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Supracostal Percutaneous Nephrolithotomy in the Management of Renal Calculi: A Prospective Observational Study

[1]Dr S. Sukesh Sindhey, [2]Dr B. Praveen and [3]Dr Mohammed Mujtaba Hussain

[1,2]Department of Urology, The Oxford Medical College Hospital and Research Centre, India

[3]Department of Urology, Gulbarga Institute Of Medical Sciences, India

ABSTRACT

Renal stone disease continues to be one of the most frequently encountered disorders in urological practice. Over the last several decades, the epidemiological profile of stone disease has evolved considerably, with increasing prevalence across both sexes and across a wider age spectrum. Simultaneously, major progress in endourology and minimally invasive stone surgery has transformed the management of renal calculi. Among the available treatment modalities, percutaneous nephrolithotomy (PCNL) has emerged as the standard procedure for large, complex, and staghorn renal stones. In selected cases, especially those involving staghorn calculi, upper calyceal stones, and complex proximal ureteric stones, supracostal access offers a more direct tract to the collecting system and may facilitate better stone clearance. However, the supracostal approach has traditionally been viewed with caution because of the perceived risk of thoracic complications. To prospectively evaluate the safety and efficacy of supracostal puncture in patients undergoing PCNL for renal and upper ureteric calculi. This prospective observational study was conducted in the Department of Urology, The Oxford Medical College Hospital and Research Centre, on 32 patients who required supracostal access for PCNL between July 2022 and January 2023. All procedures were performed using access above the 12th rib under fluoroscopic guidance. Clinical, radiological, intraoperative, and postoperative parameters were recorded. The primary outcome was stone clearance. Secondary outcomes included complications, need for additional puncture, ancillary procedures, and duration of hospital stay. The mean age of the study population was 39.69 years, with an age range of 17 to 61 years. Of the 32 patients, 21 had left-sided calculi and 11 had right-sided calculi. Staghorn calculi were present in 28 patients (87.5%), while 4 patients (12.5%) had upper ureteric stones. The mean stone size was 28.56 mm. Complete stone clearance was achieved in 28 patients (87.5%). Significant residual calculi were noted in 4 patients (12.5%), of whom one patient required adjunctive ESWL and three were followed up conservatively. Supracostal puncture was the sole access in 27 patients, while an additional puncture was needed in 5 patients. The mean postoperative hospital stay was 5.53 days. Postoperative complications occurred in 6 patients (18.75%), including haemothorax in 2 patients, pelvic perforation in 1 patient, and postoperative sepsis in 3 patients. No patient developed pneumothorax or visceral injury. Supracostal PCNL is a safe and effective procedure in selected patients with complex renal stone disease. When performed by experienced surgeons with appropriate preoperative planning and meticulous technique, supracostal access can achieve high stone clearance with acceptable morbidity. The findings of this study support the use of supracostal puncture in appropriately chosen cases requiring a direct and efficient tract to the collecting system.

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Key Words

Renal calculi, supracostal puncture, percutaneous nephrolithotomy, staghorn calculus, stone clearance, thoracic complications, endourology

Corresponding Author

Dr S. Sukesh Sindhey,
Department of Urology, The Oxford Medical College and Research Hospital, India

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INTRODUCTION

Renal stone disease is among the oldest known disorders affecting humankind and remains one of the most common diseases encountered in modern urological practice. The disease has undergone a marked epidemiological transition over time. Earlier descriptions of urinary stone disease largely emphasized bladder stones and lower urinary tract pathology; however, with changes in lifestyle, urbanization, dietary habits, occupational exposure, and improved diagnostic capabilities, the burden has shifted predominantly toward upper urinary tract stone disease. The contemporary rise in obesity, metabolic syndrome, dietary sodium consumption, reduced hydration, and sedentary behaviour has further contributed to the increasing prevalence of nephrolithiasis. The stone disease affects a broad demographic and that both incidence and prevalence correlate with age, sex, body weight, body mass index, and environmental heat exposure.

The lifetime prevalence of kidney stone disease has been estimated to range from 1% to 15%, varying according to age, geographic location, race, dietary pattern, and climate. Stone disease is relatively uncommon before the age of 20 years, but the incidence rises substantially in adulthood, with peak occurrence typically in the fourth to sixth decades of life[1-3]. The evolving age distribution of stone disease in both men and women and draws attention to the contribution of occupational exposure to high temperatures and dehydration as important risk factors.

The treatment of renal calculi has changed dramatically over the last few decades. In the pre-endourology era, many patients with renal stones were managed conservatively, especially when asymptomatic, because open stone surgery was associated with substantial pain, morbidity, prolonged hospitalization, and renal parenchymal trauma. With the development of fibreoptic technology, radiological guidance, intracorporeal lithotripsy, and improved endoscopic instrumentation, modern stone surgery has become increasingly minimally invasive. These advances have led to the establishment of extracorporeal shock wave lithotripsy (SWL), ureterorenoscopy (URS), and percutaneous nephrolithotomy (PCNL) as major pillars of contemporary stone management.

Among these, PCNL occupies a central role in the treatment of large-volume stone disease. It is particularly valuable for stones greater than 2 cm, staghorn calculi, lower pole stones not suitable for SWL, hard stones, infective calculi, stones associated with obstruction, certain anomalous kidneys, and cases in which SWL or URS has failed or is not expected to be effective[4-7]. It is emphasized that PCNL achieves higher stone-free rates and requires fewer auxiliary procedures than SWL or URS for many large renal stones. The success of PCNL is comparatively less dependent on stone composition and location than other modalities, which explains why PCNL has remained the preferred approach for large and complex calculi.

A particularly important subset of renal stone disease is the staghorn calculus. Staghorn calculi are large branching stones that occupy the renal pelvis and extend into multiple calyces, thereby resembling the antlers of a stag on imaging. These stones may be partial or complete and are associated with significant morbidity when left untreated. It is clear that untreated staghorn stones can result in recurrent urinary tract infection, repeated episodes of urosepsis, deterioration in renal function, and even death[8-11]. Complete loss of function in a substantial proportion of kidneys may occur if these stones are not managed definitively. These risks form the basis for the recommendation by the American Urological Association that staghorn calculi should generally be managed surgically, with complete stone removal as the therapeutic objective[12].

The success of PCNL depends fundamentally on the quality of renal access. Creation of an optimal tract is the most critical step of the procedure because it determines the ease of stone fragmentation and retrieval, the degree of manoeuvrability within the collecting system, the need for additional tracts, and the likelihood of complications. In many cases, subcostal puncture is adequate. However, in patients with staghorn calculi, upper calyceal stones, complex renal stones, and some proximal ureteric stones, a supracostal puncture may provide a shorter, straighter tract along the axis of the kidney and allow improved access to the pelvis, upper calyx, and ureteropelvic region[13,14]. This long-axis approach reduces torque on the nephroscope and may limit trauma to the infundibular and pericalyceal vascular structures.

Historically, supracostal puncture has been approached cautiously because of concern regarding pleural and pulmonary complications. The risk of pleural injury, hydrothorax, hemothorax, and pneumothorax is undeniably higher when access is obtained above the 12th rib and increases further when puncture is made above the 11th rib. Nevertheless, the literature suggests that when the puncture is carefully planned, performed through the appropriate intercostal space, and guided by sound anatomical principles and imaging, supracostal access can be safe and highly effective. The present study was therefore undertaken to prospectively assess the efficacy and morbidity of supracostal puncture in PCNL in a selected patient population.

Aim and Objectives: The present study was designed to evaluate the role of supracostal puncture in percutaneous nephrolithotomy for the management of complex renal calculi. The primary aim was to prospectively assess the efficacy of stone clearance in patients undergoing PCNL through a supracostal approach.

The specific objectives of the study were:

- To determine the stone clearance rate following supracostal PCNL
- To evaluate the perioperative and postoperative safety profile of supracostal puncture
- To assess the frequency and nature of thoracic and non-thoracic complications associated with this access route
- To determine the need for additional punctures and ancillary procedures such as ESWL
- To assess postoperative recovery in terms of nephrostomy drainage and duration of hospital stay

Review of Literature: The history of stone surgery extends back centuries. The early surgical intervention for renal calculi was from Cardan of Milan in 1550, when he reportedly opened a lumbar abscess in a young girl and removed multiple renal calculi[15]. For many years thereafter, open surgery remained the only feasible means of dealing with significant renal stone disease. Historical descriptions from Hippocrates and later surgeons recognized the symptoms of renal colic and the grave complications associated with stone-related obstruction and infection[16].

Before the advent of endourology, most upper tract calculi were treated by open procedures such as pyelolithotomy, radial nephrolithotomy, ureterolithotomy, anatrophic nephrolithotomy, or extended open procedures for staghorn stones. These operations, while effective in selected situations, were associated with considerable morbidity, prolonged hospitalization, postoperative pain, and potential damage to renal parenchyma. With the introduction of minimally invasive procedures, the role of open surgery has been dramatically reduced. The historical evidence is showing a major decline in open stone surgery over time, with only a very small proportion of stone procedures now being performed by open techniques[17].

The conceptual foundation of modern PCNL was established in 1976, when Fernstrom and Johansson first described the creation of a percutaneous tract specifically for stone removal[18]. Their work marked a turning point in stone surgery and led to the development of percutaneous nephrolithotomy as a practical, reproducible, and increasingly refined procedure. Subsequent pioneers, including Alken, Wickham, Kellett, Segura, and Clayman, contributed to the standardization of percutaneous access, tract dilatation, nephroscopy, and intracorporeal lithotripsy. By the early 1980s, PCNL had become an accepted alternative to open stone surgery for many renal and proximal ureteric stones.

Several comparative studies established the advantages of PCNL over open surgery. These advantages include a shorter hospital stay, lower analgesic requirement, more rapid return to normal activities, lower overall cost, and high patient satisfaction. Over time, PCNL became the standard approach for large and complex renal calculi and is now widely regarded as the gold standard for large stone burdens, particularly staghorn stones[19,20].

The success of PCNL is determined not only by stone burden but also by the choice of access tract. Access through a superior calyx, although technically more demanding, offers a short and straight tract along the long axis of the kidney, thereby improving reach to multiple calyces and reducing the torque required by rigid instruments. This is especially important in staghorn stones, where a lower pole access may result in angulation, limited reach, and greater parenchymal trauma. The superior calyceal approach reduces the chances of injuring the peri-infundibular venous plexus and may thereby reduce bleeding.

However, the advantage of supracostal access comes with concern for thoracic complications. Munver and colleagues, reported a significantly higher rate of intrathoracic complications with punctures above the 11th rib compared with those above the 12th rib[21]. Punctures above the 12th rib have a substantially lower complication rate than supra-11th rib access and emphasizes that careful adherence to proper technique is crucial. Historical series have reported rates of pleural effusion or pneumothorax requiring intervention ranging from approximately 1.8% to 8%[22]. This reinforces the idea that supracostal access should not be used casually, but neither should it be avoided when it provides the best route to complete stone clearance.

The modifications of PCNL, include mini-PCNL, ultramini-PCNL, and micro-PCNL. While these approaches aim to reduce morbidity, they are not universally suitable for all stone burdens. In large, branched, or staghorn calculi, standard-caliber PCNL remains superior because it allows efficient fragmentation and retrieval of large stone volumes.The exact role of miniaturized PCNL techniques continues to evolve, but they do not displace standard PCNL in all clinical scenarios.

In summary, PCNL is the treatment of choice for large and complex renal stones, and supracostal access

is a rational and effective route in selected cases where straight, direct access is needed to maximize stone clearance. The present study was undertaken within this clinical context.

MATERIALS AND METHODS

Study Design and Setting: This was a prospective observational study carried out in the Department of Urology, The Oxford Medical College Hospital & Research Centre, Bangalore. Patients admitted between July 2022 and January 2023 who required supracostal puncture for PCNL were included in the study. A total of 32 patients formed the study group.

Inclusion Criteria:

Patients were included if they had:

- Staghorn calculi, defined in the manuscript as stones more than 2.5 cm
- Upper calyceal stones
- Upper ureteric calculi associated with acute angulation between the lower calyx and ureter.

Exclusion Criteria:

Patients were excluded if they had:

- Lower calyceal stones
- Lung disease
- Spine deformity
- Cardiac disease

Preoperative Evaluation: All patients underwent detailed history taking and thorough clinical examination. Baseline laboratory investigations included routine blood investigations, serum creatinine, urine routine examination, and urine culture with sensitivity testing. Radiological workup included ultrasonography of the abdomen and pelvis, CECT urography or NCCT KUB, and X-ray KUB. These investigations were used to assess stone size, location, radiodensity, anatomy of the collecting system, hydronephrosis, status of the opposite kidney, and any additional abnormalities. Patients also underwent pre-anaesthetic evaluation, with chest X-ray and echocardiography performed when indicated for anaesthetic fitness. Patients with positive urine cultures received appropriate antibiotics and were taken up for surgery only after sterile urine was documented. One gram of intravenous cefoperazone was administered preoperatively, and patients were kept fasting overnight.

Instruments and Armamentarium: The source manuscript provides a detailed inventory of the instruments used. These included a 22Fr cystoscope sheath with bridge and 30-degree telescope, high-definition camera and light source, C-arm fluoroscopy, puncture needles, tract dilators, nephroscope, intracorporeal lithotripters, guidewires, forceps, ureteric catheters, and irrigation fluid. The study used a Karl Storz cystoscope, a 24Fr nephroscope, fluoroscopic guidance under C-arm, and ballistic lithotripsy using the EMS Swiss Lithoclast Master. Tract creation was performed using fascial dilators followed by metallic serial telescopic dilators.

Operative Technique: All procedures were carried out under general anaesthesia, which was preferred particularly because upper pole puncture requires good control of respiratory movements to reduce pulmonary risk. Initially, with the patient in lithotomy position, a ureteric catheter was passed into the renal pelvis using cystoscopy. The patient was then turned prone with appropriate padding under the chest and pelvis. Retrograde pyelography was performed using diluted contrast to delineate the pelvicalyceal anatomy and identify the optimal calyx for puncture.

Access to the pelvicalyceal system was obtained using an 18G diamond-tip puncture needle under continuous fluoroscopic guidance, using either the bull's-eye technique or triangulation technique. Once urine was aspirated and access was confirmed, a 0.035-inch hydrophilic guidewire was negotiated into the collecting system and, if possible, advanced into the ureter. Sequential tract dilatation was performed first with fascial dilators and subsequently with Alken telescopic metal dilators up to 30 Fr, after which an Amplatz sheath was positioned. Nephroscopy was then performed using a rigid 24Fr nephroscope. Stones were fragmented using a ballistic intracorporeal lithotripter and the fragments were extracted using forceps. At the conclusion of the procedure, complete inspection of the collecting system was carried out to identify residual fragments, perforation, or bleeding. A Double J stent was placed in all patients, followed by nephrostomy tube placement.

Intraoperative and Postoperative Assessment: During surgery, note was made of operating time, technique, presence of pus, adequacy of fragmentation and extraction, evidence of pelvicalyceal rupture, gross haemorrhage, and injury to surrounding structures. Postoperatively, patients were monitored for pain, fever, sepsis, urinary leak, thoracic complications such as haemothorax, hydrothorax and pneumothorax and other complications including visceral injury. The nephrostomy tube was managed according to postoperative drainage and removed after ensuring the absence of significant leak, bleeding, or pain. Follow-up included X-ray KUB, ultrasonography, and

urine culture at 30 days, with further assessment at 3 months. Stone-free status was defined as complete absence of stones or the presence of residual fragments measuring less than 5 mm.

RESULTS AND DISCUSSIONS

A total of 32 patients underwent supracostal PCNL. All cases were managed using puncture above the 12th rib, and there were no supra-11th rib punctures in the study. This is an important methodological point, because it likely influenced the complication profile by avoiding the higher thoracic risk associated with access above the 11th rib.

The mean age of the patients was 39.69 years, with a minimum age of 17 years and a maximum age of 61 years. The sex distribution consisted of 19 males (59.4%) and 13 females (40.6%). Age group analysis showed that 10 patients were 30 years or younger, 7 were between 31 and 40 years, 7 were between 41 and 50 years, and 8 were older than 50 years.

Table 1: Distribution of Patients according to Age

Age group	No of Patients	Percent (%)
≤30 Years	10	31.3
>50 Years	8	25.0
31-40 Years	7	21.9
41-50 Years	7	21.9
Total	32	100.0

Table 2: Distribution of Patients according to Sex

SEX	No of Patients	Percent (%)
Female	13	40.6
Male	19	59.4
Total	32	100.0

Regarding laterality, 21 patients (65.6%) had left-sided calculi, while 11 patients (34.4%) had right-sided calculi. In terms of stone location, 28 patients (87.5%) had renal pelvic or staghorn calculi and 4 patients (12.5%) had upper ureteric calculi. The mean stone size was 28.56 mm, with a range from 25 mm to 36 mm.

Table 3: Distribution of Patients according to Side of Calculus

Side of Calculus	No of Patients	Percent (%)
Left	21	65.6
Right	11	34.4
Total	32	100.0

Table 4: Distribution of Patients according to Location of Calculus

Location	No of Patients	Percent (%)
Pelvis	28	87.5
Upper ureter	4	12.5
Total	32	100.0

Complete stone clearance was achieved in 28 patients, corresponding to a success rate of 87.5%. Residual significant calculi were present in 4 patients (12.5%). Of these, one patient required adjunctive extracorporeal shock wave lithotripsy, while the remaining three patients were followed up. Thus, supracostal PCNL monotherapy rendered 87.5% of patients stone-free or with only clinically insignificant residual fragments. Notably, all four patients with upper ureteric stones achieved complete clearance, while incomplete clearance was seen among some patients with renal pelvic stone burden, reflecting the greater complexity of large branched intrarenal stones.

Supracostal puncture was the only tract used in 27 patients (84.37%). An additional puncture was required in 5 patients (15.62%). This suggests that in the majority of selected cases, a single supracostal tract provided adequate access for stone clearance. The mean postoperative hospital stay was 5.53 days, with a range from 4 to 7 days.

Table 5: Distribution of Patients based on Complete Clearance

Complete Clerance	No of Patients	Percent (%)
NO	4	12.5
YES	28	87.5
Total	32	100.0

Table 6: Distribution of Patients based on requirement of additional puncture

Additional Puncture	No of Patients	Percent (%)
NO	28	87.5
YES	4	12.5
Total	32	100.0

Table 7:Comparison of Age group with Complete clearance

Age group	Complete Clearance			Total
		No	Yes	
≤30 Years	No of Patients	1	9	10
	Percent (%)	10.0%	90.0%	100.0%
31-40 Years	No of Patients	1	6	7
	Percent (%)	14.3%	85.7%	100.0%
41-50 Years	No of Patients	1	6	7
	Percent (%)	14.3%	85.7%	100.0%
>50 Years	No of Patients	1	7	8
	Percent (%)	12.5%	87.5%	100.0%
Total	No of Patients	4	28	32
	Percent (%)	12.5%	87.5%	100.0%

p=0.992

Table 8: Comparison of Sex with Complete Clearance

Sex	Complete Clearance			Total
		No	Yes	
Female	No of Patients	2	11	13
	Percent (%)	15.4%	84.6%	100.0%
Male	No of Patients	2	17	19
	Percent (%)	10.5%	89.5%	100.0%
Total	No of Patients	4	28	32
	Percent (%)	12.5%	87.5%	100.0%

p=0.682

Complications: Postoperative recovery was uneventful in 26 patients (81.25%). Complications occurred in 6 patients (18.75%). Thoracic complication in the form of hemothorax occurred in 2 patients (6.25%). In both cases, the hemothorax caused only minimal blunting of the costophrenic angle and was managed conservatively without blood transfusion. Importantly, there were no cases of significant hydrothorax requiring chest tube insertion and no cases of pneumothorax.

One patient (3.12%) developed pelvic perforation during surgery, leading to abandonment of the procedure and prolonged nephrostomy drainage for 7 days. One patient developed a

Table 9: Comparison of Side of Calculus with Complete Clearance

Side of Calculus	Complete Clearance			Total
		No	Yes	
Left	No of Patients	4	17	21
	Percent (%)	19.0%	81.0%	100.0%
Right	No of Patients	0	11	11
	Percent (%)	0.0%	100.0%	100.0%
Total	No of Patients	4	28	32
	Percent (%)	12.5%	87.5%	100.0%

p=0.122

Table 10: Comparison of Location of Calculus with Complete Clearance

Location	Complete Clearance			Total
		No	Yes	
Pelvis	No of Patients	4	24	28
	Percent (%)	14.3%	85.7%	100.0%
Upper ureter	No of Patients	0	4	4
	Percent (%)	0.0%	100.0%	100.0%
Total	No of Patients	4	28	32
	Percent (%)	12.5%	87.5%	100.0%

p=0.419

Table 11: Distribution of Patients Based on Requirement of Additional Puncture

Additional Puncture	No of Patients	Percent (%)
NO	28	87.5
YES	4	12.5
Total	32	100.0

Table 12: Comparison of Age group with Complete Clearance

Age group	Complete Clearance			Total
		No	Yes	
≤30 Years	No of Patients	1	9	10
	Percent (%)	10.0%	90.0%	100.0%
31-40 Years	No of Patients	1	6	7
	Percent (%)	14.3%	85.7%	100.0%
41-50 Years	No of Patients	1	6	7
	Percent (%)	14.3%	85.7%	100.0%
>50 Years	No of Patients	1	7	8
	Percent (%)	12.5%	87.5%	100.0%
Total	No of Patients	4	28	32
	Percent (%)	12.5%	87.5%	100.0%

p=0.992

Table 13: Comparison of Sex with Complete Clearance

Sex	Complete Clearance			Total
		No	Yes	
Female	No of Patients	2	11	13
	Percent (%)	15.4%	84.6%	100.0%
Male	No of Patients	2	17	19
	Percent (%)	10.5%	89.5%	100.0%
Total	No of Patients	4	28	32
	Percent (%)	12.5%	87.5%	100.0%

p=0.682

Table 14: Comparison of Side of Calculus with Complete Clearance

Side of Calculus	Complete Clearance			Total
		No	Yes	
Left	No of Patients	4	17	21
	Percent (%)	19.0%	81.0%	100.0%
Right	No of Patients	0	11	11
	Percent (%)	0.0%	100.0%	100.0%
Total	No of Patients	4	28	32
	Percent (%)	12.5%	87.5%	100.0%

p=0.122

Table 15: Distribution of Patients based on Complete Clearance

Complete Clerance	No of Patients	Percent (%)
NO	4	12.5
YES	28	87.5
Total	32	100.0

perinephric collection that was managed by aspiration. Postoperative sepsis occurred in 3 patients (9.37%), including one patient who progressed to septicemic shock and required intensive care unit management. All patients with infection recovered with intravenous antibiotics and supportive measures. Blood transfusion was required in one patient. No visceral injuries were noted in the series.

The comparisons of complete clearance according to age, sex, side of calculus, and stone location, with no statistically significant associations reported in these comparisons.

The present prospective study evaluated the performance of supracostal puncture in PCNL for complex renal calculi in a selected cohort of patients. The principal finding was that supracostal PCNL achieved a high complete clearance rate of 87.5% with acceptable morbidity. These results support the continued use of supracostal access in cases where upper pole or long-axis access is anatomically preferable.

The importance of complete stone clearance in large and branched stones cannot be overstated. Residual fragments may act as a nidus for recurrence, persistent infection, or future obstruction. This is especially relevant in staghorn stones, where incomplete clearance can compromise both renal function and infection control. In the present study, most patients had staghorn calculi, yet a complete clearance rate of 87.5% was achieved. This is broadly comparable to the outcomes reported in studies by Tarek El-Karamany, Gupta, and Hariharasudhan Sekar[23-25]. The ability to approach the collecting system along the axis of the kidney through a superior tract likely contributed to the favorable clearance rate.

The need for additional puncture in only a minority of patients is another noteworthy finding. Although multiple tracts may sometimes be necessary in staghorn stones, each additional tract can potentially increase bleeding risk and parenchymal trauma. In this series, a single supracostal access was sufficient in more than four-fifths of patients. This supports the notion that when the superior calyx is the optimal entry point, supracostal access can reduce the need for multiple lower tracts and may thereby improve procedural efficiency.

The thoracic safety of supracostal puncture remains the central concern in clinical decision-making. It is clear that the risk of pleural and pulmonary complications depends strongly on the rib level of access. Above 11th rib punctures carry significantly greater risk than above-12th rib punctures. In the present study, all punctures were above the 12th rib and none were above the 11th rib. This likely explains why no patient developed pneumothorax and no patient required intercostal

Table 16: Distribution of Patients based on requirement of additional puncture

Additional Puncture	No of Patients	Percent (%)
NO	28	87.5
YES	4	12.5
Total	32	100.0

Table 17: Comparison of Age Group with Complete Clearance

Age group	Complete Clearance			Total
		No	Yes	
≤30 Years	No of Patients	1	9	10
	Percent (%)	10.0%	90.0%	100.0%
31-40 Years	No of Patients	1	6	7
	Percent (%)	14.3%	85.7%	100.0%
41-50 Years	No of Patients	1	6	7
	Percent (%)	14.3%	85.7%	100.0%
>50 Years	No of Patients	1	7	8
	Percent (%)	12.5%	87.5%	100.0%
Total	No of Patients	4	28	32
	Percent (%)	12.5%	87.5%	100.0%

p=0.992

Table 18: Comparison of Sex with Complete Clearance

Sex	Complete Clearance			Total
		No	Yes	
Female	No of Patients	2	11	13
	Percent (%)	15.4%	84.6%	100.0%
Male	No of Patients	2	17	19
	Percent (%)	10.5%	89.5%	100.0%
Total	No of Patients	4	28	32
	Percent (%)	12.5%	87.5%	100.0%

p=0.682

Table 19: Comparison of Side of Calculus with Complete Clearance

Side of Calculus	Complete Clearance			Total
		No	Yes	
Left	No of Patients	4	17	21
	Percent (%)	19.0%	81.0%	100.0%
Right	No of Patients	0	11	11
	Percent (%)	0.0%	100.0%	100.0%
Total	No of Patients	4	28	32
	Percent (%)	12.5%	87.5%	100.0%

p=0.122

Table 20: Comparison of Location of Calculus with Complete Clearance

Location	Complete Clearance			Total
		No	Yes	
Pelvis	No of Patients	4	24	28
	Percent (%)	14.3%	85.7%	100.0%
Upper ureter	No of Patients	0	4	4
	Percent (%)	0.0%	100.0%	100.0%
Total	No of Patients	4	28	32
	Percent (%)	12.5%	87.5%	100.0%

p=0.419

chest drainage for hydrothorax. The two cases of haemothorax were mild and managed conservatively. This finding aligns with the principle that good outcomes with supracostal PCNL are less a matter of avoiding the approach altogether and more a matter of using it judiciously with strict technical discipline.

Pelvic perforation and postoperative sepsis are recognized complications of PCNL. In the present series, one patient sustained pelvic perforation, necessitating prolonged nephrostomy drainage. Sepsis occurred in three patients, one of whom required ICU care. While these figures underscore that supracostal PCNL is not free of morbidity, they remain within the broad complication ranges reported in the literature for PCNL in general and for supracostal access in particular. The complications are influenced by stone burden, radio-opacity, and duration of surgery. Large infected stones, particularly staghorn calculi, may inherently carry higher septic risk regardless of access site.

No patient in this series developed visceral injury. This is clinically important because structures adjacent to the kidney-including pleura, lung, colon, spleen, liver, and duodenum-may occasionally be injured during percutaneous renal access. The absence of these complications reflects careful case selection, imaging-based planning, and technical execution.

The present study has certain limitations. The sample size was relatively small, and the study was observational rather than comparative. There was no matched infracostal control group, and therefore the study does not directly prove superiority or equivalence of supracostal access relative to infracostal access. Rather, it demonstrates that supracostal PCNL can be performed safely and effectively in selected patients when clinically indicated.

Despite these limitations, the present findings are clinically valuable. They reinforce that the choice of tract should be governed by stone anatomy and the goal of complete clearance, not by an excessive fear of supracostal access. When a superior calyceal tract provides the most direct and efficient route, supracostal puncture is justified and can be expected to produce good results in experienced hands.

CONCLUSION

Percutaneous nephrolithotomy remains a cornerstone in the management of large and complex renal calculi. In selected patients, supracostal puncture offers a direct and effective route to the upper collecting system, especially in staghorn stones, upper calyceal stones, and complex upper ureteric calculi. In this prospective observational study of 32 patients, supracostal PCNL performed above the 12th rib achieved a high complete clearance rate of 87.5% with acceptable postoperative morbidity. Haemothorax occurred in a small proportion of patients and was managed conservatively, while no patient developed pneumothorax or visceral injury. The study demonstrates that supracostal PCNL is both safe and effective when carried out in appropriately selected cases by experienced surgeons using meticulous technique and careful perioperative monitoring. Although the sample size is limited, the results support the continued use of supracostal access as an important option in the endourological management

of complex upper urinary tract stones. Further large-scale prospective. comparative studies are warranted to define more precisely the relative role of supracostal and infracostal access.

Summary: This prospective study from the Department of Urology,The Oxford Medical College Hospital and Research Centre, Bangalore evaluated 32 patients who underwent PCNL through supracostal puncture for complex renal stone disease. Most patients had staghorn calculi, all punctures were made above the 12th rib, and the procedure achieved an 87.5% complete clearance rate. Additional puncture was required in a minority of cases, and the mean hospital stay was 5.53 days. Complications occurred in 18.75% of patients, most notably mild haemothorax, pelvic perforation, and postoperative sepsis, but there were no cases of pneumothorax or visceral injury. These findings indicate that supracostal PCNL is an effective and acceptably safe procedure in carefully selected patients.

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