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Feasibility of Percutaneous Nephrolithotomy under Assisted Local Anaesthesia: A Prospective Study on Selected Patients with Upper Urinary Tract Obstruction

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Abstract

Objective: To evaluate the feasibility of performing percutaneous nephrolithotomy (PCNL) under local anaesthesia in selected patients.
Methods: Twenty-four patients with unilateral renal obstruction due to pelvic stones $\geq$2.0 cm were enrolled in our study. First a percutaneous nephrostomy to decompress the obstructed kidney was performed using local anaesthesia (lignocaine). A 16-Fr nephrostomy tube was left in place for 1 wk, and then the second stage was carried out. After having infiltrated the tract and the renal parenchyma with lignocaine, dilatation of the nephrostomy tract was performed. Subsequently, PCNL was done using a 24-Fr rigid nephroscope and a ballistic lithotripter. All patients were premedicated with pethidine HCl intramuscularly 30 min before the beginning of both stages. Diazepam was given (0.1 mg/kg orally) to patients before the second stage. Pain scores were collected using 10-cm linear visual analogue scale (VAS) after the completion of both procedures.
Results: The procedure was well tolerated. One patient needed further treatment with midazolam during PCNL. The mean VAS score was 38 mm (range: 17–60 mm) for the first stage and 36 mm (13–69 mm) for the second stage. The mean operative time, including both stages, was 127 min (85–155 min). No anaesthesia-related complications occurred.
Conclusion: Our study indicates that PCNL under assisted local anaesthesia is safe and effective in selected patients.

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1. Introduction

Percutaneous nephrolithotomy (PCNL) is considered to be the most appropriate treatment for the management of large or staghorn stones [1,2]. The techniques and equipment used in PCNL have improved, and efforts have been made to decrease the procedure's morbidity, analgesic requirements,

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and hospitalization time. Toward these aims, the mini-perc technique and tubeless procedure were introduced, and a few early studies on outpatient PCNL have been published [3–7]. Interest in performing endourological procedures, including PCNL and ureteroscopic lithotripsy, under local anaesthesia has arisen due to physicians' increased experience with these techniques, the rising cost of health care, and limited operative time required for these procedures [8,9]. The aim of the present study was to investigate the feasibility of PCNL under assisted local anaesthesia (i.e., local anaesthesia in premedicated patients).

2. Patients and methods

Between February 2003 and October 2005, 24 patients (15 men, 9 women) with unilateral kidney obstruction due to a renal pelvis stone of ≥2.0-cm diameter were enrolled in this prospective study. The mean stone diameter was 2.3 cm (range: 2.0–3.2 cm). The maximum diameter of stones was measured on plain KUB X-ray.

Exclusion criteria were uncorrected coagulopathy, allergy to opioids, obesity, urinary infection, renal anatomic variations, and previous renal operations. Three patients were found to have infections (2 with *E. coli* and 1 with proteus) and were excluded from the study. Patients with staghorn calculi and stones with a diameter >3.5 cm were also excluded to avoid excessive disintegration time during the operation that could result in patient discomfort. A total of 121 PCNLs were performed during the study period, but only 20% (24/121) of patients met our inclusion criteria.

Diagnostic work-up included medical history, physical examination, blood tests, urine culture (urine collected at the time of renal puncture), plain X-ray, and ultrasonography of the kidneys and bladder. All 24 patients included in the present study had sterile urine cultures. All patients were capable of independently completing a visual pain analogue scale (VAS) and a written consent form.

The first stage was to introduce a percutaneous nephrostomy (PCN) to all patients to relieve the obstruction. PCN was performed at the radiology suite as an outpatient procedure. Thirty minutes before PCN, 100 mg of pethidine HCl were administered intramuscularly (IM) to all patients. A single 300-mg dose of intravenous netilmicin was given as antibiotic prophylaxis. Patients were placed in the prone position, and the appropriate site of puncture was selected under ultrasonic guidance. Infiltration of the skin and injection of 2% lignocaine (Xylocaine) along the direction of the intended puncture was performed. A 17.5-gauge Chiba needle was advanced. Access was achieved under ultrasonic and fluoroscopic guidance. A nephrostomogram was performed in every patient to assess upper urinary tract anatomy; in cases of ambiguous findings regarding renal anatomy, a CT was performed. A 0.038-in floppy-tip J guide wire was inserted through the needle, and then dilatation of the nephrostomy tract was performed using Alken type metal telescoping dilators over the wire to 18 Fr. A 16-Fr nephrostomy catheter was inserted and left in place for 1 wk to achieve maturation of the percutaneous tract.

Patients were asked to complete the VAS immediately after the procedure. Pain score was evaluated using a 10-cm linear VAS. The scale consisted of a horizontal line marked "no pain" at one end and "worst possible pain" at the other. Data acquired from the VAS pain questionnaires was taken as a length measurement (mm) using a ruler.

One week later the second stage, PCNL under assisted local anaesthesia, was performed. All patients received premedication with pethidine HCl (100 mg IM) and diazepam (0.1 mg/kg orally). A single 300-mg dose of intravenous netilmicin was also administered as antibiotic prophylaxis. PCNL was performed in the operating room, and an anaesthesiologist was available in case of an undesired event or if general anaesthesia was required. Midazolam (5 mg, intravenously) could also be given intraoperatively upon demand of the patients. During the procedure, heart rate, arterial pressure, ventilatory frequency, and peripheral oxygen saturation were monitored continuously. The procedure was carried out in the prone position. Contrast media was injected to opacify the collecting system and a 0.038-in floppy-tip J guide wire was inserted. The nephrostomy tube was withdrawn and a long 22-gauge Spinal needle (BD Medical System, Franklin Lakes, New Jersey, USA) was advanced alongside the guide wire under fluoroscopic and ultrasonic guidance. When the needle reached the renal parenchyma, aspiration was done to ensure that the needle had not entered a blood vessel. Then 2% lignocaine was injected slowly while the needle was rotated and moved out to infiltrate the renal parenchyma and capsule. The needle was withdrawn and lignocaine was also injected along the tract. Dilatation of the nephrostomy tract then was performed using Alken type metal dilators until a 27-Fr channel resulted. A 26-Fr Amplatz sheath was inserted and a 24-Fr rigid nephroscope (Richard Wolf, Knittlingen, Germany) was then advanced into the renal pelvis. Stone disintegration using a ballistic lithotripter (Swiss Lithoclast, EMS Corp., Dallas, Texas, USA) in standard mode followed, and a 16-Fr nephrostomy tube was placed at the end of the procedure.

All patients graded their pain on the VAS at the end of the operation and went directly back to the ward. A nephrostomogram was performed 24–48 h postoperatively to evaluate residual stone burden and the integrity of the collecting system.

3. Results

The average age of the 24 patients was 47 yr (range: 32–69 yr). The mean operative time, including both stages was 127 min (range: 85–155 min). The mean operative time of first stage was 26 min (19–37 min), and that of the second stage was 101 min (66–125 min). Average haemoglobin decrease was 1.5 dl/g (range: 0.5–3.7 dl/g), but no patient needed a blood transfusion. During the first stage 10 ml of lignocaine was routinely used for local anaesthesia (Table 1). Access was easily gained in all cases due to the pre-existing dilatation of the system, resulting

Table 1 – Scheme of assisted local anesthesia for PCNL

	Stage 1		Stage 2	
	N patients	Dose	N patients	Dose
HCl pethidine	24	100 mg IM	24	100 mg IM
Diazepam	NO		24	0.1 mg/kg p.o.
Lidocaine	24	10 cc	24	18 cc (12–20 cc)
Midazolam	NO		1*	5 mg IV

NO: not offered.
* Upon demand.

in only one percutaneous puncture. The mean VAS score was 38 mm (range: 17–60 mm). Twenty-two patients were discharged on the same day; the remaining two were admitted for surveillance due to bleeding and discharged 2 days later. In one patient a CT was performed to further evaluate upper urinary tract anatomy; no renal abnormality was revealed, and the patient was included in the study.

In the second stage, the average lignocaine used was 18 ml (range: 12–20 ml). In all but one patient, who was given 5 mg of intravenous midazolam, the whole procedure was well tolerated without any need for general anaesthesia (Table 1). The mean VAS score was 36 mm (range: 13–69). No anaesthesia-related complications occurred. Fever (>38 °C) was noted in one patient (4.2%), who was treated with intravenous antibiotics. Three patients (12.5%) had residual stone fragments that were retrieved the next day through the nephrostomy tract, using a mini-nephroscope under local anaesthesia. The average hospital stay was 2.1 days (range: 1–5 days).

4. Discussion

There are several reasons to develop PCNL under local anaesthesia, including that some patients are unfit to receive general anaesthesia due to severe comorbidity, the need for cost suppression, and the long waiting lists due to the limited availability of anaesthesiologists and anaesthesiology nurses. Reddy et al. [5] removed percutaneously caliceal and poorly accessible renal stones with a variety of techniques under local anaesthesia using an intravenous sedative and narcotic. Preminger et al. [6] described an outpatient PCNL in 5 patients with small renal stones using assisted local anaesthesia. Recently, Dalela et al. [8] described a novel technique for performing PCNL under local anaesthesia. Lignocaine was infiltrated at the site of renal entry to produce a renal capsular block in 11 patients; the procedure was well tolerated with good results.

It is believed that pain during PCNL is mainly caused by the dilatation of the renal capsule and parenchyma and not by stone disintegration [8,10,11]. Therefore, the renal capsule should be the target of local anaesthesia. However, one question is if the eventual capsular puncture site is the same spot the anaesthesia needle hits. In the present study, a suitable tract was initially created to decompress the dilated collecting system and allow us to optimize local anaesthesia for percutaneous nephrolithotomy 1 wk later. The sequence of our manoeuvres in two stages seems to ensure that the local anaesthetic would be administered along the entire tract, from the skin to the capsular puncture site and the underlying parenchyma.

Although pain is a subjective symptom, it is also important to identify factors that may affect pain intensity. Lang et al. [12] identified procedure duration as a critical parameter in the pain experience. Furthermore, a study on abdominal interventional procedures found that patients who underwent technically more difficult and more time-intensive interventions reported greater pain [13]. Discomfort from the prolonged stay in the prone position can also lead patients to give a higher pain score. Anxiety is another factor that can contribute toward patient discomfort. Therefore, in the present study all procedures were performed by experienced endourologists to guarantee the fastest completion. In addition, premedication was given to all patients. This combination resulted in mean VAS scores (38 and 36 mm for stages 1 and 2, respectively) that can be considered acceptable [14]. The acceptance and tolerability of the method was indicated by the fact that, after having undergone the first stage, none of our patients refused to undergo the second stage, although they had the option to choose another type of anaesthesia. The obtained scores are similar to the mean VAS score (33.6 mm) recorded by Park et al. [9], who performed ureteroscopic lithotripsy under local anaesthesia. Dalela

et al. [8] blocked the renal capsule during PCNL and recorded a mean score of 1.63 using a numeric pain rating scale.

Our study revealed the feasibility of PCNL under local anaesthesia in a selected group of patients, those without previous renal operation or staghorn stones, which could result in greater pain, increased operative time, or the need for more than one access tract. The described technique was performed on only 20% (24/121) of our PCNL patients due to the rigid selection criteria. Other patients, however, including those with stones <10 mm that can be removed en bloc after failure of extracorporeal shock wave lithotripsy, could benefit from PCNL under local anaesthesia.

Our findings suggest that efficacy and safety are not affected by the use of local anaesthesia. Our success rate (87.5%) is consistent with the reported success rates in other series of PCNL [15]. No major complications associated with the procedure occurred, and safety of percutaneous nephrolithotomy under local anaesthesia was comparable to that of PCNL under general anaesthesia [15]. In addition, our group of patients did not experience any anaesthesia-related complication, as lignocaine was administered locally and at a very low dose. Toxicity from lignocaine has been primarily associated with intravenous administration [16].

Although comparative studies on anaesthesia costs have inherent difficulties, particularly across different health care systems, the cost savings of PCNL under local anaesthesia is evident. The lack of anaesthesia charges (anaesthesiologist, anaesthesia nurse, and recovery room) help to decrease overall health care costs. This suggests that solutions to cost-effective medicine do not come only from technological advances but also from intuitive procedural modifications that are supported by clinical findings.

Our results demonstrate the feasibility of PCNL performed under local anaesthesia in a selected group of patients who were able to cooperate with the physician, had an optimal renal stone size, and had a dilated upper urinary tract that facilitated the first stage of the procedure. Based on these preliminary findings, local anaesthesia with the analgesic effect of pethidine and the sedative effect of diazepam seem to be sufficient to allow the successful completion of the procedure and may reduce treatment costs. Furthermore, we believe that other groups of patients (including those with high anaesthetic risk) could also undergo PCNL under assisted local anaesthesia if they are properly selected. Additional studies with different patient populations and drugs combinations are required to validate our results.

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Editorial Comment

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Most percutaneous nephrolithotomy (PCNL) procedures are performed under general anaesthesia. The authors of this study demonstrate that PCNL can be done under local anaesthesia in certain patients with upper urinary tract obstruction, which represents only 20% of the procedures in their experience. The two steps technique included primary nephrostomy followed by PCNL one week later. Local anaesthesia was done with a non-specific needle and lignocaine was injected within kidney, capsule and parietal tract. Intramuscular and oral premedication were associated with local anesthesia since intravenous sedation could be required if necessary to reduce patient's anxiety.

Patients with high co-morbidity are eligible for such anaesthesia but stone burden must be considered as an important factor since the effects of lignocaine are restricted in time (30–60 min). Likewise, one must keep in mind that maximum safe dose of local anaesthetics is limited to 3 mg/kg for lignocaine and 5 mg/kg when associated with vasoconstrictor [1].

Stones <10 mm which can be removed en bloc without fragmentation represents a good choice, especially hard stones treated after ESWL failure. For the above mentioned reasons, stones requiring fragmentation must be limited to a moderate bulk (<40 mm diameter) to reduce disintegration time.

Various techniques of local anaesthesia were described for percutaneous renal procedures and most authors emphasise the need of capsular and parenchymal anaesthesia since they consider such structures to be painful [2,3]. Nevertheless, parietal anaesthesia must be optimised along the dilation tract [2]. The use of a vascular sheet with a Y sideport allows the injection of a complement of lignocaine all along the posterior abdominal wall, while the sheet is mobilized before dilation [2].

PCNL is feasible under local anaesthesia in carefully chosen patients respecting maximal safe dose of drugs.

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