Original Article

Percutaneous approach in pediatric urological pathology

Abordaje percutáneo en patología urológica pediátrica

Beatriz Fernández-Bautista,[1*] Laura Burgos,[1] Rubén Ortiz,[1] Alberto Parente,[2] José María Angulo.[1]

Abstract

Introduction: The safety of the percutaneous approach has made it possible to improve instrumentation and progressively decrease the caliber of the instruments. The objective of this study is to present our experience in the use of the percutaneous approach for the treatment of recurrent lithiasis and recurrent pyeloureteral stenosis in children.

Material and methods: A retrospective review was carried out in our center, including all the patients who underwent a percutaneous approach between the years 2007-2020. In the case of patients with recurrent pyeloureteral junction obstruction (PUJO) a high-pressure balloon is placed retrogradely at the pyeloureteral junction. Next, the kidney was percutaneously approached by ultrasound and fluoroscopic control. Percutaneous endopyelotomy or lithotripsy was accomplished using monopolar hook electrocautery or holmium laser fiber. All patients had a double J catheter for 3-4 weeks. Nephrostomy was necessary in 9 of 24 patients.

Results: A total of 24 patients were included. Two groups were established: group 1 (n=15) had recurrent PUJO, and group 2 with 7 patients had kidney stones. Two more patients are added who do not belong to the groups described, a 16-year-old patient with hydrocalyx and a 13-year-old patient with renal cyst. The median age was 5 years (2-16). The most frequent complication was hematuria, followed by urinary tract infection in 3 patients. The median surgical time in group 1 was 60 minutes (35-90), in group 2 was 100 minutes (75-180). The mean time of admission in both groups was 3 days (2-7). The mean follow-up time in group 1 was 6 years (2-13), in group 2 it was 7 years (5-8).

Conclusions: Percutaneous approach is a safe and very practical technique in the management of lithiasis and recurrent PUJO in children. The miniaturization of the instruments makes it possible to expand the indications and reduce morbidity in our patients.

Keywords: Percutaneous approach, Pediatric renal litiasis, Recurrent pyeloureteral junction obstruction, Endopyelotomy

Citation: Fernández-Bautista, B., Burgos, L., Ortiz, R., Parente, A., Angulo, J. M. *Percutaneous approach in pediatric urological pathology. Rev Mex Urol. 2024;85(2):* 1-12

***Corresponding author:** Beatriz Fernández-Bautista. Adress: St/ O´Donnell, 48. 28009, Madrid, Spain. Email: Bea.bfb89@gmail.com

[1.] Hospital General Universitario Gregorio Marañón, Madrid, España.
[2.] Hospital Universitario Reina Sofia, Córdoba, España.

Accepted: February 27, 2025.
Received: July 3, 2025.

Resumen

Introducción: La seguridad del abordaje percutáneo ha permitido mejoras en la instrumentación y la miniaturización progresiva de los instrumentos quirúrgicos. El objetivo de este estudio es presentar nuestra experiencia en el uso de la técnica percutánea para el tratamiento de litiasis recurrente y estenosis pieloureteral recurrente (EPU) en pacientes pediátricos.

Material y métodos: Se realizó una revisión retrospectiva en nuestro centro, incluyendo todos los pacientes que fueron sometidos a procedimientos percutáneos entre los años 2007 y 2020. En los casos de EPU recurrente, se colocó un balón de alta presión de forma retrógrada en la unión pieloureteral. Posteriormente, se accedió al riñón de forma percutánea bajo control ecográfico y fluoroscópico. Se realizó endopielotomía o litotricia utilizando electrocauterio monopolar tipo gancho o fibra láser de holmio. Todos los pacientes recibieron un catéter doble J durante 3–4 semanas. La colocación de nefrostomía fue necesaria en 9 de los 24 pacientes.

Resultados: Se incluyeron un total de 24 pacientes. Se definieron dos grupos: Grupo 1 (n=15) con EPU recurrente, y Grupo 2 (n=7) con litiasis renal. Se añadieron dos pacientes adicionales fuera de estos grupos: uno de 16 años con hidrocalix y otro de 13 años con quiste renal. La edad mediana fue de 5 años (rango: 2–16). La complicación más frecuente fue hematuria, seguida de infección urinaria en tres pacientes. El tiempo quirúrgico mediano fue de 60 minutos (rango: 35–90) para el Grupo 1 y de 100 minutos (rango: 75–180) para el Grupo 2. La estancia hospitalaria promedio en ambos grupos fue de 3 días (rango: 2–7). El tiempo medio de seguimiento fue de 6 años (rango: 2–13) en el Grupo 1 y de 7 años (rango: 5–8) en el Grupo 2.

Conclusiones: El abordaje percutáneo es una técnica segura y práctica para el manejo de la litiasis y la EPU recurrente en niños. La miniaturización de los instrumentos permite ampliar las indicaciones y reducir la morbilidad en pacientes pediátricos

Palabras clave:
Abordaje percutáneo,
Litiasis renal pediátrica,
Estenosis pieloureteral recurrente,
Endopielotomía

Introduction

Since the first percutaneous renal surgery (CRP) performed in 1976 by Fernston and Johanson, the current therapeutic approach is oriented towards minimally invasive procedures.[1] Although it is a frequent approach in adults, its use for pediatric urologists it is not a routine approach.

The main indication for percutaneous renal surgery has been the treatment of kidney stones, mainly those of large size or those located in the lower calyx.[2] However, its application has been extended to the treatment of other pathologies such as recurrent pyeloureteral junction obstruction (PUJO).[3] The safety of the percutaneous approach has made it possible to improve instrumentation and progressively decrease the caliber of the instruments, reducing morbidity for the patient.[4]

Regarding the anatomical position to perform the percutaneous approach, percutaneous nephrolithotomy (PCNL) in the prone position has been considered the gold standard for the treatment of kidney stones. However, during the last few years, a new approach in modified lithotomy position has been proposed with the purpose of simplifying the procedure and improving its efficacy.[2]

It is often necessary to combine a percutaneous approach with the lithotomy position, mainly in lithiasis. The modified Valdivia position allows us simultaneous percutaneous and transurethral access to the entire urinary tract. The combination of a simultaneous retrograde and antegrade access is considered an evolution of the percutaneous approach.[5]

The objective of this study is to present our experience in the use of the percutaneous approach for the treatment of recurrent lithiasis and recurrent pyeloureteral stenosis in children. The review includes the evolution of instrumentalization towards a minimally invasive approach in the field of endourology.

Material and methods

A retrospective review was carried out in our center, including all the patients who underwent a percutaneous approach between the years 2007-2022.

All procedures were performed with the patient in modified Valdivia position under general anesthesia. This is with the ipsilateral leg extended with slight knee flexion and slightly separated and the contralateral limb in the cystoscopy position (Figure 1).

Figure 1

Ultrasound of both kidneys was performed in all cases to ensure the best place for percutaneous access in the supine position.

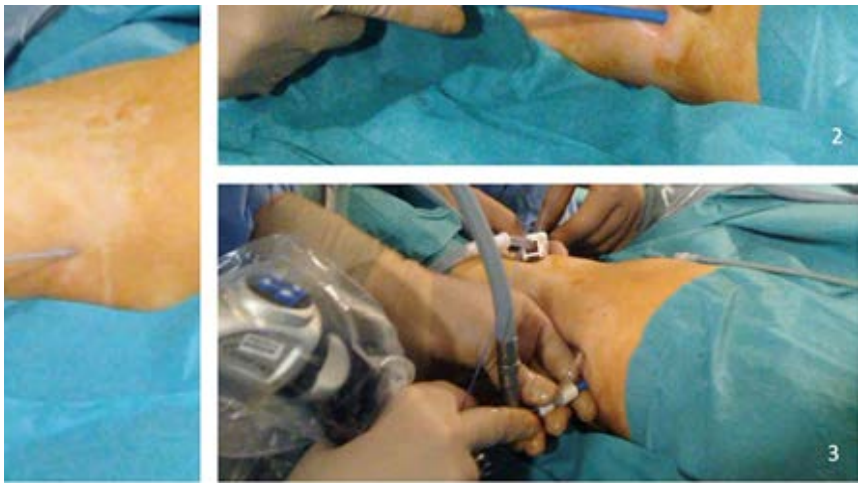
In the case of patients with recurrent PUJO, before percutaneous approach, a 5 or 6 mm high-pressure balloon is placed retrogradely at the pyeloureteral junction to improve the location of the pyeloureteral junction under cystoscopic and fluoroscopic guidance. It also serves as a safety support to perform percutaneous pyeloplasty.

Next, the kidney was percutaneously approached in the middle pole. Percutaneous access was guided by ultrasound and fluoroscopic control (Figure 2). The, percutaneous endopyelotomy was accomplished using monopolar hook electrocautery or holmium laser fiber. The cut is performed in the anterolateral aspect of ureteropelvic junction to avoid damaging nearby structures.

Figure 2

Depending on the size of the patient, a nephrostomy can be performed with a miniperc (12 Fr) or a microperc device (4.8 or 8 Fr). In any case, to perform the percutaneous approach, the Sedlinger technique was performed (Figure 3).

Figure 3



The microperc system has three connectors: one for the optics, one for the introduction of saline and the other for the introduction of the laser fiber or coagulation electrode. In counterpart, the system introduce type miniperc was performed using a 9.5Fr pediatric cystoscope or a rigid 7Fr, 43 cm ureteroscope in older children.

5/15 patients in the group with recurrent pyeloureteral junction stenosis, a micropercutaneous puncture was performed. In the rest a miniperc system was used.

Likewise, miniperc system was used in all patients in the lithiasis group. This system, can be used with larger laser fibers or with the lithotripter. When using the 9.5 Fr cystoscope, baskets or devices can be inserted to allow the removal of the lithiasic rests.

All patients had a double J catheter for 3-4 weeks. Nephrostomy was necessary in 9 of 24 patients (3 patients with lithiasis, 5 with pyeloureteral junction stenosis and patient with renal cyst).

Results

A total of 24 patients were included (Table 1). Two groups were established: group 1 (n=15) had recurrent pyeloureteral junction stenosis, and group 2 with 7 patients had kidney stones.

Table 1

Pathology	Patients (nº)	Age (years)*	Percutaneous technique	Complications (minor)	Results	Follow-up (years) *
PUJO **	15	4	Mini/Microperc (10/5)	Hematuria	Hydronephrosis improvement (15)	6
Lithiasis	7	7	Miniperc	Hematuria/ TUI	Residual stone 2/7	7
Kidney cyst	1	16	Miniperc	None	Cyst disappearance	6
Hydrocaliz	1	13	Miniperc	Hematuria	Hydrocalyx resolution	1

*Median
** Ureteropelvic junction obstruction

Two more patients are added who do not belong to the groups described.

A 16-year-old patient presented a hydrocalyx that connected to the right renal middle calyx. The infundicle was dilated with a high pressure balloon using a percutaneous approach.

The other 13-year-old patient with a history of autosomal dominant polycystic disease had a 7-cm right septate renal cyst that caused compression on the urinary tract, generating hydronephrosis III. Through a percutaneous approach, the cyst was punctured and the cystoscope was introduced through it, ablating the cyst septa and communicating it with the renal pelvis to facilitate its drainage.

In both cases, the Miniperc system was used.

The median age was 5 years (2-16).2-16 According to the group classification, in group 1 the median was 4 (2-16), and in group 2 it was 7 (2-14).

In the group of patients with recurrent PUJO, 9 were on the left side and 6 on the right side.

In this group, 5 patients had undergone an open pyeloplasty and 10 had an endoscopic high-pressure balloon pyeloplasty, requiring two of them in the use of a cutting-balloon.

A single percutaneous approach was performed in all patients in this group.

In the lithiasis group, there was a right predominance (5 vs 2 patients on the left side).

Regarding the location of the stone, 4 were in the lower calyx and 3 in the renal pelvis, the mean size of the stone was 15 mm (12.7-30). It should be said that all the stones located in the pelvis were larger than 2 cm.

In 85% of the patients had previously undergone ureterorenoscopy, and 57% had therapy with extracorporeal lithotripsy.

In 87%, a simultaneous procedure of ureterorenoscopy and percutaneous approach was performed.

Regarding the ablation of the lithiasis, in two cases holmium laser fiber was used and in 5 the lithotripter.

In this group, 57% of patients required a single percutaneous procedure, while the rest more than 2.

The most frequent complication was hematuria, followed by urinary tract infection in 3 patients.

The median surgical time in group 1 was 60 minutes (35-90), in group 2 was 100 minutes (75-180).

The mean time of admission in both groups was 3 days (2-7).

All patients with PUJO had grade IV hydronephrosis preoperatively with severe thinning of the renal parenchyma with subsequent ultrasound improvement. Likewise, there was a resolution of the obstructive curve and kidney function improvement in the renogram.

In the second group, there was residual stone in 2/7 patients, in whom a second percutaneous procedure had to be repeated later.

The mean follow-up time in group 1 was 6 years (2-13), in group 2 it was 7 years (5-8).

Discussion

Since the first description of percutaneous nephrolithotomy, the surgical evolution has not been an easy process.[6] Surgical technique has progressively evolved, improving the instruments that can be used and as a consequence, the results currently obtained using this classic approach.

Since its first description in 1987 and its internationalization in 1998 by Valdivia, the supine position for the performance of percutaneous nephrolithotomy, and in general for percutaneous renal surgical procedures, has demonstrated its versatility and advantages over the prone position.[2]

Increasing familiarity with the supine approach in percutaneous renal surgery has allowed combined retrograde and antegrade surgery.[7] This has been a practical advance for surgeons, since it reduces the time to change the position of the patient and the morbidity associated with different procedures.[8,9]

Also, advances such as fluoroscopy and ultrasound guided percutaneous access can help

urologists achieve access with less morbidity. The increasing miniaturization of equipment has led to the development of minimally invasive techniques, reducingpatient damage and allowing good long-term results in the series presented.[10–12]

Although it is true that the frequency of pediatric stones is increasing, the percutaneous approach is not a frequent technique within the clinical practice of pediatric urologists. Technological advancement and development has allowed pediatric surgeons to become increasingly familiar with this approach and the instruments to be better adapted to the small pediatric patient.[13] This has facilitated the indications and results, reaching the use of this technique in 2-year-old patients in our series presented.[14]

Similarly to the adult, indications for pursuing treatment via PCNL include large upper tract stone burden (> 1.5 cm), lower pole stones greater than 1 cm, concurrent anatomic abnormalities (PUJO, a duplicated system, urinary diversion), or patients with known cystine or struvite stones. In these cases, the percutaneous approach allows a more direct entry into the kidney and the success rate in the treatment of stones is higher.[15]

Miniaturization of both ureteroscopes and percutaneous nephrolithotomy equipment has facilitated access to the entirety of the urinary tract and has made ureteroscopy a first line therapy option along with shock wave lithotripsy for kidney and ureteral stones.[16,17]

In our experience, the miniperc approach for the treatment of kidney stones is a straightforward and easily reproducible approach that allows the introduction of the 9.5 Fr compact cystocopy, with which we are more familiar, which has a larger working channel and allows to insert laser fibers (until 570 microns), coagulation electrodes, lithotripter or baskets to collect lithiasic fragments. Only in younger patients, especially those under 5 years of age, we do consider that the micropercutaneous approach may be advantageous.

Regarding the treatment of recurrent pyeloureteral junction stenosis, it is controversial. The number of patients with recurrent PUJO is small, making it difficult to establish a standard surgical approach for failed pyeloplasty.[18] Use of minimally invasive techniques such as endoscopic or laparoscopic pyeloplasty has recently been expanded, with good results.[19] Likewise, series have already been published that show good results with percutaneous treatment.[3]

Moving a little further in the miniaturization of the instruments, we find the micropercutaneous approach. The technique can be safely used also in children younger than 4 years and body weight less than 10 kg.[4] Its main advantage is the absence of dilation of the tract, reducing bleeding inherent to percutaneous access and damage to renal parenchyma, as well as post-surgical pain and hospital stay.[20,21]

In our department, we have been performing the percutaneous approach for 15 years. We started with the treatment of kidney stones, learning from adult urologists in the use of instruments. However, familiarization with this approach allowed us to treat other infrequent pathologies in children, such as recurrent PUJO. In the latter case, the percutaneous route allows a better and safe exposure of the pyeloureteral junction, which has previously been treated through an endourological, laparoscopic or open approach.

The use of a high pressure balloon at the pyeloureteral junction facilitates the anatomi-

cal location of the pyeloureteral junction and allows us to perform the endopyelotomy in a more secure way.

In our experience with the percutaneous approach, we have obtained good results in the treatment of patients with larger stones in the renal pelvis or lower calyx, as well as those with recurrent PUJO. As main limitations, it requires training and management of endourology.

However, we consider the low number of patients as the main limitation of the study. We need larger prospective studies to verify our results.

Percutaneous approach is a safe and very practical technique in the management of lithiasis and recurrent PUJO in children. The miniaturization of the instruments makes it possible to expand the indications and reduce morbidity in our patients.

Conclusion

Percutaneous approach is a safe and very practical technique in the management of lithiasis and recurrent PUJO in children. The miniaturization of the instruments makes it possible to expand the indications and reduce morbidity in our patients

Conflict of interest

There is no conflict of interest-

Funding

This work received no funding.

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