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Safety and Efficacy of Supracostal Percutaneous Nephrolithotomy. Our Experience

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Abstract

Aims: To evaluate the safety and efficacy of supracostal access of Percutaneous Nephrolithotomy (PCNL) for the clearance of renal stones.

Methodology: This retrospective study conducted at Hamdard University Hospital, from April 2018-January 2022 included patients > 14 years of age who underwent supracostal PCNL for a large renal or upper ureteral stone, multiple renal stones in > 2 calyces, obstructive stone, or a stone in a single functioning kidney. The preoperative stone burden was measured along the longest dimension and sum for multiple stones. No stone or < 4 mm stone was considered as complete clearance on imaging.

Results: Out of 57, there were 32 males and 25 females with a mean age of 41.51 ± 9.29 years, the duration of surgery was 52.13 ± 8.91 minutes, and the maximum longitudinal length was 3.42 ± 1.12 cm. A total of 49 patients went stone free, eight patients had residual stones, with calyceal residual stones in six, and two had small stone fragments migration in the ureter. Overall complications were seen in nine, with significant bleeding in three, high-grade fever in four, and urinary leakage in two.

Conclusion: Supracostal access for the PCNL in an experienced hand is safe and efficacious in renal stone clearances with few complications.

Keywords: Percutaneous nephrolithotomy; PCNL; Supracostal access; Renal stones; Urolithiasis

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Introduction

Urolithiasis represents the most common urological problem in everyday practice. It constitutes about 40–50% of the overall urological workload. Pakistan falls into the famous stone belt, stretching from Egypt to far east Asian countries with a high incidence of urolithiasis and a prevalence of 12% [1].

Endoscopic management of renal stones is a well-established mode of treatment. Fernstrom and Johansson first reported the Percutaneous Nephrolithotomy (PCNL) in 1976, revolutionizing the treatment for large renal stones [2].

Over the years, PCNL has been established as the safest management tool for large renal stones. This percutaneous modality is also useful for the management of ureteropelvic junction (UPJ) obstruction, proximal ureteric stones/strictures, and upper collecting system tumors [3].

Ideal access for PCNL is the one that makes access through the renal calyceal system easier, avoiding damage to major vessels and viscera with minimal parenchymal injury [4].

The conventional method of PCNL comprises access through the subcostal region below the 12th rib with the patient in the prone position. Over half a century, there have been many technological changes in PCNL access according to surgeons' preferences [5]. Supracostal access above the 12th rib for renal stone disease is one of such changes now universally practiced amongst urologists [6].

Major centers around the world with their broad experience advocate supracostal access for complete renal stone clearance with lesser complications [7]. This study was conducted to evaluate the safety and efficacy of this supracostal access of PCNL for the clearance of renal stones.

Methods

This observational study was carried out at a tertiary care hospital through a retrospective collection of data from April 2018-January 2022.

This was a nonprobability consecutive sampling that included all males and females above 14 years of age, those who underwent supracostal PCNL with indications i.e. staghorn calculus, large renal calculus (> 2 cm), large upper ureteral stone (> 1.5 cm), multiple renal stones in > 2 calyces, obstructive stone > 2 cm, or a stone in a single functioning kidney. Those who did not give consent to be included in the study, those with the same procedure but infracostal access or concomitant supra and infracostal access, those having abnormal anatomy of kidneys, severe kyphoscoliosis, previous thoracic surgeries on the ipsilateral side, or those with other surgeries done simultaneously (which could have affected the study) were excluded.

After getting approval from the institutional review board, with a waiver of the requirement of informed consent (being a retrospective data collection), all patients fitting into the inclusion and exclusion criteria were included. Data regarding demographic details (age, gender), stone burden (ultrasound and Computed tomography scan findings), stone clearance with primary PCNL and combination, need for auxiliary procedures like Extracorporeal Shock Wave Lithotripsy (ESWL), secondary PCNL, or URS, and complications were recorded.

X-ray KUB / Ultrasound KUB was done on the second postoperative day to confirm clearance and/or for residual stones. The preoperative stone burden was measured along the longest dimension and sum for multiple stones. Complete stone clearance postoperatively was defined as no stone or less than 4 mm in size. Complications were reported as per Modified Clavien Grading.

Under general anesthesia, all patients underwent retrograde urography in the dorsal lithotomy position and PCNL in the prone position with C-arm positioned at 30 degrees. 'Bull's Eye Technique' was used for puncture using a spinal needle 18-gauge. The site of interest was marked before painting and draping the patient. 12th rib, lateral border of Erector Spinae muscles, and the Iliac Crest was marked. For supracostal access, the area lateral to the lateral border of the Erector Spinae muscles (to avoid pleural injury) and close to the upper border of the lower rib (to avoid injury to the neurovascular bundle) was selected.

Likewise, the forniceal rather than the Infundibular region was targeted under Fluoroscopy. For high-located kidneys, the Renal Descensus technique was adapted by hyperinflating lungs and holding breath for a short instance. To protect from barotrauma with long and sustained pressure, the lungs were inflated at the submaximal level and the puncture needle was positioned at the proposed puncture point to acquire bull's eye on fluoroscopy before Hyperinflating at the final puncture under a fluoroscope.

A small 0.5 cm incision was made guided by a fluoroscope, before the insertion of the puncture needle. A guidewire was then passed into the collecting system and then further ahead when possible. The skin incision was then extended and the tract

was dilated. A 26 Fr access sheath was then placed in the collecting system and a 24 Fr Nephroscope coupled with an ultrasonic lithotripter was used for stone fragmentation. Fragments were then removed using 3-clawed forceps or suction. A guidewire in the collecting system is then slowly removed, followed by the access sheath. The nephroscope is then used to inspect the track for any bleeders. A 28 Fr Nephrostomy tube was placed in most cases at the end of the procedure for 48 hours to allow the tract to mature. The wound is closed with a 2–0 nylon suture with a pressure dressing.

Results

A total of 57 patients underwent PCNL through supracostal access. Indication for the surgery is mentioned in Table 1. There were 32 (56.15%) males and 25 (43.86%) females.

Table 1. INDICATIONS FOR THE SUPRACOSTAL APPROACH (n = 57)

Indication	Frequency	Percentage
Stag horn stones	35	61.40%
Single pelvic stones	9	15.78%
Upper calyceal/diverticular stones	6	10.52%
Upper ureteric stones	7	12.30%

The mean age of patients was 41.51 ± 9.29 years, the overall duration of surgery was 52.13 ± 8.91 minutes, and the stone size (maximum longitudinal length) was 3.42 ± 1.12 cm. A total of 49 (85.96%) patients went stone free, eight (14.04%) patients had residual stones, with calyceal residual stones in six, and two had small stone fragments migration (Steinstrasse grade 1) in the ureter.

An auxiliary procedure (ESWL) was required in six patients with residual calyceal stones. Two patients with ureteric stone fragments migration were managed conservatively with alpha-blockers, hydration, and prolonged ureteric stent placement for a week.

Overall complications were seen in nine patients (15.8%), with significant bleeding and hemoglobin drop in three (managed with blood transfusion), high-grade fever in four requiring intravenous antibiotics and hydration, while two patients developed urinary leakage from puncture sites which were managed conservatively.

Discussion

Complete stone clearance is the primary goal in the management of renal stone disease with early return to routine activity. Before the advent of minimally accessible surgeries, open surgeries were the only resort for patients with stone disease but it is now almost nonexistent. The introduction of ESWL and endourology advances allowed patients with renal stones to be treated with minimal or no invasion at all [8,9].

Over the years, with the advent of sophisticated endourological instruments and an increase in skills, broad training opportunities, and availability of master trainers for PCNL, it's become one of the common procedures in day-to-day urological practice [10].

Studies have proven the efficacy and safety of PCNL over other modalities like ESWL for renal stones of more than 2 cm or above, patients with multiple calyceal stones, stones in the calyceal diverticulum, stones in morbidly obese patients, or anatomically challenging kidneys like a horseshoe, malrotation or other anatomical anomalies [11].

The choice of puncture is an important factor in the overall outcome of PCNL surgery. Meticulous assessment of both pre-operative and intra-operative imaging of renal calyceal anatomy plays a decisive role in planning the right approach/access [12].

Both supracostal and subcostal punctures can be used to get access to the renal calyceal system during PCNL surgery. Access through supracostal puncture favors approaching the whole calyceal system of the kidney and upper ureter and it also has better results in stone clearance than subcostal access however due to the anatomical proximity of intercostal vessels, pleura, and other viscera, there is often reluctance shown by surgeons to approach through supracostal access [13]. A better understanding of surgical anatomy, meticulous assessment of pre-operative and intra-operative imaging, experienced hands, and supracostal access have shown better efficacy and safety [14].

In this current study and our previous studies, we observed that over a period, as we acquire more and more experience, the outcome of the surgeries is getting better with better stone clearance rates and fewer complications [6,13,15,16].

Conclusion

Supracostal access for the PCNL in an experienced hand is proven to be safe and efficacious in renal stone clearances with fewer complications. It is also a better option for anatomically challenging renal tracts.

Declarations

Conflict of Interest

None to declare.

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