Research Article

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Percutaneous Management Of Renal Calyceal Diverticular Stones In Children.

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ABSTRACT

Introduction: Caliceal diverticula are outpouchings of the collecting system and can be complicated by the development of calculi within them. Several minimally invasive and non-invasive procedures have been described for the treatment of these diverticular stones. We report our experience with the management of these caliceal diverticular stones with PCNL in paediatric patients.

Materials & Methods: We retrospectively reviewed the hospital data, for children who underwent PCNL for caliceal diverticular stones. A pre-operative CT (Computed tomography) Urogram was performed to assess the location of the diverticula, the size of the stone and the function of the kidney. Using direct stone-guided puncture with the bull's eye technique, percutaneous access was achieved, and a 12 Fr mini PCNL nephroscope was used to extract the stones. The mouth of the diverticulum was cauterized.

Results: Six children (five females and one male) with a mean age of 12.4 years underwent PCNL for caliceal diverticular stones during the study period. Pain in the flanks was the presenting symptom in all patients. Complete clearance was achieved in all the children.

Conclusions: PCNL offers the best minimally invasive option in the management of caliceal diverticular calculi. It is both effective and safe in the paediatric population.

Keywords: Caliceal diverticula, Caliceal diverticular stones, percutaneous nephrolithotomy.

INTRODUCTION

Caliceal diverticula are outpouchings affecting the upper collecting system and lying within the contours of the kidney. [1] These outpouchings are lined by transitional cell epithelium, non-secreting and communications with the main pelvicalyceal system via a narrow channel, allowing for passive filling with urine. Rayer was the first to describe this condition in 1841. [2] The prevalence of these calyceal diverticula is about 0.21% to 0.6% as seen on intravenous urograms (IVU) performed on adults, and the prevalence is similar in children too. [1,3-5] The upper pole calyces are the most affected 48.9% in comparison to 29.7% in the middle and 21.4% in the lower poles. [6] Females (63%) are more affected than men (37%) and have no predilection toward a particular side of the body. [6] The average size of the diverticulum is 1.72 cm (range 0.5 to 7.5).

These diverticula can be complicated by the development of calculi in up to 50% of patients. [7] The average stone size recorded in various series is around 12.1 mm (range from 1 to 30 mm). [6] The indications for treatment include flank pain, pyuria, and urinary tract infection (UTI). [8] Several procedures have been described for the treatment of these diverticular stones including shockwave lithotripsy (SWL), percutaneous nephrolithotomy (PCNL), ureterorenoscopic surgery (URS), and laparoscopy. However, the stone-free and symptom-free rates are found to be best with PCNL. [9-11] In this paper we report our experience with caliceal diverticular stones presenting in children and managed with PCNL. We also describe the outcomes of PCNL and its complications in this group of patients.

MATERIALS & METHODS

We retrospectively reviewed the inpatient data of our hospital, for children who underwent PCNL for caliceal diverticular

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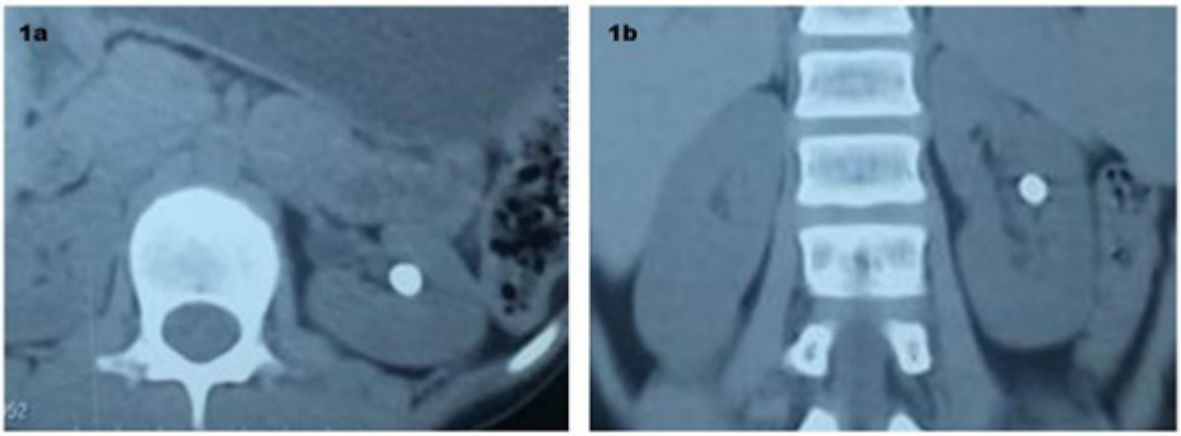
stones (CDS) from January 2006 to December 2020. This study was approved by the Institutional ethical Committee. All the children were evaluated preoperatively with a CT (Computed tomography) Urogram (**Figure 1**) so to assess the location of the diverticula, the size of the stone and the function of the kidney. PCNL was performed in these children in the prone position under general anaesthesia.

Figures 1a and b. CT scan in a 12-year-old girl shows a calculus of 12mm in the left kidney.



Using direct stone-guided puncture with the bull's eye technique, percutaneous access was achieved. A 0.032-inch guide wire was inserted and allowed to coil within the diverticulum. The tract was dilated over the guide wire using sequential dilators. In case of not being able to coil the guide wire within the diverticulum, then a stiff guide wire was used instead of the thin hydrophilic wire and a one-step tract dilation were performed without the risk of bending. A 12 Fr mini PCNL was used and the stones within the diverticulum were fragmented using either a pneumatic lithoclast or holmium laser (**Figure 2**). After the complete removal of the stones, the diverticular cavity was inspected to locate the neck of the diverticula. If visible the mouth of the diverticulum was fulgurated with a cautery and a PCN tube was left in place. In case the mouth was not visible the chemical cauterization was performed with a mixture of contrast and doxycucline.

A plain X-ray of the kidney ureter bladder (KUB) region was obtained one day later to look for any residual stones. Postoperatively after 24 hours, the contrast was inserted into the diverticulum and delineated. The PCN tube was removed and the patient was observed for any complications. The child was discharged within 72 hours of the procedure. Postoperative follow-up included a contrast CT at around 3 months to assess diverticular resolution or decrease in its size.

Figure 2.

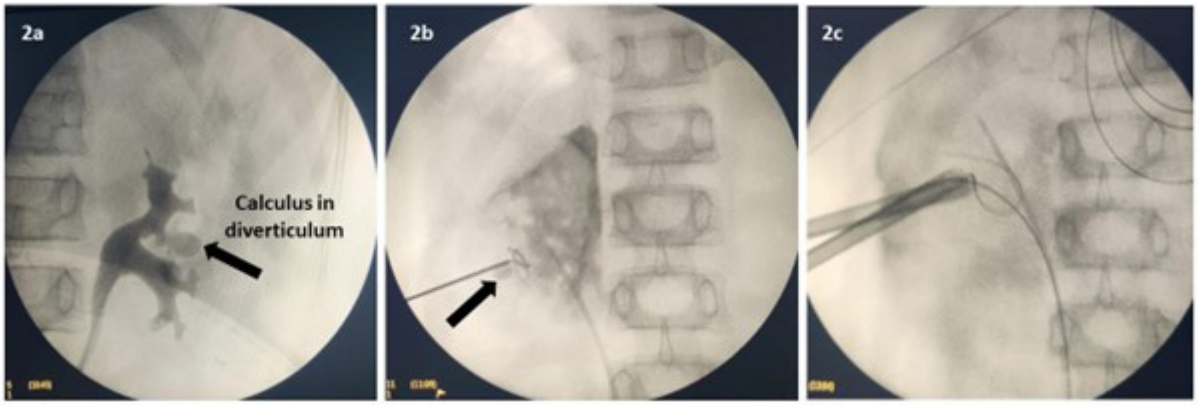


Figure 2a. The retrograde pyeloureterogram shows the good filling of the left pelvi calyceal system with a calyceal diverticulum arising from the middle calyx. A stone is seen within the diverticulum.

Figure 2b. The Bulls eye technique was used to puncture the diverticulum and a guide wire was placed within it.

Figure 2c. Complete clearance of the stone achieved.

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RESULTS

During the study period, six children (five females and one male) with a mean age of 12.4 years underwent PCNL for caliceal diverticular stones. Pain in the flanks was the presenting symptom in all patients, whereas two patients had recurrent urinary infections. Three diverticula were located at the upper calyx, followed by two in the middle and one in the lower calyx. The size of stones ranged from 1 to 2.3 cm (mean 1. 6 cm).

Percutaneous access was obtained through a direct stone-guided puncture in all patients. The access was infra-costal for all the children. The stones were fragmented well and the fragments were cleared using forceps. Complete clearance was achieved in all the children. Both intra-operative and post-operative complications were minimal. One child needed an extra PCN as the punctured calyx needed drainage because of turbid contents. None of the patients had a post-operative fever. All the children have been followed up for at least 24 months during which none of them had any recurrence or pain.

DISCUSSION

Children with caliceal diverticular calculi present with flank pain, pyuria, recurrent urinary tract infections and haematuria. The diagnosis of these stones is based on imaging including X-rays, CT and ultrasonography. It is believed that urinary stasis and increased particle retention play a role in the genesis of these diverticular stones, [12] however there seems to be no consensus regarding the role of metabolic abnormalities. Auge and colleagues [13] found that all diverticula patients in their series receiving a complete metabolic workup were found to have at least one metabolic abnormality, with hypercalciuria and hyperuricosuria being the most common among them.

Since the mid-1980s, minimally invasive approaches have been used to treat stones within the diverticulum including SWL, ureteroscopic and percutaneous methods, and laparoscopic approach. Treatment modality should be selected according to factors such as diverticulum location and stone burden and size. [14] Extracorporeal SWL has been used as a first-line treatment for symptomatic patients with calyceal diverticula and calculi as it is the least invasive treatment modality. [15] Published case series have mixed opinions and conclusions, with the majority of authors concluding that SWL monotherapy produces suboptimal stone-free and recurrence rates.

Percutaneous nephrolithotomy (PCNL) has shown to have high success rates not only in a setting of conventional renal stone but also in cases of calyceal diverticular stone. PCNL has produced universally better results than those achieved by SWL monotherapy as it provides greater access to larger, more complex, and posteriorly located stones. Moreover, it allows the surgeon to further manage the diverticulum with fulguration or incision of the diverticular neck. [16,17]

Management of diverticular stones using ureteroscopy has a better efficacy than SWL monotherapy, and at the same time is associated with lower complication rates and discomfort levels when compared to percutaneous or laparoscopic techniques. [6] Ureteroscopic management is best suited for patients with small diverticular stones located in the upper or interpolar regions of the kidney. Lower pole stones are placed at an acute angle making it difficult for ureteroscopic treatment.

The laparoscopic approach appears to be a promising option for calyceal diverticula that are anteriorly located, have unidentifiable ostia that preclude endoscopic management, carry a large stone burden, or have thin overlying parenchyma. Compared to SWL, percutaneous, and ureteroscopic management, this approach is the most invasive and needs to be considered only when the other alternatives appear to be not feasible. [18,19] Laparoscopic approach although the most "invasive" of the minimally invasive techniques, the perioperative out- comes for calyceal diverticula appear too encouraging, and its long-term results appear to be durable.

CONCLUSION

To conclude, caliceal diverticula are rare out- pouching of the upper collecting system that most likely have a congenital origin. A stone within the diverticulum is a unique complication and this is still more in the pediatric population. Diagnosis is best made using a contrast TU. Percutaneous nephrolithotomy appears to be the best option in the management of diverticular stones, especially the ones located posteriorly affecting the middle and lower poles. Moreover, it also offers the option to directly ablate the diverticulum.

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