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Outcomes following 'mini' percutaneous nephrolithotomy for renal calculi in children. A single-centre study

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Summary

Introduction
This retrospective review was undertaken to identify the postoperative outcomes of children undergoing 'mini' percutaneous nephrolithotomy (MPCNL) at a single institution.

Objective
Outcomes measured included: percentage of stone clearance, postoperative analgesia requirements, the need for intraoperative or postoperative blood transfusion, length of stay and morbidity.

Study design
A total of 46 patients were reviewed over a two-and-a-half-year period; the mean age was 7.3 years (range: 1–16 years). The MPCNL was performed with a radiological-guided peripheral puncture, followed by dilatation of the nephrostomy tract to a maximum Amplatz sheath size of 16-French; an 11-French nephroscope was used. Stone disintegration was achieved either with pneumatic or laser lithotripsy.

Results
Complete stone clearance was achieved in 35/46 children (76%). The remaining 11 children had a stone clearance rate of over 80%. No patients required intraoperative/postoperative blood transfusion. A total of 39% of patients were managed on simple/non-opiate based analgesia, with 54% requiring opioid analgesia postoperatively for less than 24 h. There were no procedure-related complications and no mortalities. The mean length of stay was 2.24 days.

Discussion
The management of urolithiasis can be challenging in children. The use of percutaneous nephrolithotomy, is becoming increasingly popular in the treatment of paediatric urolithiasis.

The stone clearance rate in children undergoing standard PCNL, has been reported to be 50–98% in the literature [1,2,3,4]. Samad et al. [2] in 2006, reported their experience in 188 consecutive PCNLs, using a 17Fr or 26Fr nephroscope. Their largest sub group included children aged >5–16 yrs. Within this group, 57% were treated with a 17Fr nephroscope and 43% with the 26Fr nephroscope, achieving stone clearance of only 47% with PCNL monotherapy. In this group the transfusion rate was 3% [2]. Badawy et al., reported their experience of 60 children in 1999, using a 26 or 28Fr Amplatz sheath. They reported an 83.3% stone clearance with single session PCNL, with only one procedure being abandoned due to intraoperative bleeding requiring blood transfusion [3]. In 2007, Bilen et al. reported their experience and compared the use of 26Fr, 20Fr and 14Fr (mini) PCNL. Stone size, previous surgery and the mean haemoglobin drop postoperatively did not change between the groups, however the blood transfusion rate was higher in the 26Fr and 20Fr Amplatz sheath groups. The stone clearance was highest in the 'mini PCNL' group at 90%, compared to 69.5% in the 26Fr and 80% in the 20Fr group [4].

MPCNL has become increasingly popular over recent years, with stone clearance reported as 80–85% [5–7] following a single session of MPCNL as monotherapy. In 2012, Yan et al. reported 85.2% stone clearance with mini PCNL monotherapy (tract size 14-16Fr), with no children requiring blood transfusion [6]. Zeng et al. reported their experience of 331 renal units in children, with stone clearance rates reaching 80.4% and a blood transfusion rate of 3.1% [8].

In our centre, we do not perform postoperative haemoglobin levels as a matter of routine and any investigations are performed on an intention to treat principle. Bilen et al. reported no blood transfusions being required in their cohort of patients undergoing MPCNL [4] and this is supported by Yan et al. [6].

Conclusion
Mini PCNL is an effective and safe procedure for the treatment of paediatric renal stones. In the present series, all children achieved greater than 80% stone clearance, none received a blood transfusion (intra/postoperatively) and there were no mortalities. Postoperative pain was managed with simple analgesia in 39%; however, the majority required opiate analgesia for less than 24 hours

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Table

Outcome Measures	Results
Complete Stone Clearance	35/46 (76%)
Stone Clearance >80%	11/46 (24%)
Intra- or Postoperative Blood Transfusion	0/46 (0%)
Mean Length of Stay (days)	2.24
Postoperative Analgesia Requirements:	
- Simple/Non-Opiate	39%
- Opiate/Opioid	54%
Mortality	0/46 (0%)

Introduction

In 2007, percutaneous nephrolithotomy (PCNL) was introduced for the management of patients with renal calculi in the paediatric surgical centre of the present study. Initially, the conventional PCNL equipment was used with either a 24-French (Fr) or 26-Fr Amplatz sheath, with a 17-Fr nephroscope and ultrasound disintegration. However, previous studies [1,2] have suggested that the use of minimally invasive percutaneous nephrolithotomy (MPCNL), using smaller gauge instruments and pneumatic lithotripsy, may be safer and more effective than conventional PCNL. Therefore, for the last two-and-a-half years, the MPCNL technique has been used for selected patients in the present institution.

The aim of the present study was to evaluate the experience of MPCNL, with the primary outcome being the rate of stone clearance. Secondary outcomes were length of stay, analgesic requirements, blood transfusion requirements and morbidity.

Methods

A retrospective review of all patients who had undergone MPCNL using pneumatic or laser lithotripsy was performed from June 2010 (when the technique was introduced) to December 2012. The patient records were reviewed, including the operation notes and postoperative care records, in order to establish a number of outcomes: a) stone clearance rate at operation, as agreed by the surgeon and interventional radiologist; b) the need for intraoperative/postoperative blood transfusion; c) length of hospital stay; d) postoperative analgesia requirements; e) complications. The inclusion criteria were all patients undergoing MPCNL, where the Amplatz sheath size was 16 Fr or less and the patients <18 years. No patients were excluded.

All patients treated at our institution had a preoperative plain Kidney-Urinary-Bladder (KUB) radiograph, renal ultrasound (USS), and either a Mercapto-acetyl-tri-glycine (MAG-3) scan or DMSA. These investigations were either performed in the institution or in the referring hospital. All patients also had preoperative haematology (full blood count (FBC), and group and save) and baseline biochemistry (urea and electrolytes/creatinine) performed. The renal USS and a plain radiograph KUB were then repeated to ensure that they were performed within 24 h of the surgery, and were reviewed with the interventional paediatric radiologist.

In the institution, children with renal stones are under the care of one of two paediatric urologists, who both perform this procedure. The MPCNL is performed under a single general anaesthetic (GA), with no second looks during the same admission. The child is placed in the lithotomy position, and preliminary ureteric catheterisation with a 4-Fr ureteric catheter and a retrograde study are performed. The ureteric catheter is subsequently secured to a Foley catheter placed in the bladder. The patient is then repositioned in the prone position with a 30—45° upward tilt of the affected side. The definitive puncture is made under radiological guidance (either fluoroscopic or ultrasound), by the interventional radiologist, with subsequent placement of a guidewire within the collecting system. The tract is then dilated using telescoping radial dilators. A lower pole posterior calyx puncture is preferred, but may vary depending on the position of the stone and the calyceal anatomy, as demonstrated in the retrograde study. A 16-Fr Amplatz sheath is then positioned. The stone is fragmented using either the lithoclast or the laser, depending on the surgeon's preference. Following maximal attempted stone clearance, residual stone burden is assessed by the interventional radiologist perioperatively. Complete stone clearance is defined as no radiological (using both USS and fluoroscopy) evidence of stone fragments. If this is not achieved, it is deemed to be incomplete clearance. The percentage stone clearance is subjectively agreed between the surgeon and radiologist.

At the end of the procedure, an 8-Fr nephrostomy is inserted through the tract, and the ureteric stent and urethral catheter are removed. The need for postoperative haematological or biochemical investigation is determined by clinical progress and intention-to-treat principle. All stone fragments are sent for metabolic analysis and the children are referred to the paediatric nephrologist for further investigations, if indicated.

All children are prescribed analgesia based on anaesthetist's preference, which is subsequently adjusted using age-appropriate paediatric pain scores. The nephrostomy is clamped at 36 hours and removed at 48 hours, just prior to discharge.

All stone-free patients are followed up at three months with a USS and plain radiograph KUB. If they are stone free at this point, these investigations are repeated in a further nine months (12 months postoperatively). The patients with residual stones are reviewed six-weeks postoperatively with a USS and plain radiograph KUB (in the present institution, computerised tomography is not used as an imaging modality to assess stone burden, so as to avoid radiation exposure). At this point, a further management plan is made, options include: conservative treatment, further PCNL or extracorporeal shockwave lithotripsy (ESWL). A functional study (eg MAG-3) is reserved in the postoperative period for the follow-up of patients with pre-existing abnormal renal function.

Results

There were 31 males (67.3%) and 15 females. The mean and median age at the time of the procedure was 7.3 years and 6.5 years, respectively (range: 1—16 years). The patient