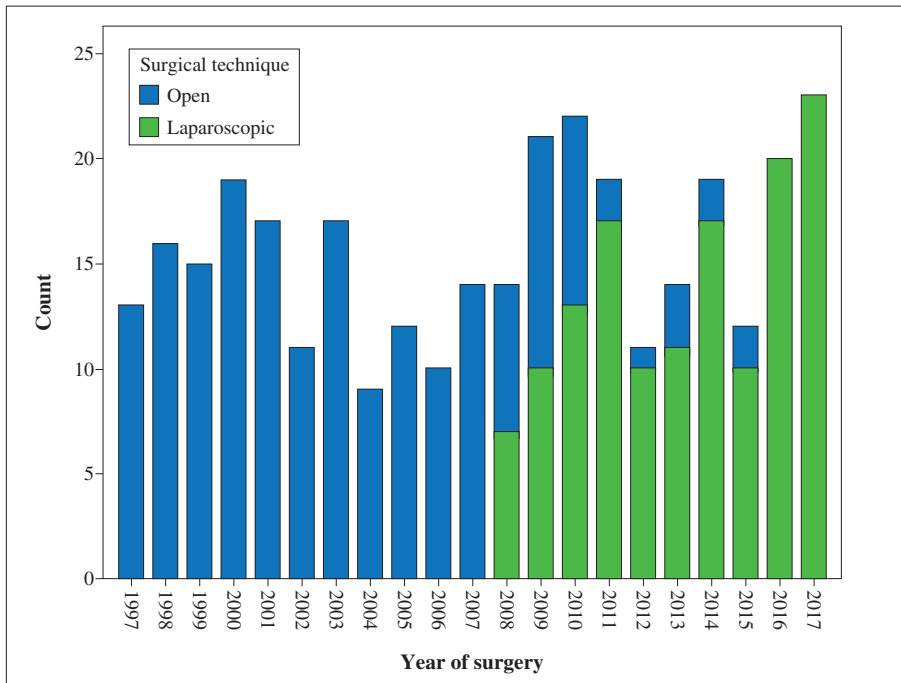


Figure 1.

lishes that the pyeloureteral junction is to be divided and the renal pelvis is to be reduced in order to avoid urine stasis and the kinking effect in the ureter⁽¹⁾.

In 1995, Peters first described the laparoscopic approach to this syndrome in a pediatric patient. This technique has been gaining prominence up until now, but owing to the technical difficulty of pyeloureteral anastomosis, the small space available, longer operating times, and the possibility of performing pyeloplasty in infants using an open approach with a small incision, the laparoscopic technique is used in a small number of healthcare facilities^(2,3).

Anderson-Hynes pyeloplasty efficacy and complications are widely described in the literature, with various factors having a potential impact on them: patient age, surgical approach, type of suture, urinary diversion, and re-interventions⁽⁴⁻⁶⁾. In our healthcare facility, laparoscopy was introduced in 2007. Since then, it has been gaining prominence and it has become the approach of choice in most patients^(3,7) (Fig. 1). The objective of this work was to review our experience in pyeloureteral junction obstruction treatment by comparing the open approach with the laparoscopic approach in pediatric patients.

MATERIALS AND METHODS

Medical records of all patients undergoing Anderson-Hynes pyeloplasty from January 1997 to December 2017 were retrospectively reviewed. Patients with <6-month follow-up and patients undergoing video-assisted surgery were excluded. Patients were divided

into two groups: open approach (OP) and laparoscopic approach (LP).

Demographic data and PUJO laterality and etiology were collected. Ultrasound, preoperative, and postoperative data were retrieved: renal pelvic anteroposterior diameter (PAD) and calyceal anteroposterior diameter (CAD). Preoperative and postoperative differential renal function (DRF) was also collected in the MAG3 diuretic renogram. Surgical indications were based on clinical criteria (urine infections, lithiasis, colic pain), ultrasound criteria (grade III or grade IV hydronephrosis), and MAG3 renographic criteria with obstructive curve and/or <40% DRF or DRF worsening during follow-up.

Success rate, complication rate, and complication severity were analyzed and compared according to Clavien-Dindo's classification⁽⁸⁾ (Table 1), as well as the use and type of urinary diversion, operating times, and mean hospital stay.

Surgery was considered successful in patients with ultrasound and/or renographic parameter improvement, and failed in patients requiring re-pyeloplasty (open or laparoscopic) or endourological treatment to dilate the pyeloureteral junction.

Surgical Technique

Open pyeloplasty (OP)

Under general anesthesia, the patient was placed in a supine position. An extraperitoneal anterior approach was used in all patients through a transverse subcostal incision until reaching the renal cell. The pyeloureteral junction and part of the renal pelvis were removed as

Table 1. Clavien-Dindo's classification⁽⁹⁾.

Grades	Definition
I	Any deviation from the normal postoperative course without the need for pharmacological treatment or surgical, endoscopic and radiological interventions Allowed therapeutic regimens are: drugs as antiemetics, antipyretics, analgesics, diuretics and electrolytes and physiotherapy. This grade also includes wound infections opened at the bedside
II	Requiring pharmacological treatment with drugs other than such allowed for grade I complications Blood transfusions and total parenteral nutrition are also included
III	Requiring surgical, endoscopic or radiological intervention <i>IIIa</i> : intervention not under general anesthesia <i>IIIb</i> : intervention under general anesthesia
IV	Life-threatening complication (including CNS complications) requiring IC/ICU-management <i>IVa</i> : single organ dysfunction (including dialysis) <i>IVb</i> : multiorgan dysfunction
V	Death of a patient

described by Anderson-Hynes. Suturing was performed using interrupted absorbable stitches. In pole vessel extrinsic compression cases, ureteropyeloplasty was carried out by transposing it anteriorly to the pole vessels. In all cases, urine was diverted using an external nephroureteral catheter, a double J stent, or a Salle stent. In some patients, a drainage was left in place in the surgical bed according to the surgeon's decision. In all patients, a bladder probe was placed and maintained after surgery.

Laparoscopic pyeloplasty (LP)

Under general anesthesia, the patient was placed in a 45-degree lateral position. A bladder probe was placed in all patients. A transperitoneal approach to the renal cell was used in all cases. 3 ports were used in case of left pyeloplasty, and 4 ports were used in case of right pyeloplasty (to separate the liver). The first port was placed in the umbilicus using an open technique. Once the scope had been introduced and we had confirmed we were inside the peritoneal space, the latter was insufflated with CO₂ until achieving 10-14 mm of Hg intra-abdominal pressures according to patient age and weight. The other accessory ports were placed in the iliac fossa and the ipsilateral hypochondrium. In right pyeloplasties, the fourth port was placed in the epigastric area to separate the liver. The scope used was a 5 mm, 30-degree scope, and the instruments were 3 or 5 mm instruments according to patient age and weight.

Once the pneumoperitoneum had been created, the renal cell was accessed following a detachment maneuver. Gerota's fascia was opened and the mid-ureter was

dissected cranially up to the pyeloureteral junction. A percutaneous traction stitch was used in all patients to suspend and stabilize the most cranial portion of the renal pelvis. In intra-renal pelvis patients and in patients where the kidney was rotated, a second traction stitch was used to suspend the anterior aspect of the renal pelvis in its most caudal portion. Once the pyeloureteral junction and part of the renal pelvis had been removed, the ureter was spatulated and the pyeloureteral suture of the posterior aspect was carried out using interrupted absorbable stitches. At this stage of surgery, a double J stent was anterogradely placed in most patients. Double J stent location was checked for by instilling methylene blue through the bladder probe – methylene blue came out through the proximal side of the stent. In external nephroureteral catheter patients, the nephroureteral catheter was passed through the renal parenchyma of the inferior calyx and exteriorized through the skin. The anterior aspect of the pyeloureteral junction and the renal pelvis were sutured using interrupted stitches.

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In patients where a double J stent was left in place, the stent was removed on an outpatient basis 1-2 months following pyeloplasty. In patients where an external diversion was left in place, diversion was removed 7-10 days following surgery.

Postoperative follow-up

Following discharge, a renal ultrasound examination was performed 1 month, 3 months, and 6 months after surgery in both groups. Renal ultrasound examination was subsequently repeated on a yearly basis. A MAG3 diuretic renogram was carried out 3-6 months following surgery.

Statistical analysis was conducted using the SPSS 18.0 statistical software. Quantitative variables were analyzed using the T of Student test or U-Mann-Whitney's test for independent data, and Wilcoxon's test for paired data. Qualitative variables were analyzed using the Chi square test or Fisher's test.

RESULTS

328 pyeloplasties (234 boys and 94 girls, with a mean age of 36.6 months) were reviewed. Open surgery was used in 186 cases, while laparoscopy was used in 142 cases. The most frequent cause was intrinsic pyeloureteral junction obstruction, accounting for 77.7% of surgeries, whereas restenosis following a first surgery represented 4.6% of cases. There were significant differences in terms of patient age and weight between both groups, but not in terms of ultrasound parameters or DRF (Table 2).

Table 2. Patient data.

	OP group (n = 186)	LP group (n = 142)	p
Age (months)*	26.8 (19.75-33.85)	49.9 (40.14-59.71)	<0.05**
Age (months)*	26.8 (19.75-33.85)	49.9 (40.14-59.71)	<0.05**
Sex (M/F)	131/55	103/39	NS***
Right/left	78/108	61/81	NS***
PUJO/pole vessel/REDO/others	159/19/6/2	96/35/9/2	NS***
Pelvic AP diameter (mm)*	30.3 (28.74-31.95)	29.7 (27.75-31.75)	NS**
Calyceal AP diameter (mm)*	9.2 (8.3-10.15)	8.74 (7.33-10.15)	NS**
DRF %*	49 (47.55-50.57)	45.6 (43.41-47.8)	NS**

*Mean and 95% confidence interval. **U-Mann-Whitney's test. ***Chi-square test.
PUJO: pyeloureteral junction obstruction; REDO: Re-pyeloplasty.

Table 3. Results.

	OP group (n = 186)	LP group (n = 142)	p
Operating time (min)*	132.95 (128.38-137.51)	174.2 (164.07-184.33)	<0.05**
Urinary diversion: yes/no	182/4	138/4	NS***
Type of diversion: external/internal	169/13	39/99	<0.05***
Mean hospital stay (days)*	7.47 (6.87-8.08)	4.66 (4.11-5.21)	<0.05**
Complications: yes/no	19/168	21/121	NS***
Clavien-Dindo: II/IIIb	15/3	10/12	<0.05***
Restenosis: yes/no	6/180	5/137	NS***

*Mean and 95% confidence interval. **U-Mann-Whitney's test. ***Fisher's test.

Mean operating time was 132.95 min in the OP group, and 174.2 min in the LP group, with significant differences.

In 6 patients only, no urinary diversion was used, with no significant differences between both groups. There were significant differences regarding the type of urinary diversion, with external diversion being more frequent in open surgery and internal diversion being more frequent in laparoscopic surgery. The use of external diversion in laparoscopic surgery has grown with experience. In the last years, it has been used in more than 80% of patients. The different types of diversion did not impact results.

Mean hospital stay was 7.4 days in the OP group and 4.66 in the LP group, with significant differences.

Complications were recorded in 40 pyeloplasties (12%), 62.5% of which were classified as Clavien-Dindo II. 15 cases required surgery under general anesthesia (Clavien-Dindo IIIb), with significant differences between the OP group and the LP group (Table 3).

The most frequent complication was urine leak, occurring in 47.5% patients with complications, without significant differences regarding the surgical approach or the use or non-use of urinary diversion. The other remarkable complication found was the presence of blood clots in the renal pelvis in 6 patients undergoing laparoscopic surgery, 1 of

whom required re-intervention owing to persistent bleeding and need for transfusion. The other patients did not require re-intervention, leaving room for spontaneous remission. The presence of clots in the renal pelvis caused urine to keep flowing through the perirenal drainage, but this remitted spontaneously once the blood clot had dissolved.

Ultrasound parameters improved in 96.6% of surgeries, without significant differences between open and laparoscopic surgery. 11 patients (3.35%) had restenosis and required a second surgery, without differences between both groups (Table 4).

DISCUSSION

There are various publications comparing the two approaches (open and laparoscopic surgery) used in pyeloureteral junction obstruction treatment. Our series had a success rate of 96.5% in both approaches, without significant differences – our success rate was similar to that of other series⁽⁹⁾. Robotic surgery appears not to have reduced complication rate, as demonstrated by a 407-case multicenter study, with a complication rate of 13%, whereas Clavien-Dindo III grade has a 35% rate⁽¹⁰⁾.

Table 4. Ultrasound results.

	Mean PAD in mm			Mean CAD in mm		
	Preoperative	Postoperative	p*	Preoperative	Postoperative	p*
OP group	30.3	11.5	<0.05	9.2	4.38	<0.05
LP group	29.7	10.76	<0.05	8.74	3.39	<0.05

*Wilcoxon's test.
PAD: renal pelvic anteroposterior diameter; CAD: renal calyceal anteroposterior diameter.

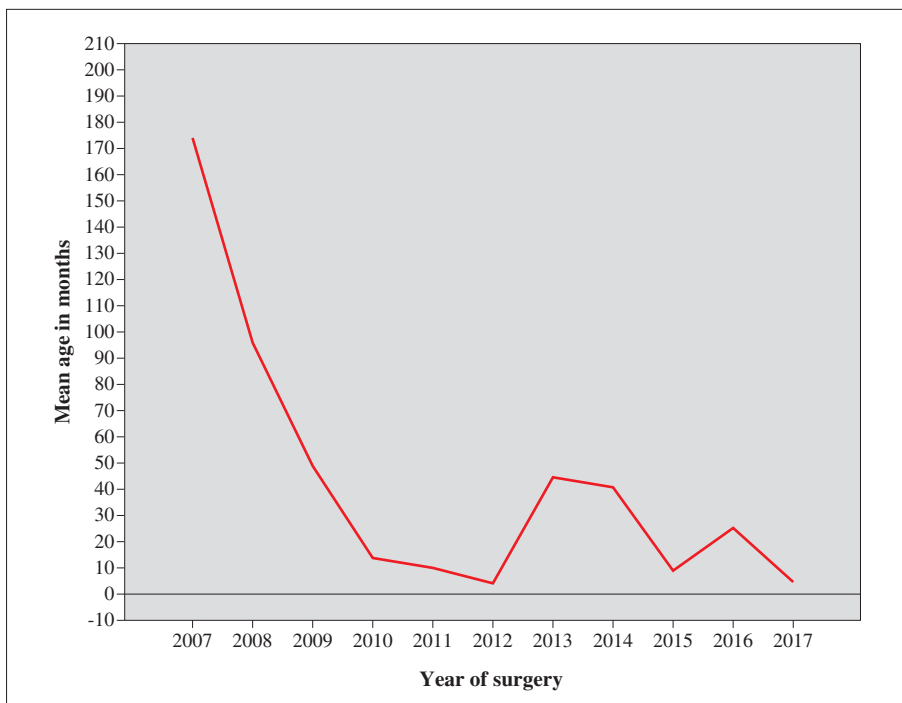


Figure 2.

Patient age and therefore weight appear as a limiting factor when it comes to using the laparoscopic approach, but according to various publications, there are no differences⁽³⁾. In our study, groups were not age- and weight-homogeneous. This is due to the fact that laparoscopic surgery was initiated in 2007 in adolescents and older children, so patients were older and heavier in the laparoscopic group (Fig. 2). However, thanks to the surgeons' growing experience, this factor has completely disappeared over time. Since 2014, of the 75 pyeloplasties performed, only 4 have been carried out using the open approach, and since 2016, no open pyeloplasties have been conducted in our healthcare facility.

Urine leak was the main complication, with an incidence similar to that of other series. The other complication requiring surgery was the presence of clots in the renal pelvis, which only occurred in the laparoscopic group, with no predisposing factors that may account for that^(6,11).

In our series, urinary diversion was not placed in 8 patients only, so we cannot state whether it should be used or not. The use or non-use of urinary diversion is an issue of discussion. We prefer to use it as it may help avoid or reduce the effect of complications, especially in the laparoscopic transperitoneal approach. Urine contact with the small bowel and the peritoneum causes paralytic ileus and metabolite reabsorption through the peritoneal membrane. In the open surgery group, an external nephroureteral catheter was used in most patients, whereas in the laparoscopic group, a double J stent was mainly used. Therefore, it cannot be established whether the type of diversion had an impact on complication rate. However, some studies have demonstrated complications both in patients with and without urinary diversion^(12,13).

In our study, the external catheter was more widely used in open surgery, which could be a factor of confusion. However, this has no longer been the case since 2016,

when external diversion was introduced in laparoscopic pyeloplasty. Of the 44 laparoscopic pyeloplasties carried out between 2016 and 2017, external diversion was used in 32, which allowed a second use of anesthesia for internal diversion removal purposes to be avoided.

Even though the number of patients is important, this work has a significant limitation – it is a retrospective study. The use of laparoscopic surgery was initially established according to patient age and/or weight, so this can be a factor of confusion. The use of external urinary diversion can also be a factor of confusion, as previously described.

CONCLUSION

In our view, the introduction of laparoscopy in pyeloureteral junction obstruction treatment has proved beneficial, since complication and restenosis rates are similar to those of open surgery, in spite of longer operating times. In our department, laparoscopic surgery is the approach of choice for pyeloureteral junction obstruction treatment, regardless of patient age and/or weight.

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