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COMBINED URETEROSCOPY AND PERCUTANEOUS NEPHROLITHOTOMY IN CHILDREN

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ABSTRACT

Introduction: Percutaneous Nephrolithotomy (PCNL) has been demonstrated as highly efficacious for treatment of large or staghorn pyelocalyceal stones in pediatric patients. In this prospective study, we used the GMSV position to simultaneously treat ureteric and ipsilateral renal stones by retrograde ureteroscopy and supine PCNL in children.

Materials & Methods: We prospectively performed retrograde ureteroscopy and supine PCNL in children with ureteric stones and ipsilateral renal calculi from Jan 2020 to May 2023. Inclusion criteria were: age younger than 18 years, Presence of ipsilateral ureteric calculi and renal calculi. Exclusion criteria included contraindications to general anaesthesia and different illnesses such as coagulation abnormalities. All procedures were performed with the patient in the supine Valdivia modified Galdakao position.

Results: A total of 39 children (23 males and 16 females) presenting with symptomatic ureteric and ipsilateral renal calculi underwent retrograde ureteroscopy and supine PCNL in a single setting. Mean age was 14 years. Mean operating time was 95 mins. Mean drop in hemoglobin following the procedure was 0.5 gm%. Our initial stone clearance rate with combined ureteroscopy and PCNL was 84.6% and following SWL for residual fragments stone clearance was 100% in all children at 3 months follow-up.

Conclusion: In this study we have been able to tackle both ureteric calculi and ipsilateral renal calculi in a single setting using the GMSV position in children. The combined procedure of ureteroscopy and ipsilateral PCNL in GMSV position is feasible, safe and effective and is associated with minor postoperative complications.

Keywords: Percutaneous nephrolithotomy; Ureteroscopy; Pediatric; Kidney stone; Supine position; Urolithiasis.

Introduction:

The incidence of stone disease in children shows a wide geographical variation [1-3]. Whatever be the treatment chosen, it must not impair the development and function of the growing kidney. Most urinary stones in children can be managed effectively by minimally invasive treatment modalities [4, 5]. PCNL has turned out to be highly efficacious for treatment of large or staghorn stones in children, with a limited risk of complications, mainly bleeding [6, 7, 8].

Recently PCNL in supine position has offered a new life to the procedure [9]. Valdivia Urìa described in the late 1980s his experience with the supine approach for PCNL [10]. In the late 1980s Ibarluzea and coworkers progressively changed the supine Valdivia position associating a modified lithotomic arrangement of the lower limbs, giving birth to the handy and ergonomic Galdakao-modified supine Valdivia (GMSV) position, which appeared in the Spanish literature in 2001 but only in 2007 in an international publication [11-13].

This position allows retrograde ureteroscopy not only as an occasional complement to PCNL bur rather as an essential part of it, with an indefeasible active role for an optimal outcome [11]. This position is associated with a number of advantages which have been widely reported. The cardiovascular, ventilatory, neuroendocrine, and pharmacokinetic problems of the prone position [9, 12, 14] are overcome in the supine positions, with better access to the airways and the cardiovascular system. This is particularly true for special patients, including children, elderly, obese, kyphotic/scoliotic, and debilitated patients [11]. In this prospective study we have used this GMSV position to simultaneously treat ureteric and ipsilateral renal stones by retrograde ureteroscopy and supine PCNL in children in a single setting.

Materials & Methods:

We prospectively performed retrograde ureteroscopy and supine PCNL in children with ureteric stones and ipsilateral renal calculi during the period Jan 2020 to May 2023. The study was approved by the Institutional Ethics Committee and written informed consent was obtained from all the parents/guardians of the patients. Inclusion criteria were: age younger than 18 years, Presence of ureteric calculi with ipsilateral renal calculi. Exclusion criteria included: contraindications to general anesthesia, attendant different illness such as coagulation abnormalities. Specific informed consent was obtained from parents before any urological treatment. Preoperative evaluation included familial and personal medical history, urinalysis and urine culture, blood laboratory investigations including blood cells count, coagulation profile, and creatinine. Renal ultrasonography (US) and plain abdomen X-ray (Figure 1) was performed in all patients. Non contrast computerized tomography (CT) (Figure 2) was performed for quantitative assessment of the stone burden and to better define the stone number and localization. Pre-treatment determination of Hounsfield units on CT was used to

distinguish the harder stones such as (cysteine, struvite) from other types of calculi and better address the urological lithotripsy treatment.

Technique: All procedures were performed with the patient in the supine Valdivia modified Galdakao position (Figure 3) [15], under general anesthesia by oro-tracheal intubation. It is important to mark the posterior axillary line on the side to be operated. This can be done with the patient standing with arm up. The patient is positioned on the operating table nearer to the border of the side to be operated upon. The contralateral arm is abducted to less than 90 degrees and slightly flexed. The ipsilateral arm of the patient crosses the chest and is supported so as to further elevate the posterior axillary line. The lumbar region is lifted approximately 20 degrees and exposed. The lower margin of the 12th rib and upper margin of iliac crest is marked. The patient is then positioned in a modified lithotomy position with both glutei on the inferior border of the operating table. The ipsilateral leg is slightly abducted and extended, and the contra lateral leg is lifted and partially flexed. The part is prepared and draped.

Cystoscopy was performed and the ureter on the side with calculi was catheterized. A retrograde ureterogram was done and the ureter and renal pelvicalyceal system opacified. A 0.018/0.025-inch guidewire was placed and ureteroscopy done using a Richard Wolf uretroscope. The ureteric stone was localized and broken into small fragments using Holmium laser. Once the ureteric stone was fragmented and all fragments retrieved, an open ended ureteric ureteric catheter was placed in the pelvicalyceal system.

The puncture site is marked at the level of posterior axillary line under the level of the 12th rib, targeting the lower posterior calyces. Calyceal puncture was performed under fluoroscopic guidance. Dilation of the nephrostomy access was obtained by Amplatz dilators up to 18Fr. A 15 Fr nephroscope (Karl Storz, Tubingen, Germany) was used in all cases. Ballistic energy was used for stone fragmentation, by a 1.0 Fr probe. Extraction of residual stone fragments was achieved by basket and for ancillary lithotripsy using Holmium: YAG laser energy by 220–335-micron fibers. A nephrostomy tube was placed for 2 to 5 post-operative days and a 4/4.5 Fr double-J ureteral stent was placed down the ureter, which was removed cystoscopically at 3-5 weeks after the PCNL procedure.

Renal US and plain abdominal (kidneys, ureters and bladder) X-ray were performed at 1 and 3 months post-operatively. Stone clearance was defined as no residual calculi or asymptomatic fragments less than 4 mm diameter, considered as clinically insignificant residual fragments. Demographic data, stones characteristics (number, dimensions, position),

metabolic evaluation, operative technique were all noted and recorded. Post-operative pain assessment was detected by the "visual analogic scale" (VAS) and by Paracetamol requirement (15 mg/kg body weight, at 6-hour intervals, if needed). Hemoglobin decrease and complications were classified according to the Clavidien-Dindo classification [16]. The need for ancillary procedures was recorded on a specific prospective data base. Statistical analysis was performed using the Chi-square test to compare categorical data and the Mann-Withney U-test to compare continuous data, as appropriate.

Results:

A total number of 39 children (23 males and 16 females) presenting with symptomatic ureteric and ipsilateral renal calculi underwent retrograde ureteroscopy and supine PCNL in a single setting. The mean age was 14 years (range 8 – 18). The most common presenting symptom was a ureteric colic of few days duration. Fever, hematuria, vomiting and distension of abdomen were the other presenting symptoms. Fourteen children (35.89%) had symptoms on the right side and the remaining (64.1%) on the left side.

The mean size of ureteric calculi was 8.9 mm (range 6 – 12 mm). All ureteric calculi were single in number. Only three (7.69%) children had a previous history of urolithiasis and all had undergone SWL for the renal calculi. Twelve children (30.76%) had an upper ureteric calculi, six (15.38%) had mid ureteric and the remaining 21 (53.84%) had lower ureteric calculi. The mean size of the biggest renal calculi was 21 mm (range 1.8-3.0 cms). Eight patients (20.51%) had more than one renal calculi, in renal pelvis 3 (7.69%), upper calyx 2 (5.12%) and lower calyx 3 (7.69%).

All the procedures were performed under general anesthesia in GMSV position. Preoperative antibiotics were given to all. Ureteroscopy was done using a semi-rigid ureteroscope and the ureteric stones fragmented using holmium laser and 220 micron fibers. A lower calyceal puncture was made in all the children. Storz nephroscopes were used for PCNL in all children. The calculi were fragmented using a combination of ballistic and laser lithotripsy. Bigger fragments were extracted. The mean operating time was 95 mins (range 75 – 140 mins). None of the children needed intra or postoperative blood transfusions. The mean drop in hemoglobin following the procedure was 0.5 gm%.

Post operatively all children needed one dose of Inj Paracetamol (15mg/Kg body weight), and only 7 (17.94%) children needed the second dose of paracetamol 6 hours later. Visual

analog scale was 0 (0- no pain to 5-pains most) in all children 24 hrs after surgery. Post-operative complications were classified as per Clavidien-Dindo classification and were as shown in (Table 1). Three children had postoperative fever which subsided after inj paracetamol. Two other children had prolonged urine leak (upto 24 hrs) from the PCNL site following removal of the nephrostomy tube. The leak stopped by itself without any intervention. Six children (15.38%) had small residual renal calculi of mean size 6.5 mm and needed to undergo SWL under general anesthesia 6 weeks later. Stone clearance rate was 84.61% after the combined ureteroscopy and PCNL procedure and 100% at three months as confirmed on ultrasonography and x-ray KUB. Biochemical analysis of the stone fragments revealed a calcium oxalate stone in 34 (87.17%) children. Postoperative advice regarding diet and fluid intake was instructed to all and the children were put on close follow-up.

Discussion:

Urolithiasis is a significant problem in children, for the uncertain urological approach and for the higher risk of recurrence through-out the life, when compared with adults [17]. Several invasive procedures such as nephrolithotomy, pyelolithotomy, ureterolithotomy or cystolithotomy have been progressively abandoned during the last three decades, mimicking the experience of endo-urological techniques in adult patients [18]. SWL is currently considered the procedure of choice in treating most upper tract calculi of small dimension, in children similarly to adult patients, offering tremendous advantages over the open surgical procedure [19]. However, SWL is associated with high re-treatment rates and high incidence of residual fragments in calyx and pelvis, with a risk of ureteral secondary obstruction (“steinstrasse”), despite many advancements in technology [20].

Not all the stones are amenable to SWL, more-so in children, who often require general anesthesia with short hospitalization for pain control during the procedure of extracorporeal treatment [19, 20]. The advent of minimally invasive endoscopic treatments has been revolutionized by the introduction improved technology, miniaturization of the instruments, flexible endoscopes and use of lasers for breaking stones [20, 21]. The idea of combining percutaneous and retrograde approach during the same surgical procedure is not new at all . It is the Galdakao-modified supine Valdivia (GMSV) position that optimally supports ECIRS (Endoscopic Combined IntraRenal Surgery), a novel combined antegrade and retrograde approach to the upper urinary tract for the treatment of large renal and associated ureteric calculi.

The idea of combining percutaneous and retrograde ureteroscopic approach during the same surgical procedure is not new at all. Several blind attempts were described in the early 1980s with the trans-cutaneous retrograde nephrostomies [9]. A few years later a simultaneous nephroscopic and ureteroscopic access with the patient in the "reverse lithotomy position" was also reported [22]. But it was in the late 1980s when Ibarluzea and coworkers changed the supine Valdivia position associating a modified lithotomic arrangement of the lower limbs, giving birth to the handy and ergonomic Galdakao-modified supine Valdivia (GMSV) position. The surgical advantages of this position include an easier puncture of the kidney lying nearer to the skin, the possibility of an Endovision-assisted renal puncture and tract dilation, a demonstrated decreased risk of colonic injury, a great versatility in the combined stone manipulation, a better descending drainage and retrieval of stone fragments from lithotripsy because of the downward position of the Amplatz sheath, low intrarenal pressures implying less pyelovenous backflow and of postoperative infectious risk[9].

In our study we have used fluoroscopy to guide the renal puncture. However it is very critical to think of the radiation especially so in children. As per the ALARA protocol, it is important to limit radiation as far as possible. Another important advantage of using this position is the limitation of radiation both for the surgeon and the patient [23]. Some authors believe that the possibility to use ultrasound which allows one to control and track needle traction is useful for renal puncture too in this position. Moreover use of ultrasound would reduce the risk of radiation and could become the ideal means of imaging during PCNL.

In this study of ours we have been able to tackle both ureteric calculi and ipsilateral renal calculi in a single setting using the GMSV position in children. Our initial stone clearance rate with combined ureteroscopy and PCNL was 84.6% and following SWL for residual fragments stone clearance was 100% in all children at 3 months follow-up. The combined procedure of ureteroscopy and ipsilateral PCNL in GMSV position was feasible, safe and effective and was associated with minor postoperative complications. The limitations of the study were a small number of patients, stones primarily limited to the renal pelvis and the children with a mean age of 14yrs. It would be better if a multicentric trail is conducted to properly assess the feasibility and success of the technique.

Conflict of Interest: NIL

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Figure legends

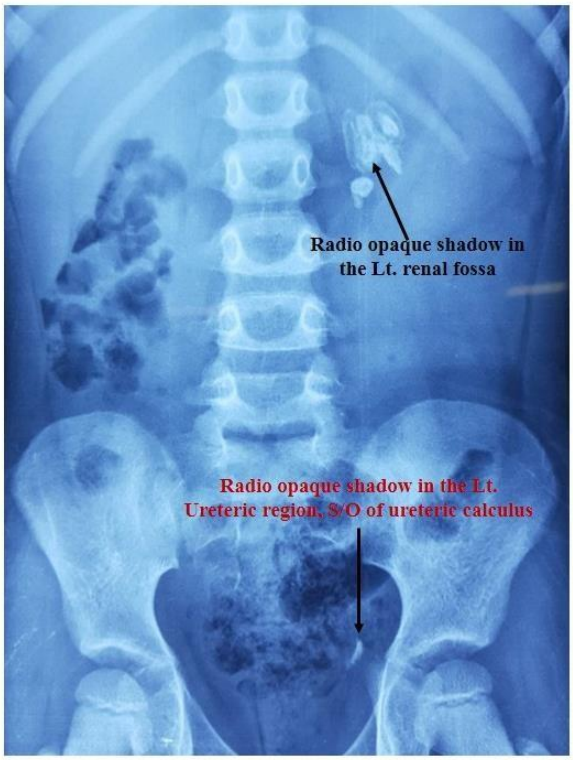

Figure 1: X-ray KUB showing radio-opaque shadows in the Lt. renal fossa & the Lt. Lower ureteric region, suggestive of calculus.

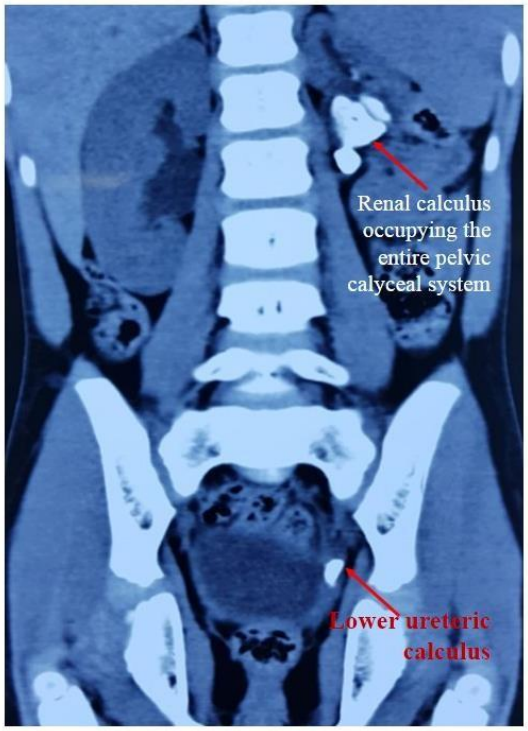

Figure 2: Non-contrast CT showing both ureteric and renal calculi in the same patient.

Figure 3. Patient in the Galdkao-modified supine Valdivia position.

TABLES

Table 1: Complications: Clavidien-Dindo classification.

Classification	Complications	N
Grade I	Any deviation from the normal postoperative course without the need for treatment (Prolonged leak)	2(5.12%)
Grade II	Requiring pharmacological treatment with drugs Blood transfusions and total parenteral nutrition are also included (Fever)	3(7.69%)
Grade IIIa	Intervention not under general anesthesia	-
Grade IIIb	Intervention under general anesthesia	-
Grade IVa	Life-threatening complication requiring IC/ICU management Single organ dysfunction (including dialysis)	-
Grade IVb	Multiorgan dysfunction	-
Grade V	Death of a patient	-