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Results of Percutaneous Nephrolithotomy under Spinal Anesthesia

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***Abstract*—**Recently, there has been a considerable increase in the number of procedures carried out under regional anesthesia. However, percutaneous nephrolithotomy (PCNL) procedures are usually performed under general anesthesia. The aim of this study was to assess the safety and efficacy of PCNL under spinal anesthesia in patients with renal calculi. We describe our 9 years experience of performing PCNL under spinal anesthesia for 387 patients with large stones of the upper urinary tract, with regard to the effectiveness and side effects. All patients received spinal anesthetics (Lidocain 5%, or Bupivacaine 0.75%) and underwent PCNL in prone position**.** The success rate was 94.1%**.** The incidence of complications was 11.6%. PCNL under spinal anesthesia is feasible, safe, and well-tolerated in management of patients with renal stones.

***Keywords*—**percutaneous nephrolithotomy, spinal anesthesia, renal calculi

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I. Introduction

PERCUTANEOUS NEPHROLITHOTOMY (PCNL), since its first description by Fernstrom and Johansson in 1976 [1], now is a popular, well established, minimally invasive procedure that is choice for removal of kidney calculi with greater than 2 to 3 cm diameters, multiple kidney calculi, staghorn calculi and the cases of failed Extra corporal shockwave lithotripsy (ESWL) [2]–[4]. Several attempts have taken place in last few years to reduce morbidity, analgesia requirements and duration of hospitalization after PCNL. One of this attempts is regional aesthesia instead of general anesthesia to avoidance of anaphylaxis due to use of multiple drugs [1], [5], reduce the anesthesiologist charge on patients and reduce complications of general anesthesia such as pulmonary (athlectasia), vascular, and neurologic disorders (brachial nerve injury); specially during change of the position [3]. There are few strong contraindications for spinal anesthesia (neuraxial block). Some of the most important ones include patient refusal; a patient's inability to maintain stillness during the needle puncture, exposing the neural structures to unacceptable risk of injury; and raised intracranial pressure, which theoretically may predispose to brainstem herniation. Relative contraindications that must be weighed against the potential benefits include intrinsic and idiopathic coagulopathy, such as that occurring with administration of Coumadin or heparin; skin or soft tissue infection at the proposed site of needle insertion; severe hypovolemia; and lack of anesthesiologist experience.

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The often-cited relative contraindication of preexisting neurologic disease (e.g., lower extremity peripheral neuropathy) is not usually based on medical criteria but rather on legal considerations [6]. However, there are inadequate published literatures [7]–[9] about using of regional anesthesia for PCNL. This is the largest study in PCNL under Spinal Anesthesia.

II. Materials and Methods

387 patients (279 male and 108 female) older than 18 years with renal or upper ureteral stones and without any contraindication for spinal anesthesia were included in this study from September 2001 to August 2010. Exclusion criteria were any contraindication for Spinal Anesthesia and patients that refused or had unsuccessful Spinal Anesthesia. After full urologic workup (Ultrasonography, KUB, IVP and Isotope scan or CT scan if necessary) and general physical and laboratory examination (CBC, FBS, BUN, Cr, PT, PTT, UA, UC) they admitted the day before PCNL. Anesthetic visit was done and patient's consent was taken if He/She could receive Spinal Anesthesia.

A. Anesthesia management

Patients were placed in sitting position on the operating table. Under aseptic condition, a dural puncture was made at the L3-L4 interspaces with a 23-25 gauge spinal needle and hyperbaric Bupivaccaine 0.75% or Lidocaine 5% was administrated in subarachnoid space, and the head of the bed was tilted down for few minutes, while checking the level of anesthesia (see Fig 1).



Fig. 1 Spinal anesthetics injection in subarachnoid space

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Epinephrine or Phentanyl was asked to add to anesthetic agent if a long procedure expected.

B. Surgical procedure

After stabilization of anesthesia, cystoscopy, ureteral and urethral catheterization done in frog leg or lithotomy position. We did all cases in prone position. Renal puncture made under fluoroscopic control and dilate the track by telescopic or one shot technique to accept 24 to 30F Amplatz sheath. 21F Wolf nephroscopy and EMS pneumatic lithoclast used for stone fragmentation. 2nd and 3rd access tracks made if necessary. We choose the best calices to have access to whole or most part of calculi. We didn't hesitate to make intercostals access if it was mandatory. All the maneuvers tried to make him/her stone free and check them again by fluoroscopy. Nephrostomy tube fixed only in cases with residual stone, single kidney or pyelocaliceal system injury. Based on surgeon`s preference double J catheter were fixed in some cases, and retained for 30 days (see Fig 2).



Fig. 2 percutaneous nephrolithotomy procedure

All the patients checked by KUB or Ultrasonography, and chest X-ray in cases with intercostals access, the day after surgery. Re-PCNL under spinal anesthesia did through same tracks or new one, if there were significant residual particles. Lab data rechecked 24 hours after operation, nephrostomy tube removed and patients discharged on 2nd or 3rd day after surgery. Data analyzed with SPSS software 17th edition. Statistical tests such as chi-square, Fischer's exact, and T student used for analysis of parameters. A P-value < 0.05 was considered significant.

III. Results

The mean of patients' age was 48.1 ± 0.71 years (mode 41, min 18, and max 86). Stone burden was staghorn in 104 patients (26.9%), larger than 2 cm in 251 patients (64.8%) and smaller than 2 cm in 32 patients (8.3%). 76 patients (72.8%) had partial, and 28 patients (27.2%) had complete staghorn stones. The localization patterns of renal stones are outlined in Table I. Intercostal puncture was needed in 81 cases, blind access in 26 cases and multiple tracks in 30 cases to complete stone removal. The mean operation time was 49.9 ± 0.98 minutes (mode 45, min 15, and max 120).

TABLE I
LOCALIZATION PATTERN OF RENAL STONES

Stone Locations	Patient Numbers	Frequency
Upper calyces	16	4.1%
Middle calyces	4	1%
Lower calyces	42	10.9%
Renal Pelvis	68	17.6%
Proximal ureters	16	4.1%
More than 1 region*	241	62.3%

*Staghorn or complex stones

The success rate was 94.1% (stone-free patients (92.5%) and patients with residual stones < 4 mm (1.6%)). Others with residual stones > 4 mm were 5.4% and managed by RePCNL. The localization pattern of tracks, and number of tracks, are outlined in Table II.

Only 2 patients required to change from spinal to general anesthesia. The incidence of operative complications was 8.3%.

TABLE II
LOCALIZATION TRACKS AND NUMBER OF TRACKS

Tracks	Patient Numbers	Frequency
Access By 1 Track	357	92.2%
Access By 2 Tracks	29	7.5%
Access By 3 or more Tracks	1	0.3%
Sub costal Access	306	79%
Intercostals Access	81	21%

There were no significant intraoperative problems or other complications related to the spinal anesthesia. The incidence of complications was 11.6%. In 2 cases blood transfusion were reported (see Table III).

IV. Discussion

It has been shown that PCNL under assisted local anesthesia is safe and effective in selected patients [10].

TABLE III
IMPORTANT ANESTHESIA AND SURGICAL ASSOCIATED COMPLICATIONS

Complications	Patient Numbers	Frequency
Intra operative pain	7	1.8%
Sever hypotension and nausea*	1	0.3%
Nausea and vomiting in start of operation	6	1.6%
Intra operative chills and irritability	4	1%
Intraoperative bleeding	15	3.4%

*Change anesthesia to general

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Maintaining a good postoperative quality of life, may be achieved in most patients regardless of the technique of anesthesia. However, anesthesia can influence the early postoperative patient's recovery, and because the aim of an urologist is to discharge the patients from the hospital in safe condition as early as possible, the choice of anesthesia is matter [11].

According results of our medical websites searches, many attempts for simplification of anesthesia for PCNL have been done and were seen some good results:

Ballestrazzi V, and colleagues in the urology service of the Regional Hospital Center of life in 1988 were described 112 patients who underwent percutaneous renal surgery with epidural anesthesia with 88% hemodynamic and respiratory parameters satisfaction, as the first description of regional anesthesia for PCNL [12].

El –Husseiny T. and colleagues in Endourology and Stone Services, Barts and The London NHS Trust, London, UK, in 2009, were done Percutaneous endourologic procedures in 27 medical high-risk patients with a mean age of 62 years and an American Society of Anesthesiologists score of 3+, that 22 of them were undergo PCNL that majority (78%) had regional anesthesia and were fully awake and alert during the operation.

Their results were safely performance of regional anesthesia with avoidance from the risks of general anesthesia and allowing patient-anesthetist communication throughout the procedure, also, cardiac and respiratory parameters stability, and easily controlling, and patient's more comfortably [13].

Kuzgunbay B, and colleagues in Department of Urology, Baskent University, Ankara, Turkey, in 2009; were studied 82 patients who underwent percutaneous nephrolithotomy (PCNL) for management of kidney stone disease and were compare them in 2 groups with general anesthesia and combined spinal-epidural anesthesia. They were not found significant differences between 2 groups, among surgical parameters, including age, stone area, operative time, irrigation fluids, fluoroscopy time, delta hemoglobin, and hospitalization time ($P = 0.439$), and also, stone-free rates ($P = 0.543$); they were concluded that combined spinal-regional anesthesia is a feasible technique in PCNL because the efficacy and safety were not affected [14].

Andreoni C, and colleagues in Department of Surgery/Division of Urologic Surgery, Washington University School of Medicine, Missouri, USA, between 1999-2000; were studied the impact of one dose of subarachnoid spinal analgesia on postoperative pain and recovery after percutaneous nephrolithotomy (PCNL) in 20 patients; they were concluded that a single preoperative dose of subarachnoid spinal analgesia, provides a statistically significant decrease in postoperative parenteral pain medication and earlier ambulation, and also, appears to reduce the amount of postoperative pain and nausea ($P > 0.05$) [15].

We described our experience in 387 patients that underwent PCNL with spinal anesthesia. Our study is greater than all previous studies according cases number, for a new procedure implication. Despite spinal anesthesia at the L3-L4 interspaces, incidence of intercostals access were 20.9% without significant anesthesia and surgical associated complications in compare with sub costal access (P-value = 0.89).

Stone free rate is 92.5%, that in patients with lower pole calyceal stones was 97.6% and in patients with upper pole calyceal stones was 87.5%.

The mean of operation time is about 49.9 minutes that is significantly less than previous studies; it can describe with good experience of urologist. Difference between mean time of operation for renal stones less than 2cm (35.7 minutes), greater that 2 cm (45.5 minutes) and for staghorn stones (64.6 minutes) is significant (P-value < 0.00001), that is acceptable with stones size.

Operation associated complication were only 8.3% and anesthesia associated complication were only 4.7%.

In patients with hydronephrosis, Complications of surgery ($P = 0.024$) and anesthesia ($P = 0.022$), and also total complications ($P = 0.015$); were significantly lower than patients without hydronephrosis. This correlation, according our data, not presented in pervious studies.

The mean of hemoglobin drop was 1.6 ± 0.09 g/dl, and mean of hematocrit drop was $4.7 \pm 0.26\%$.

Only 0.5% of the patients required blood transfusion. Considering the significant differences between our study and previous studies [15], [16] on the need for blood transfusion was observed, it is better that a blood transfusion protocol in our center to be re-evaluated.

V. Conclusion

PCNL under spinal anesthesia is feasible, safe and well tolerated in management of patients with renal stones. The method is particularly valuable for elderly patients with significant co morbidities such as pulmonary diseases and who are not able to receive general anesthesia. Also spinal anesthesia for PCNL is effective and safe in management of patients with upper pole calyceal stones as well as patients with lower pole calyceal stones.

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