

ORIGINAL RESEARCH

Study On Outcome Of Supracostal And Subcostal Puncture In PCNL For Renal Calculus: A Retrospective Analysis

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ABSTRACT

Background: Percutaneous nephrolithotomy (PCNL) is a standard technique for the treatment of upper urinary stone disease. Stone clearance during PCNL depends on the precise placement of a percutaneous tract that provides direct access for stone manipulation. We retrospectively evaluated the safety and outcome of the supracostal and Subcostal approach for the percutaneous removal of renal stones. **Methods:** Retrospective study was conducted in the department of urology from September 2018 To March 2020. Patient with complains of loin pain, haematuria, fever, nausea, vomiting, suspected to have urolithiasis were documented. General physical examination, spine and genitourinary examination finding were documented. Patient diagnosed to have large renal calculus, upper ureteric calculus, PUJ calculus and calyceal calculi were included in this study. **Results:** Total 123 Patients had undergone PCNL during the study period. 53 cases of Supracostal and 70 Cases Of Subcostal PCNL. Demographic variables were insignificant in both supracostal and subcostal puncture group. Most common stone distribution was large renal calculi, which was around 34%. 55% patients had stone size between 1-2 cm, whereas mean stone size was 2.05 cm. Duration of surgery and hospital stay was almost comparable in both group. SFR in supracostal group was comparable with subcostal group. Overall SFR in over study was 92%. Perioperative bleeding was a most common complication seen around 13.2% in supracostal puncture and 3% subcostal puncture group. 10% required blood transfusion in supracostal puncture, whereas in subcostal puncture was 3%. Atelectasis (7.5%) and pneumothorax (3.7%) were the intrathoracic complications seen in supracostal puncture group. **Conclusions:** Supracostal puncture technique is a safe feasible procedure with minimal morbidity when compared with subcostal technique. The intrathoracic complications can be avoided by proper planning of puncture site, on or lateral to posterior axillary line during expiration.

Key words: PCNL, ESWL, SFR, PCN, PCS, POD.

Abbreviations:

PCNL- Percutaneous nephrolithotomy

ESWL- Extra corporeal shock wave lithotripsy

SFR- Stone free rate

PCN- Percutaneous nephrostomy

PCS- Pelvicalyceal system

POD- Postoperative day

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INTRODUCTION

Percutaneous nephrolithotomy (PCNL) is a well-known procedure for the treatment of upper urinary tract stone disease. As a minimally invasive technique to the Pelvicalyceal System, The Percutaneous tract

presents a convenient path for the diagnosis of upper urinary tract pathology.¹ The essential for success and secure percutaneous entry into the renal collecting system depends on understanding of the anatomic relationships of the kidney and surrounding

structures.² Fruitful stone removal requires the precise position of a percutaneous tract that gives direct access to stone manipulation. The ideal access for the staghorn, large upper calyceal, and complex renal stone is through the upper-pole posterior calyx by supracostal puncture. The supracostal puncture is generally a worry as a result of the expected complications like pneumothorax, hydrothorax, and lung injury. The Subcostal approach was recommended in large renal calculi with lower pole stone burned, upper ureteric calculus and partial staghorn calculus.³

The kidney stone prevalence is approximately 2 to 3% and lifetime risk is 12% while men and women correspond to 11% and 7%.⁴ Risk factor for stone formation includes changes in diet and atmosphere, pre-existing medical conditions like diabetes, obesity. Renal calculi has propensity to recur, with recurrence rate as 50% at 5 years and 80- 90 % at 10 years respectively.⁵ We retrospectively assessed the outcome and effectiveness of the supracostal and subcostal approach for the percutaneous removal of staghorn and complex renal stones. In the era of minimally invasive surgical procedure, urologists who are able to learn the technique of percutaneous renal assess to have distinct advantage in final at the leading edge of the hastily evolving field of endourology.⁵

MATERIALS AND METHODS

A Retrospective study was conducted in the Department Of Urology at SRM Medical college Hospital from 2018 to June 2020. The preoperative, interoperative and post-operative details were recorded for the patients undergone PCNL.

INCLUSION CRITERIA

Patients With H/o Renal Pelvic calculus, Proximal Ureteric calculus, PUJ Calculus, Calyceal Calculi, Partial Staghorn calculus, Complete Staghorn calculus, Large renal calculus.

EXCLUSION CRITERIA

Patients with Recurrent stone formers, Previous History of urological intervention, coagulopathy disease, Symptomatic UTI, Pleural Pathology, Hepatomegaly and Splenomegaly.

Our patients were investigated with complete blood count, blood grouping and RH typing, serum creatinine, random blood sugar, viral markers, urine for culture sensitivity and microscopy In case urine culture was positive, appropriate culture sensitive antibiotics were started prior to surgery. Alongwith ultrasound KUB and plain CT- KUB/IVU/ X ray KUB(To know the exact location of calculi, pelvicalyceal anatomy, relationship with renal and surrounding organs) was done. Antibiotics were given at the time of induction of anaesthesia. Type of puncture either supracostal or subcostal was analysed preoperatively and perioperatively after RGP. All cases were done under general anaesthesia.

During PCNL initial patient was placed under lithotomy position, Cystoscopy 20Fr/30⁰, retrograde ureteric catheterization was placed with No 5 Fr ureteric catheter over a 0.035/0.025 guide wire under C-arm. Then the patients were turned to prone position with adequate paddings, RGP was done with urograffin 1:2 dilution with normal saline(10ml of urograffin with 20ml normal saline). The infundibulopelvic angle and grade of hydronephrosis was noted in relation to the stone. Supracalycal or Infracalycal was chosen for puncturing, infundibulopelvic angle > 45⁰

for entering the pelvicalyceal system under fluoroscopy. Puncture was made internal to the lateral border of erector spinae muscle, at the level of posterior axillary line, was done during expiration. Needle position was confirmed both in 0 and 30⁰ angles under fluoroscopy. After confirmation of needle position within the PCS and stellate was removed to look for urine gush. After which tract was dilated with Metallic Dilators over the guide wire. Serial dilatation of the tract was done upto 22Fr with Amplatz sheath was placed into the Pelvicalyceal System with guide wire in-situ till the end of the procedure. Rigid Nephroscope 20Fr was used for the PNL procedure. Normal saline was used for irrigation. For ICL, Pneumatic Lithotripter was used depending on stone burden. Stone fragments were retrieved with stone holding forceps. Entire PCS was visualized at the end of the procedure and confirmed with fluoroscopy for complete stone clearance. Fluoroscopy was used to assess significant pleural breach and pulmonary complications in immediate intraoperative period.

Antegrade DJ Stent 4/5Fr was placed in all cases. Nephrostomy tube size 20Fr was used as PCN in all cases and was secured to the skin. Ureteric catheter was removed at the end of the procedure. Post-operatively broad spectrum antibiotics were continued for 3-5 Days. CBC and haematocrit was checked on POD1. PCN tube was removed On POD2 in all patients as urine was clear or mildly haemorrhagic. In case of gross haematuria, PCN was clamped and was removed on POD3 once the urine is clear. Postop X-Ray KUB was taken to assess the clearance of stone. Ultrasound was done in cases of radiolucent stones and Ultrasound Chest done if there is any significant evidence of Pleural breach clinically or on X-Ray. Patients who developed chest pain and breathing difficulty in the recovery room and CXR revealed pleural effusion, the ICD tube were placed.

The auxiliary procedure like ESWL was recommended in case of significant residual calculus. For patients with postoperative urosepsis repeat urine culture was done and were treated accordingly.

RESULTS

Total 123 patients have undergone PCNL during the study period. 53 cases Of Supracostal PCNL and 70 cases of subcostal PCNL.

The most common age group in supracostal puncture was between age group of 31– 40years with percentage of 36, whereas in Subcostal puncture was between age group of 41-50 years with 33%. In this study group, there was a higher representation of males in comparison to females. In the Supracostal puncture category, there were 34 males (64%) and 19 females (36%). Within the Subcostal Puncture group, there were 47 males (67%) and 23 females (33%). Fifty-six patients underwent a right percutaneous nephrolithotomy (PCNL), with 18 having the

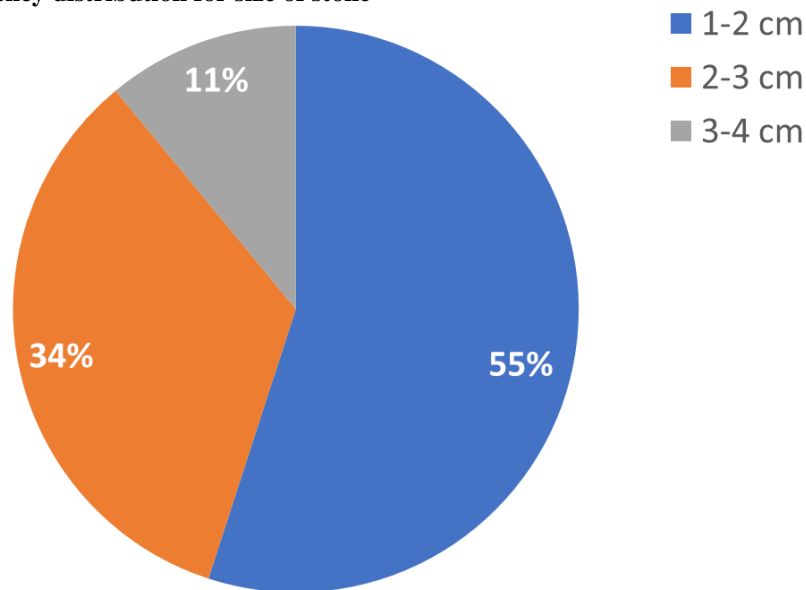
supracostal approach and 38 the subcostal approach. For left PCNL, a total of 67 patients were treated, with 35 undergoing the supracostal method and 32 the subcostal approach. Demographic variables were insignificant in both Supracostal and subcostal puncture group. The most prevalent stone distribution in our study was accounted for by large renal calculi, comprising approximately 34%. The stone site distribution is summarized in Table 1.

Table 1: Frequency distribution for site of stone

Stone location	N= 123
Large Renal calculi	42 (34)
Pelviureteric junction calculus	19 (15)
Partial Staghorn calculus	22 (18)
Complete staghorn calculus	13 (11)
Upper ureteric calculus	6 (5)
Renal pelvis calculus	21 (17)
Data presented as n (%). 123	

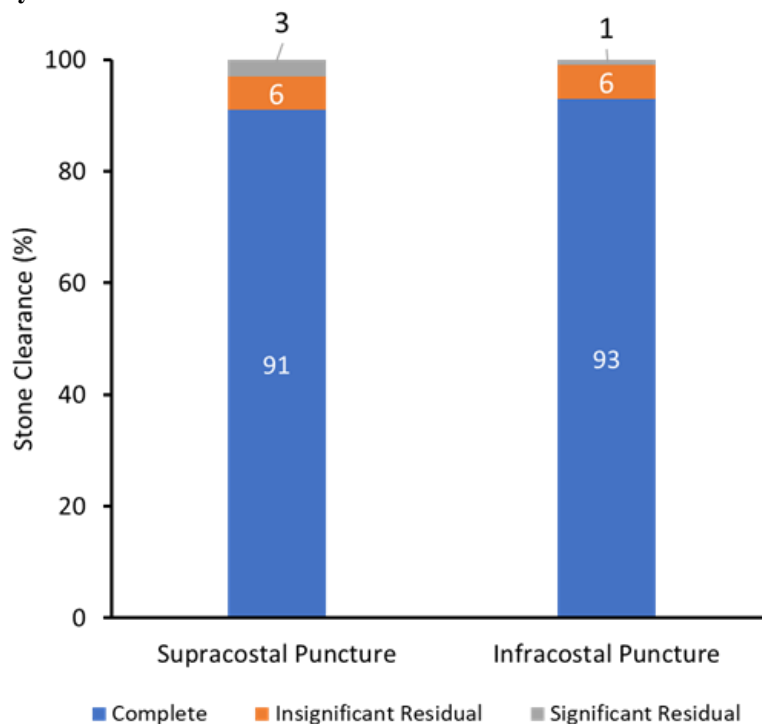
55% of patients exhibited stone sizes ranging between 1 to 2 centimeters, while the mean stone size measured 2.05 centimeters. [Figure 1]

Figure 1: Frequency distribution for size of stone



The average surgical duration for Supracostal puncture was 98.86 minutes, and for Subcostal puncture, it stood at 94.42 minutes, showing a nearly comparable duration in both groups. When it came to the average hospital stay, patients undergoing Supracostal puncture stayed for around 5 days, while

those in the Subcostal group had an average stay of 4.5 days. In the supracostal puncture group, 91% of patients achieved complete stone clearance, while in the subcostal puncture group, this figure was 93%. When considering the entire study, the overall stone-free rate (SFR) was 92%. [Figure2]

Figure 2: Frequency distribution for stone clearance rate

The most frequent complication observed was perioperative bleeding, occurring in approximately 13.2% of the supracostal puncture cases and 3% of the subcostal puncture cases. Specifically, 10% of the supracostal puncture group required blood transfusions, while this was 3% for the subcostal puncture group. Intrathoracic complications such as atelectasis (7.5%) and pneumothorax (3.7%) were identified among the supracostal puncture cases. [Table 2]

Table 2: Complications of Supracostal and Subcostal Puncture PCNL

Complications	Supracostal Puncture N=53	Subcostal Puncture N=70
Atelectasis	4 (7.5)	0
Fever	6 (11.3)	4 (5.7)
Perioperative bleeding	7 (13.2)	2 (3)
Late haemorrhage	2 (3.7)	0
pneumothorax	2 (3.7)	0
Hydrothorax	0	0
Blood Transfusion	5 (9.4)	2 (3)
Wound Infection	1 (2)	0
Sepsis	2 (4)	0
Urine Leak	4 (7.5)	2 (3)
Colonic and organ injury	0	0

Data presented as n (%).

DISCUSSION

Percutaneous nephrolithotomy is a standard technique in the treatment of large renal calculi, either as alone or combined with ESWL and it has swapped open procedure for large renal or upper ureteral calculus as a less obtrusive technique. Under explicit conditions, related to the kidney requires the upper pole access. The benefit of upper-pole access in PCNL is immediate access to the greater part of the collecting system and upper ureter. Upper-pole access can be accomplished either Supracostally or Subcostally

approach. Whereas in standard PCNL, subcostal puncture was done from beneath the 12 th rib lateral to the paraspinal muscles for access to the collecting system. Likewise, we have Supracostal approach. Supracostal puncture were recommended in Complete Staghorns, Partial Staghorn stones, Proximal ureteric stones, PUJ calculus, Renal calculi with Upper pole stone burden, Renal pelvic calculus, and stones in anatomically variation of kidneys. Subcostal puncture technique was indicated in patients with Large renal calculi or

Upper Or Partial Staghorn Stone where the stone burden is Lower Pole. Enter desired calyx in a straight line during subcostal technique to avoid undue scope angulation, so that scope manipulation is better and stone clearance rate is maximum.

Regardless of high stone clearance rates, significant worries in PCNL include blood loss, organ injuries, and severe infections.⁶ Lee et al stratified the risk of PCNL into major and minor complications, which includes death, persistent bleeding requires intervention, serious infection as major complications and postoperative fever, bleeding requires transfusion, and urine leak from the flank around 50% of patients were concluded as minor complication.⁷

In our study we observed perioperative bleeding was a major complication seen around 13.2 % at supracostal group. Other complications such as atelectasis, pneumothorax were observed in supracostal group. Minor complication like fever was seen in 11%. The predisposing factors like renal insufficiency, diabetes, morbid obesity, or cardiopulmonary diseases associated with risk of complications during PCNL.⁸ The supracostal Puncture was associated with major complications due to the presence of significant anatomic structures like colon, spleen, liver, pleura, lungs, intercostal artery, phrenic nerve, and diaphragm. Bleeding is the most common complication of PCNL, with required blood transfusion rate of 1–10%.⁹ Bleeding due to AV fistulae or pseudoaneurysm requires emergency angio embolization and it is seen in 0.5% of patients.^{10,11} The placement of a PCNL tube is satisfactorily to control the bleeding due to venous nature. In case of persistent bleeding in post PCNL by clamping the PCN tube for 10 min is helpful in tamponade effect.¹² During PCNL there will be some absorption of irrigation fluid. Whereas in supracostal puncture, chest should be examined at end of procedure due to the irrigation fluid may extravasated into the pleural cavity leads to pleural effusion or pneumothorax and requires drainage in 4–12%.^{13,14} The high incidence of intrathoracic complication (34.6%) were noted whenever puncture above 11th rib, compared with the supra 12th rib access (1.4%). We observed incidence of pneumothorax is 3.7% in our cases. These factors are verified strategy to avoid complication as related to high approach as much as possible. If the clinical findings suggest of pneumothorax or haemothorax, immediate placement of a chest tube is mandatory. The tube is removed based on clinical improvement, usually within 24 h if indicated. If the patient has extensive hemothorax, a large ICD tube is advisable.¹⁵

The PCNL tract access between the 11th and 12th rib suggested by Pardalidis and Smith et al, mentioned 10% of patients present to have pneumothorax.¹⁶ Supracostal approach by Lojanapiwat et al on the 170 cases, SFR was 82.2%, and hydrothorax was found in 15.3% of cases.¹⁷

PCNL tubes were removed on POD3 in most of the cases, Chest x-ray was within normal limits in all patients. Post-operative period was uneventful except for pain, bleeding and fever which was managed conservatively. In Supracostal puncture there was no need for extended hospital stay. A comparative study by Radecka et al between Supra and Subcostal puncture, respiratory complication noted in 32% Vs 5%, in 5% of cases in both group required arterial embolization for uncontrolled bleeding, and 5% had pleural effusion and pneumothorax in both groups.¹⁷ Study by Sukumar et al on Supracostal approach with sample size of 110, overall complication rate and stone clearance rate was seen in 11.8% and 86.4% respectively.¹⁸ Our overall SFR was 92%. Falahatkar et al study on techniques of PCNL on the 20 cases, in which upper calyx was entered with subcostal approach synchronous with lung inflation, instead of supracostal approach. However, they reported a SFR of 85% with no pulmonary complication but study needs more number cases with a different study design.¹⁹

CONCLUSION

Supracostal puncture technique is a safe feasible procedure with minimal morbidity when compared with subcostal technique. The intrathoracic complications can be avoided by proper planning of puncture site, on or lateral to posterior axillary line during expiration. Supracostal technique as high SFR of > 90 % particularly when the stone in upper pole and complete staghorn calculi. Operative time and hospital stay in supracostal technique compared with subcostal technique were same. The axillary procedure like ESWL may need for complete stone clearance in case of residual calculus. Preoperative evaluation of puncturing site can be done adequately to avoid risk of solid or hollow organ injury. Supracostal and Subcostal approach can be done safely in age group of 11-70 years along with complications like bleeding can be avoided by appropriate preoperative evaluation in related to bleeding diathesis and can be managed by principles of appropriate calyceal punctures and tract dilatation.

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