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Defining Myths and Facts of Supracostal Tubeless Mini-percutaneous Nephrolithotomy Performed Under Spinal Anesthesia: Single Center Experience

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What's known on the subject? and What does the study add?

Mini-percutaneous nephrolithotomy (PCNL) is taking over standard PCNL for the management of kidney stones because of fewer associated complications and better stone clearance. Supracostal PCNL is not very popular among urologists because of the associated thoracic complications, and there are only small case series reported in the literature exploring its safety. We highlight the safety of supracostal mini-PCNL performed under spinal anesthesia in terms of fewer thoracic and non-thoracic complications. It is the largest series of supracostal Mini-PCNL procedures performed under spinal anesthesia, which explores the versatility of upper calyces in clearing kidney stones.

Abstract

Objective: Percutaneous nephrolithotomy (PCNL) is considered the gold standard for the treatment of kidney stones >2 cm in size and those who fail other treatment modalities. Standard PCNL is associated with a significant number of complications mostly attributed to the larger tract circumference. Mini-PCNL, which utilizes a small tract size of less than 22 Fr, is associated with significantly fewer complications while maintaining a clearance rate comparable to that of standard PCNL. Prone position leads to upward migration of the kidney under the rib cage, making supracostal puncture necessary in a significant number of cases. Mini-PCNL, when performed under spinal anesthesia, is safe and reduces operative time without compromising stone clearance rate. This study was carried out to establish the safety and efficacy of supracostal tubeless mini-PCNL done under spinal anesthesia.

Materials and Methods: This is a retrospective study carried over a period of 5 years. It includes all the patients who underwent supracostal mini-PCNL under spinal anesthesia. The procedure was carried out in the prone position, employing 18 Fr Amplatz sheath with 12 Fr nephroscope. The outcome and perioperative complications were recorded and stored via Microsoft Excel and analyzed using SPSS Software, version 20.0.

Results: This study included 1135 patients with an average age of 40.6±13.8 years. The average stone size was 2.87±0.98 cm, and stones had predominantly calyceal distribution in 42.37% of cases. The 11th and 10th intercostal spaces were entered in 89.16% and 10.83% of cases, respectively, to gain access to superior (35.85%) and middle (64.14%) calyces. A single tract was usually required (78.32%) and the average operative time was 52.72±11.42 minutes. The rate of blood transfusion was 0.61%, and angioembolization was required to seal pseudoaneurysm/AVF in 0.52% of patients. The rate of hydrothorax/pneumothorax associated with 11th and 10th intercostal space entry was 0.49% and 7.3%, respectively. Only 1.23% of patients required intracostal tube drainage for pneumothorax/hydrothorax. The average rates of stone clearance and hospital stay were 97.53% and 1.8±0.45 days, respectively.

Conclusion: Supracostal tubeless mini-PCNL done under spinal anesthesia is safe and has high stone clearance rate. The associated thoracic and non-thoracic complications are minimal and the procedure can be safely performed when indicated, provided proper technique is employed.

Keywords: Hemothorax, hydrothorax, mini percutaneous nephrolithotomy, supracostal PCNL

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Introduction

Nephrolithiasis has affected humans since antiquity, and the incidence reaches up to 15% in the northern renal stone belt of the Indian subcontinent (1). Treatment of renal stone diseases has evolved from invasive open operations to minimally invasive endourologic procedures offering rapid recovery and significantly higher stone clearance. Percutaneous nephrolithotomy (PCNL) remains the gold standard for the management of large and complex renal stones. Both American Urological Association and European Association of Urology recommend PCNL as first line treatment for large size renal stones because it offers high stone free rate and effectiveness of the procedure is not limited by stone burden and composition. Utilization of small size nephroscope and tracts is associated with fewer complications and bleeding, with stone free rates comparable to standard PCNL (2,3). With advancements in optics and lithotripters, nephroscopes have become slimmer, reducing the tract size for PCNL. Mini-PCNL, defined as tract size less than 22 Fr, has proved to be effective in managing renal stones of all sizes with fewer complications and a clearance rate comparable to standard PCNL (4). Mini-PCNL permits better maneuverability in a less dilated pelvicalyceal system (PCS) resulting in better clearance, less bleeding, and a reduced number of tracts required to achieve complete clearance (5). PCNL, when performed under general anesthesia (GA), allows better control of hemodynamics, controlled ventilation to fix the target calyx for perfect entry, and permits the surgeon to prolong the procedure when required. On the other hand, spinal anesthesia (SA) is safe in patients with pulmonary comorbidities, reduces the procedure time, cost, and hospital stay. Although each method of anesthesia has advantages and disadvantages, final choice of anesthesia is dictated by patient condition and preference of surgical team (6).

An ideal calyx for PCNL is the one which provides the shortest path to the majority of the stone burden, while providing good access to the upper ureter. It is generally dictated by stone burden, distribution of stone, PCS anatomy, and surgeon preference. Middle and superior calyceal access in PCNL has been reported to provide better stone clearance, less need of additional punctures, and easy access to the upper ureter for stone clearance as well as deployment of a Double J stent (7). In the prone position, middle and superior calyces often stay above the 12th rib, making supracostal puncture a necessity for optimal clearance. Most urologists use deep breathing maneuvers to position the kidney below the 12th rib for renal puncture. With these maneuvers, descent of the lung is greater than kidney movements, making the lung and pleura susceptible to injury (8). In our retrospective study, we analyze the safety and efficacy of supracostal punctures in mini-PCNL performed under SA.

Materials and Methods

This is a retrospective study conducted over a period of 5 years from June 2015 to June 2020 at a tertiary care center. Patients with renal stones with a size greater than 1 cm who were planned for mini-PCNL and required supracostal puncture were included in this study. Pediatric patients with supracostal punctures were excluded from the study as all these patients were operated on under GA. Patients were evaluated by dedicated contrast computed tomography (CT) with urography. Informed consent was taken from all the patients and risks of the procedure were explained. The study was approved by the Sher-i-Kashmir Institute of Medical Sciences Institutional Ethical Committee (date: 03.06.2025, approval number: SIMS 131/IEC-SKIMS/2024-129). The procedure was carried out under SA in the prone position. Desired calyx for access was selected after retrograde contrast injection, and the entry point was marked on the intercostal space. An 18 G initial puncture needle was used for puncturing the calyx, and advanced with the fluoroscope in 0°, and depth was assessed by changing the fluoroscopy angle to 30° in the cranio-caudal direction. All punctures were made through the summit of the calyx on papillary impression, and the position was confirmed with a free flow of contrast. A 0.032 hydrophilic guidewire was passed through the needle, and the first dilatation was done with a 10 Fr Teflon dilator. Subsequent dilatation was carried out with a single 18 Fr Amplatz dilator over a guide rod. An 18 Fr Amplatz sheath was deployed for nephroscopy. A 12 Fr nephroscope was used with a pneumatic lithotripter for the fragmentation of renal stones. Fragments were mainly flushed out with saline, and larger fragments required forceps for retrieval. Small fragments in the non-accessible calyces were flushed out with a puncture needle under fluoroscopic guidance. Need for additional dilatations was determined by stone distribution, and no more than 4 dilatations were used in any given case. A 4.5 Fr stent was left inside at the end of the procedure, and no nephrostomy was used in any case. An X-ray abdomen was taken the next morning to assess clearance of stone, and any radiopaque shadow more than 2 mm or multiple radiopaque shadows were considered as incomplete clearance. Patients with chest pain and breathing difficulty were evaluated by chest X-ray (Figure 1) or chest CT (Figure 2) for any hydro or pneumothorax. Any complications in the perioperative period were recorded and graded as per the modified Clavien Dindo classification. Intercostal tube drainage (ICTD) was done for symptomatic pneumo/hydrothorax.

Statistical Analysis

The perioperative data were collected and stored via Microsoft Excel program and analyzed using SPSS Software, version 20.0. Categorical data were expressed as frequencies and percentages. Continuous variables were expressed as mean ± standard deviation. The chi-square test was used to compare the differences in proportions between the two groups. Student's t-test was used to compare continuous variables in two independent groups. The odds ratio (95% confidence interval) of the unrelated clinical parameters was calculated using univariate regression models to predict the outcome variable or complications. All p values less than 0.05 were considered statistically significant.

Figure 1. X-ray showing right sided pneumothorax

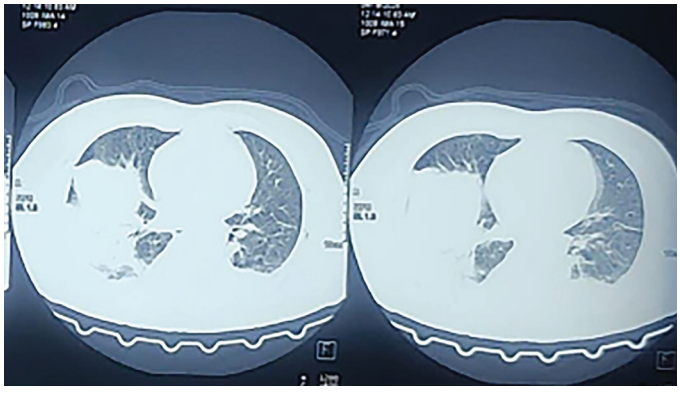

Figure 2. Computed tomography chest showing right sided hemothorax

Results

The demographic profile of patients is displayed in Table 1. Analysis of the data from patients with nephrolithiasis who underwent mini-PCNL at our center showed that 1135 patients underwent supracostal puncture to remove stones. All these procedures were performed on adults under SA. The percentage of male and female patients in our study was 63.5% and 36.5%, respectively. The mean age and body mass index of patients in the study were 40.6±13.8 years and 23.7±2.7 kg/m², respectively. 44.4% of patients had the procedure done on the right side and 51.71% of patients had the procedure done on the left side. Only 3.87% of patients had bilateral mini-PCNL performed concurrently. The distribution of stones was predominantly calyceal (42.37%) followed by pelvic (35.06%). 11.92% of patients had staghorn calculi while upper ureteric calculi were present in 10.66% of patients. 75.59% of

Table 1. Demographic profile of patients undergoing supracostal mini-PCNL under spinal anesthesia

Variables	Values
Number of patients	1135
Male/female (%)	721/414 (63.5/36.5)
Mean age in years ± SD (range)	40.6±13.8 (17-88)
Mean BMI ± SD (kg/m²)	23.7±2.7
Charlson comorbidity index n (%)	
0-1	812 (71.54)
2-4	209 (18.41)
5 or higher	114 (10.04)
Laterality n (%)	
Right	504 (44.4)
Left	587 (51.71)
Bilateral	44 (3.87)
Stone location n (%)	
Staghorn	135 (11.92)
Pelvis	398 (35.06)
Calyceal	481 (42.37)
Upper ureter	121 (10.66)
Previous stone procedure n (%)	
Pyelolithotomy	86 (7.57)
PCNL	102 (8.98)
ESWL	89 (7.85)
Nil	858 (75.59)
Renal anomalies	
Malrorated kidney	15 (1.32%)
Horseshoe kidney	11 (0.96%)
Ectopic kidney	1 (0.08%)
Average stone size (cm ± SD)	2.87±0.98

SD: Standard deviation, BMI: Body mass index, PCNL: Percutaneous nephrolithotomy, ESWL: Extracorporeal shock wave lithotripsy

patients were naive, while 8.98% and 7.57% of patients had previous history of PCNL and pyelolithotomy, respectively. The average size of stone operated on in this study was 2.87±0.98 cm.

The perioperative data of patients are assembled in Table 2. The primary entry was made through the middle calyx in 64.14% of cases and the superior calyx in 35.85% of cases. The supracostal punctures were made in the 11th intercostal space in 89.16% of patients, and the 10th intercostal space in 10.83% of patients. The majority of patients required single tract (78.32%) dilatation whereas two and three tracts were required in 17.18% and 3.87% of patients, respectively. Only 0.61% of patients required four tracts for complete clearance of stones. The average operative time in our study was 52.72±11.42 minutes, and included the time from the start of puncture to the closure of the tract. Perioperative complications, graded as per modified Clavien Dindo classification, were predominantly Grade I with transient fever, and transient rise in creatinine reported in 3.78 and 0.79% respectively. 0.26% of patients had a transient urine leak via the tract site, while significant bleeding requiring blood transfusion was recorded in 0.61% of patients. Bleeding resulting from pseudoaneurysm and arteriovenous fistula (AVF) requiring angioembolization was reported in 0.52% of patients. 1.23% of patients required ICTD for hemothorax/pneumothorax. One patient (0.08%) had pelviureteric junction stricture requiring subsequent pyeloplasty. Sepsis was reported in 1.32% of patients, however there was no mortality related to the procedure. Entry made through the 11th intercostal space resulted in hemothorax/pneumothorax in 0.49% of patients, while the same complication was reported in 7.3% of patients when the 10th intercostal space was chosen for entry. Complete clearance of stone was achieved in 97.53% of patients. The average hospital stay was 1.8±0.45 days in our study.

We performed a univariate analysis of demographic and operative variables according to the complications (Table 3). On analysis of the 123 complications observed in our series, it was found that high mean body mass index (p=0.018), non-pelvic location of stones (p=0.043), presence of renal anomalies (p=0.014), larger average stone size (p=0.0001), superior calyceal entry (p=0.049), 10th intercostal entry (p=0.0005), more than one tract dilatation (p=0.002) and longer operative time (p=0.0001) were independent risk factors for overall complications.

Discussion

Nephrolithiasis is prevalent worldwide, with high incidence in northern India. According to the international guidelines, PCNL should be preferred for renal stones >2 cm (9). Standard PCNL, which employs the tract size of 24 to 30 Fr, produces excellent stone clearance but with a relatively higher complication rate

Table 2. Perioperative parameters of operated patients undergoing mini-PCNL under spinal anesthesia

Variables	Values
Primary entry calyx, n (%)	
Superior	407 (35.85%)
Middle	728 (64.14%)
Supra 12th rib/11th intercostal entry	1012 (89.16%)
Supra 11th rib/10th intercostal entry	123 (10.83%)
Number of tracts dilated, n (%)	
Single	889 (78.32%)
Two	195 (17.18%)
Three	44 (3.87%)
Four	7 (0.61%)
Average operative time (minutes ± SD)	52.72±11.42
Complications classified by the modified Clavien grading system, n (%)	
Grade I	
-Postoperative pain on VAS scale	
*No pain	312 (27.49%)
*Mild pain	487 (42.90%)
*Moderate pain	315 (27.75%)
*Severe pain	15 (1.32)
*Very severe pain	6 (0.52%)
*Worst pain possible	0
-Transient fever	43 (3.78%)
-Transient rise of creatinine	9 (0.79%)
Grade II	
-Tract site urine leak	3 (0.26%)
-Bleeding requiring transfusion	7 (0.61%)
Grade IIIa	
-Bleeding requiring angioembolization	6 (0.52%)
*Normal renal anatomy	5 (0.44%)
*Horse shoe kidney	1 (9.09%)
-Hemothorax/pneumothorax requiring chest tube drainage	14 (1.23%)
*Normal kidney anatomy	13 (1.15%)
*Horse shoe kidney	1 (9.09%)
-Retenrion due to clots	3 (0.26%)
Grade IIIb	1 (0.08%)
-PUJ stricture	
Grade IVa	1 (0.08%)
-Acute kidney injury requiring hemodialysis	
Grade IVb	15 (1.32%)
-Sepsis	
Grade V	0
Pneumothorax/hydrothorax related to entry level (number of hydro or pneumothorax/no. of supracostal entries)	
Supra 12th rib/11th intercostal space	5/1012 (0.49%)
Supra 11th rib/10th intercostal space	9/123 (7.3%)
Complete clearance on fluoroscopy and X-ray KUB, n (%)	1107 (97.53)
Average hospital stay (days ± SD)	1.8±0.45

SD: Standard deviation, KUB: Kidney, ureter, and bladder, PCNL: Percutaneous nephrolithotomy, VAS: Visual analog scale, PUJ: Pelviureteric junction

of 23.3% (10). As reported in the literature, larger tract size has been attributed to an increased risk of bleeding, and attempts have been made to minimize it. Mini-PCNL, described as the tract size of 14-20 Fr, was introduced to reduce complications and achieve excellent stone clearance. We prefer mini-PCNL with a tract size of 18 Fr at our center, and all of the patients in our study were operated by the same technique and equipment. Mini-PCNL, initially introduced for small sized stones, has been found to be very effective in managing medium and large sized stones as well with a reduced complication rate (5). All types of stones, including staghorn calculi, were managed by mini-PCNL in our study, with the average size of the stones being 2.87±0.98.

PCNL can be done under general or regional anesthesia or SA. GA is preferred by most urologists and anesthesiologists because it offers better control of hemodynamics, controlled ventilation to fix target calyx for easy entry, and the ability to prolong anesthesia required for clearing larger stones. On the other hand, GA is associated with lung atelectasis, prolonged operative time, and is contraindicated in a chronic respiratory illness. SA offers better postoperative pain control, shorter operative time, and early identification of lung complications, with overall results, including stone clearance, comparable to those of GA (11). Indra Rachman et al. (6), in their meta-analysis of spinal vs GA for PCNL, documented reduced operative time, faster recovery, reduced hospital stay, and less need for analgesics in the postoperative period in patients operated under SA, without compromising on stone-free rate. All the patients were operated under SA, and the average operative time was 52.72±11.42 minutes, which is less than most of the studies, including the one done by Khadgi et al. (12)

Table 3. Univariate analysis of demographic and perioperative factors predicting complication in supra-costal mini-PCNL

Parameters	Complications (123)	No complications (1012)	Odds ratio	p-value
Age (mean ± SD)	39.27±12.7	41.23±13.12	(95% CI: 0.4898-4.4098)	0.116
Gender				
Male	79 (64.2%)	642 (63.43%)		0.863
Female	44 (35.77%)	370 (36.56%)		
Mean BMI ± SD	23.89±2.7	23.4±2.1	(95% CI: 0.8970-0.0830)	0.0183
Laterality				
Right	55 (44.71%)	449 (44.36%)	1 (reference)	0.941
Left	64 (52.03%)	523 (51.67%)	0.999 (95% CI: 0.6819-1.463)	0.995
Bilateral	6 (4.87%)	38 (3.75%)	1.289 (95% CI: 0.5212-3.187)	0.582
Stone location				
Pelvic	33 (26.82%)	365 (36.06%)	1.5386 (95% CI: 1.0119-2.3393)	0.043
Non pelvic	90 (73.17%)	647 (63.93%)		
Previous procedure				
No previous procedure	93 (75.6%)	765 (75.59%)	0.9991 (95% CI: 0.6461-1.5448)	0.996
Previous procedure	30 (24.39%)	247 (24.40%)		
Renal anomalies				
Normal	116 (94.30%)	992 (98.02%)	2.9931 (95% CI: 1.2390-7.2303)	0.014
Anomalies	7 (6.69%)	20 (1.97%)		
Average stone size (cm ± SD)	2.91±0.93	2.1±0.74	(95% CI: 0.9529-0.6671)	<0.0001
Primary entry calyx				
Superior calyx	54 (43.9%)	353 (34.88%)	1.461 (95% CI: 1.0003-2.1340)	0.049
Middle calyx	69 (56.09%)	659 (65.11%)		
Level of entry				
11th intercostal	98 (82.11%)	914 (90.9%)	2.379 (95% CI: 1.4633-3.8684)	0.0005
10th intercostal	25 (17.88%)	98 (9.09%)		
No. of tracts dilated				
Single	80 (65.04%)	809 (79.94%)	2.142 (95% CI: 1.4340-3.1997)	0.0002
More than one tract	43 (34.95%)	203 (20.05%)		
Average operative time	58.56±12.56	46.2±10.12	(95% CI: 14.310-10.409)	<0.0001

PCNL: Percutaneous nephrolithotomy, SD: Standard deviation, CI: Confidence interval, BMI: Body mass index

The reduced operative time in our study is partly attributed to the skills of the surgeon performing a large volume of PCNLs, the use of SA, and the tubeless nature of the procedure. Success of PCNL is primarily determined by the establishment of a proper tract that provides safe access to the bulk of the stone. Singh et al. (13), advocated that supracostal access made through superior and middle calyx provided good access to staghorn calculi, pelvic calculi, and ureteric calculi, significantly reducing the number of tracts required to achieve complete clearance. We have a preference for superior and middle calyces for most kidney stones, which results in better outcomes, reduced operative time, and less need for additional tracts for complete clearance. In our study, middle and superior calyceal access was made in 64.1% and 35.85% of cases, respectively. This is reflected in the higher clearance rate of 97.53%, with the majority of the procedures (78.32%) requiring a single tract for clearance. Khadgi et al. (12) reported a stone clearance of 87.6% by mini-PCNL in their study. The stone clearance rate in our study is much higher than in most of the studies. Besides the above-mentioned factors, use of a puncture needle under fluoroscopy to flush fragments out of calyces into the accessible pelvis reduced the need for additional tracts and markedly increased the stone clearance rate. Maheshwari et al. (14) reported the use of percutaneous calyceal irrigation for stones in inaccessible calyces during PCNL to increase stone clearance and reduce the need for additional tracts. Goldberg et al. (15) concluded from their randomized study that tubeless supracostal PCNL is associated with less postoperative pain, minimal tract site urine leak, decreased incidence of hydrothorax, and shorter hospital stay. We performed all our supracostal mini-PCNL as tubeless to utilize the aforementioned advantages.

Mini-PCNL has a lower complication rate, which is primarily attributed to its small tract size. Eddula et al. (16) reported that patients undergoing PCNL under SA experienced lower VAS scores and reduced requirement for analgesics in the postoperative period compared to GA. In our study, most patients had either no pain or mild pain, and only severe pain was reported among those patients with thoracic complications. Ruhaye et al. (17), reported that small tract size is associated with less bleeding and reduced need for blood transfusion. Ferakis et al. (5) reported a transfusion rate of 1.4% in their series. Post PCNL renal pseudoaneurysm/AVF is the result of direct injury to segmental arteries and their branches. These fragile anomalies are exposed to the high-pressure renal arterial system, resulting in bouts of massive bleeding usually on the 7th-14th postoperative day. The incidence of post PCNL pseudoaneurysm/AVF, as reported by Seitz et al. (10), ranges from 0.6-2.5% with a transfusion rate of 1% to 11%. The rate of angioembolization and transfusion in our series is just 0.52% and 0.615, respectively, which is much less than that reported in the literature. Most of the studies agree on the opinion that hypertension, diabetes, renal anomalies, anticoagulants, stone size, tract size, number of tracts, and non-papillary punctures increase the risk of a post-PCNL pseudoaneurysm/AVF (18). Among 11 patients with horseshoe kidney in our series, one patient developed pseudoaneurysm requiring angioembolization. The presence of renal anomalies proved to be an independent risk factor for overall complications in our series. Lower rate of pseudoaneurysm/AVF in our series may be related to small tract size, precise papillary puncture, limited number of tracts required attributed to needle flushing, and the volume of cases performed by the surgeon.

Despite the high success rate, the primary concern for supracostal puncture remains the thorax complications associated with it. The reported incidence of thoracic complications after supracostal puncture has been quite variable in the literature. Sekar et al. (19), reported the incidence of 2.17% thoracic complications in their series of supracostal punctures. Yadav et al. (20), in their series of 762 patients with supracostal puncture, needed intracostal tube drainage of hydrothorax in 3.35% of cases. In our series, the incidence of symptomatic hydrothorax/pneumothorax requiring intracostal chest tube drainage was 1.23%, which is less than most of the series of supracostal PCNL. Prone position leads to cephalad migration of kidneys, in about 80% of patients, making supracostal puncture imperative to clear stones in a significant number of patients (21). The incidence of thoracic complications after supracostal PCNL depends on level of intercostal space entered, laterality of entry point from midline, real time level of lung during breathing cycle, and rotational anomalies of kidneys. Maheshwari et al. (22), in their study of supracostal PCNL, reported an incidence of 4.9% of hydrothorax in total, with the percentage of hydrothorax increasing with the level of intracostal entry. They reported the incidence of hydrothorax as 1.2%, 10.6% and 35.7% on entering through 11th, 10th and 9th intercostal space respectively. While reviewing the anatomy of pleura, it is worth to note that the costophrenic recess reaches up to 12th rib medial to the midscapular line and recedes up on crossing lateral to the midscapular line reaching to 10th rib in mid axillary line. So, the supracostal punctures made medial to the midscapular line are more likely to cause pleural injury compared to the punctures made lateral to it. Same anatomical factor makes superior calyceal puncture in malrorated kidney prone to thoracic injuries. In horseshoe and malrorated kidneys, pelvis faces anteriorly and calyces are directed posteriorly, medial to the midscapular line. In our series there were 11 patients with horseshoe kidney, and one of them developed hydrothorax upon entering the superior calyx. The movements of the lungs during the breathing cycle change their relation to the surface markings on the chest wall. Hopper et al analysed the chest CT imaging of patients during breathing and found that on full expiration, the possibility of a needle passing through the 11th

posterior intercostal space traversing the lung was 29% on the right side and 14% on the left side, respectively. However, the same point of entry in full inspiration would penetrate the lung in most cases. With the 10th posterior intercostal approach, the chances of lung injury were excessive regardless of the phase of breathing (23). The low incidence of thoracic complications in our study is attributed to lateral intercostal puncture, needle descending during expiration, and entry close to the upper border of the rib.

The drawback of our study is its retrospective design. There is always a possibility of selection and recall bias in such studies. Since it is a single-center study, a multicentric study is therefore needed to formulate adequate results.

Conclusion

Our findings suggest that supracostal puncture in mini-PCNL under SA may be considered safe and effective when indicated, provided that careful technique is employed._It is highly efficient in clearing stones with minimal non-thoracic complications. Puncturing during expiration, entering lateral to the midscapular line and above the superior border of the rib is key to avoid thoracic complications in supracostal mini-PCNL.

Ethics

Ethics Committee Approval: The study was approved by the Sher-i-Kashmir Institute of Medical Sciences Institutional Ethical Committee (date: 03.06.2025, approval number: SIMS 131/IEC-SKIMS/2024-129).

Informed Consent: Informed consent was taken from all the patients.

Footnotes

Authorship Contributions

Surgical and Medical Practices: S.A.P., Concept: S.A.P., Design: S.A.P., Data Collection or Processing: Y.M., Analysis or Interpretation: G.K., A.B.R., Literature Search: F.A.B., Writing: A.R.K., T.A.K.

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References

1. Kakkar M, Kakkar R. A 13 year hospital based study on the trend of urinary stone disease in Uttarakhand, India. Nepal J Epidemiol. 2021;11:949-958. [Crossref]
2. Zeng G, et al. EAU Guidelines on urolithiasis. Eur Urol. 2023;84:267-286. [Crossref]
3. Assimos D, Krambeck A, Miller NL, Monga M, Murad MH, Nelson CP, Pace KT, Pais VM Jr, Pearle MS, Preminger GM, Razvi H, Shah O, Matlaga BR. Surgical management of stones: American Urological Association/Endourological Society Guideline, PART I. J Urol. 2016;196:1153-1160. [Crossref]
4. Jackman SV, Docimo SG, Cadeddu JA, Bishoff JT, Kavoussi LR, Jarrett TW. The "mini-perc" technique: a less invasive alternative to percutaneous nephrolithotomy. World J Urol. 1998;16:371-374. [Crossref]
5. Ferakis N, Stavropoulos M. Mini percutaneous nephrolithotomy in the treatment of renal and upper ureteral stones: lessons learned from a review of the literature. Urol Ann. 2015;7:141-148. [Crossref]
6. Indra Rachman R, Birowo P, Nurullah G, Cho PSY, Atmoko W, Widyahening IS, Rasyid N. General versus spinal anesthesia in percutaneous nephrolithotomy: a systematic review and meta-analysis. F1000Res. 2023;12:281. [Crossref]
7. Ma Y, Lin L, Luo Z, Jin T. Superior calyceal access vs. other calyceal access in percutaneous nephrolithotomy: a systematic review and meta-analysis. Front Surg. 2022;9:930159. [Crossref]
8. He Z, Tang F, Lu Z, He Y, Wei G, Zhong F, Zeng G, Wu W, Yan L, Li Z. Comparison of supracostal and infracostal access for percutaneous nephrolithotomy: a systematic review and meta-analysis. Urol J. 2019;16:107-114. [Crossref]
9. Zhong Q, Zheng C, Mo J, Piao Y, Zhou Y, Jiang Q. Total tubeless versus standard percutaneous nephrolithotomy: a meta-analysis. J Endourol. 2013;27:420-426. [Crossref]
10. Seitz C, Desai M, Häcker A, Hakenberg OW, Liatsikos E, Nagele U, Tolley D. Incidence, prevention, and management of complications following percutaneous nephrolitholapaxy. Eur Urol. 2012;61:146-158. [Crossref]
11. Mehrabi S, Mousavi Zadeh A, Akbartabar Toori M, Mehrabi F. General versus spinal anesthesia in percutaneous nephrolithotomy. Urol J. 2013 Winter;10:756-761. [Crossref]
12. Khadgi S, Darrad M, El-Nahas AR, Al-Terki A. Tubeless mini-percutaneous nephrolithotomy for renal stones larger than 20 mm. Indian J Urol. 2021;37:54-58. [Crossref]
13. Singh R, Kankalia SP, Sabale V, Satav V, Mane D, Mulay A, Kadyan B, Thakur N. Comparative evaluation of upper versus lower calyceal approach in percutaneous nephrolithotomy for managing complex renal calculi. Urol Ann. 2015;7:31-35. [Crossref]
14. Maheshwari PN, Andankar MG,Trivedi N Jain R, Parmaro VP. Percutaneous calyceal irrigation for small calyceal calculi during percutaneous nephrolithotomy. African Journal of Urology. 2003;9:133-137. [Crossref]
15. Goldberg H, Nevo A, Shtabholtz Y, Lubin M, Baniel J, Margel D, Ehrlich Y, Lifshitz D. Tubeless supra-costal percutaneous nephrolithotomy is associated with significantly less hydrothorax: a prospective randomized clinical study. BJU Int. 2020;125:276-283. [Crossref]
16. Eddula M, Patil VP. Spinal anesthesia versus general anesthesia for percutaneous nephrolithotomy surgeries - a prospective study. International Journal of Basic & Clinical Pharmacology. 2022;11:388-394. [Crossref]
17. Ruhayel Y, Tepeler A, Dabestani S, MacLennan S, Petřík A, Sarica K, Seitz C, Skolarikos A, Straub M, Türk C, Yuan Y, Knoll T. Tract sizes in miniaturized percutaneous nephrolithotomy: a systematic review from the European Association of Urology Urolithiasis Guidelines Panel. Eur Urol. 2017;72:220-235. [Crossref]
18. Irani D, Haghpanah A, Rasekhi A, Kamran H, Rahmanian M, Hosseini MM, Dejman B, Kiani S. Predictive factors of delayed bleeding after percutaneous nephrolithotomy requiring angioembolization. BJUI Compass. 2023;5:76-83. [Crossref]
19. Sekar H, Krishnamoorthy S, Kumaresan N, Ramanan V. Supracostal punctures for PCNL: factors that predict safety, success and stone free

rate in stag horn and non-stag horn stones: a single centre experience and review of literature. J Clin Diagn Res. 2016;10:PC17-PC21. [Crossref]

20. Yadav R, Aron M, Gupta NP, Hemal AK, Seth A, Kolla SB. Safety of supracostal punctures for percutaneous renal surgery. Int J Urol. 2006;13:1267-1270. [Crossref]
21. Preminger GM, Schultz S, Clayman RV, Curry T, Redman HC, Peters PC. Cephalad renal movement during percutaneous nephrostolithotomy. J Urol. 1987;137:623-625. [Crossref]
22. Maheshwari PN, Arora A, Sane MS, Jadhao V. Evaluating factors associated with the risk of hydrothorax following standard supracostal percutaneous nephrolithotomy. Asian J Urol. 2022;9:301-306. [Crossref]
23. Hopper KD, Yakes WF. The posterior intercostal approach for percutaneous renal procedures: risk of puncturing the lung, spleen, and liver as determined by CT. AJR Am J Roentgenol. 1990;154:115-117. [Crossref]