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Supracostal Percutaneous Nephrolithotomy: Therapeutic Advantage over Infracostal Approach: A Prospective Comparative Study in A Tertiary Hospital of South India

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Abstract

Introduction: Optimum calculi clearance particularly in staghorn and renal calculus relies heavily on proper preoperative renal access. Percutaneous nephrolithotomy (PCNL) has been the surgery of choice for large renal calculi. But it is pertinent to realise that not all stones can be cleared by the most favoured infracostal approach.To gain further insight we compared supracostal to infracostal approach of PCNL in terms of stone clearance, surgical ease and complications. *Aims and Objectives*: A prospective study was conducted to compare supracostal versus infracostal approach in PCNL for removal of complex renal calculi. *Materials and Methods*: A total of 90 patients with comple renal stones were recruited for PCNL in our Tertiary care referred between January 2018 to November 2019. Fourtyeight of them underwent supracostal, while Fourty two underwent infracostal puncture. The two approaches were compared on various parameters like a total duration of surgery, intraoperative blood loss, infundibular/pelvic tear, rate of complete stone clearance and postoperative complications (pulmonary, bleeding, fever and sepsis, etc.). *Observation and Results*: In our study, the success rate was 72% for those in the infracostal 87% for those in the supracostal approach.21.4% required secondry puncture while 26% required so in infracostal approach. There was no statistically significant difference noted in terms of mean operative time and duration of inpatient stay. In terms of complication blood transfusion was more in infracostal approach.Thoracic complications (hydrothorax) which is most feared in supracostal approach happened in just 1 patient. *Conclusion*: Supracostal approach when judiciously used in properly selected patients can offer better calculi clearance with less rate of secondary punctures, peroperative complications and lesser need for ESWL.

Keywords: Percutaneous; Nephrolithotomy; Staghorn; Supracostal Puncture.

Introduction

PCNL has been the surgical treatment of choice for large renal calculi, staghorn calculi and large upper ureteric calculus. It is widely performed since its inception in 1976. Percutaneous endourological procedures allow the urologist an access to the kidney and facilitate antegrade intrarenal and ureteral procedures. PCNL can be done both through supracostal and infracostal approach.[1] An ideal puncture would be one that gives

a. Quickest, shortest and linear most access to the calculi
b. Lies along the axis of the calculi and calyx
c. Causes minimal renal parenchymal damage.
d. Avoids major organs and blood vessels in vicinity.
e. Decreases intraoperative clearance time and complications.

So we shall strive to compare the above two approaches and deduce the clinical advantage of supracostal over infracostal approach. Presently the consensus is that PCNL through a supracostal access approach can clear stones efficiently with a low rate of complications.

Materials and Methods

A Prospective comparative study was conducted in the period between January 2018 to November 2019 at our hospital after clearance from the Institutional ethical committee.

Inclusion Criteria:

- Complex renal calculi Large stones >2cm, staghorn calclus.

Exclusion Criteria

- Pediatric age group
- Comorbid medical conditions like Diabetes mellitus, Hypertension, anticoagulant therapy.
- Bleeding disorders, Acute/Chronic pyelonephritis.
- Congenital renal anomalies,pelvic ureteric junction obstruction, bifidpelvis, megaureter, horse shoe kidney.

All patients underwent proper preoperative evaluation in the form of blood investigations, cardiology work up, radiological investigations like ultrasound, Intravenous Urography, NCCT KUB. Under aseptic precautions after general anesthesia cystoscopic ureteric catheterization was done and patient was shifted to prone position and fluoroscopic guided puncture was made above lateral half of the 12th rib lateral to erector spinae 7-8 cm from the midline.All supracostal punctures was done in full expiration and needle was advanced just above the upper border of 12th rib.This avoids the injury to lung parenchyma and intercostals vessels respectively. Renal stones as defined above were included in our prospective study and underwent PCNL[2]. Patients in the pediatric age group, comorbid conditions (diabetes mellitus, hypertension, and on anticoagulant therapy), associated pyonephrosis, and congenital anomalies (pelviureteric junction obstruction, bifid pelvis, megaureter, horseshoe kidney, etc.) were excluded from the study . Patients were divided into two groups as per the primary calyceal punctures taken during PCNL[3] . Institutional Ethical Committee approval was obtained prior to commencement of the study. Written and informed consent was taken from all patients undergoing PCNL.

Patients were divided into two groups as per the primary calyceal punctures taken during PCNL. Between January 2018 and November 2019, 90 patients underwent PCNL; supracostal access was obtained in 48 patients, and infracostal access was obtained in 42 patients. The preoperative evaluation included hematocrit, renal function, urinalysis, and urine culture. Radiologic evaluation routinely included an intravenous urogram; ultrasonogram and NCCT KUB. All the procedures were performed in a single stage under general anesthesia. After cystoscopic ureteral catheterization, the patient was positioned prone and a puncture was made above the lateral half of the 12th rib lateral to the erector spinae, usually 7 to 8 cm from the midline, under fluoroscopic guidance. All the supracostal punctures were made during full expiration to prevent parenchymal injury to the lung, and the needle advanced just above the upper border of the 12th rib to avoid damage to the intercostal vessels. Entry into the renal parenchyma was made in deep inspiration to provide full downward displacement of the kidney for easy access to the superior pole posterior calyx. Once the pelvicalyceal system was entered, the guidewire was manipulated down the ureter if possible or coiled in the distant calyx and subsequently the tract was dilated using serial fascial dilators and a 28- 30 F Amplatz sheath was placed. A standard 26 F nephroscope was then introduced through the Amplatz sheath and the stone was fragmented with the pneumatic lithotripter and removed. At the end of procedure, a 26-28 F chest tube was placed as nephrostomy tube. All patients had a chest X-ray and ultrasound scans soon after surgery to exclude pneumothorax or fluid collection. Stone clearance was assessed with a plain X-ray KUB at 1 or 2 days follow-up. Complete clearance was considered as no radiological evidence of residual stone disease. Asymptomatic residual, non obstructing, nonstruvite stone fragments less than 5 mm in diameter were considered clinically insignificant residual fragments. Significant residual calculi were managed by ESWL. The data was analysed for the indications for supracostal access sites, clearance rates and postoperative complications.

Results

The patients were in the age range of 23- 55 years (mean 39 years); 67 (74%) patients were males. And 23 (27%)were females (Table 1).In 47 patients the procedure was right-sided and left-sided in 43 (Table 1).Fourty eight of them underwent supracostal, while fourty two underwent in fracostal puncture.(Table 2).The majority of them were partial and complete staghorn stones. Other indications were large pelvic stones ,calyceal stones in high-lying kidneys and upper ureteric stones .

Complications developed in 8 (28%) patients (Table 4), with a chest complication haemothorax developed secondary to injury of the intercostal artery in 1 patient; this patient made an uneventful recovery after insertion of the chest tube and a blood transfusion. The chest tube was removed 6 days after surgery. The patient with perinephric collection was treated by conservative measures. Both the patients with sepsis recovered well with intravenous antibiotics and supportive measures. Blood transfusion was required in 3 patients. The

Table 1: Patients demographics.

	Supracostal puncture	Infracostal puncture	Total
No of patients	48	42	90
Male	35	32	67
Female	13	10	23
Right side	25	22	47
Left side	23	20	43
Stone size in cm (Mean)	2.9	2.7	–

Table 2: Comparision of Supracostal and Infracostal.

Site of Puncture	Number of patients
Supracostal	48
Infracostal	42

Single-tract access was sufficient in 70 (78%) cases; 20 (22%) cases needed an additional access tract (Table 3). Additional punctures were required mainly for staghorn stones. With PCNL monotherapy, stones were completely cleared in 83 cases (92%). Significant residual fragments were present in 5 patients. The 3 patients were later rendered stone free with Check Nephroscopy and 2 patients needed ESWL. The mean operative time was 72 minutes in supracostal and 74 minutes in infracostal.(Table 3)

Table 3: Operative parameters.

Characterstics	Supracostal Puncture	Infracostal Puncture
Mean Operative time(min)	72.5	74.5
Secondary puncture required	9	11
Mean Hospital stay(Days)	5.5	5.5

Table 4: Complications of supracostal access.

Complications	Number
Hydrothorax	0
Intercostal vessel injury(Hemothorax)	1
Perinephric collection	2
Infection /Sepsis	2
Blood loss	3
Total	8

mean postoperative hospital stay was 5.5 days (range 2-9days).

Discussion

The outcome of PCNL is directly related to an optimal access tract. The majority of stones in the pelvis and mid or lower calyces can be easily reached via a subcostal puncture. However, for stones in the upper ureter, superior calyx and for staghorn stones, an approach through the superior calyx has clear advantages[4] Though technically more demanding, access through a superior calyx provides a straight tract along the axis of the kidney, with excellent visualization of upper and lower calyces, the pelvis, and the pelviureteric junction . A straight tract also favours easier manipulation of the rigid scopes and forceps. This ability to operate along the long axis of the kidney causes less torque of the rigid nephroscope, thereby reducing the chances of excessive bleeding . Invariably the superior calyceal approach is supracostal, which incurs few extra complications than subcostal access[5]. Staghorn stones are best approached through the supracostal puncture. The subcostal inferior calyx approach in staghorn stones has the problem of angulation and torque on the kidney, which may cause trauma and bleeding. Also it is particularly difficult to clear the residue in the superior calyx. Our analysis revealed good stone clearance rates by PCNL alone. Supra costal approach is mandatory for superior calyceal stones as these stones are particularly difficult to approach through the inferior calyx because of the angulation of the tract[6] Upper ureteric stones are best approached via a supra costal tract. Although access through the middle or inferior calyx may be selected, it can lead to angulation between the working sheath and the pelvis, leading to difficulty in passing instruments or the lithoclast probe. The major disadvantage of supracostal access is the potential for pleural complications. Therefore a thorough knowledge of the anatomical relationships of the diaphragm, pleura and lung is important to avoid this risk[7]. The parietal pleura is reflected to the level of 10th rib in the mid-axillary line and posteriorly it is usually reflected obliquely at the midpoint of the 12th rib. In full expiration, the visceral pleura never descends to the level of the midpoint of the 12th rib. Hence, a supracostal puncture made in full expiration with optimal lateral approach will avoid the pleural space. The cause of hydrothorax has been attributed to accidental entry into the pleura and failure to seal the tract with the working sheath during

the procedure or to inadequate drainage of the kidney afterward. Another potential complication of supracostal access is the risk of injury to the lung, leading to tension pneumothorax. No such injury was encountered in the present series and was not reported by others[8] Injury to the viscera (liver or spleen) may occur with the more cephalad puncture, and thus we avoided access above the 11th rib. Haemothorax secondary to the laceration of the intercostal artery developed in one patient. Injury to the intercostal artery may be avoided by staying immediately above the upper border of the lower rib . In conclusion, the supracostal superior calyceal approach provides optimum access to large upper calyceal and ureteric stones, being particularly suited to the percutaneous removal of complex staghorn stones.[9,10] Although the morbidity is slightly higher than with a subcostal approach, this may be avoided to some extent by adhering to the basic principles of always puncturing in full expiration, sufficiently laterally to the margin of erector spinae muscle closer to the midscapular line, and always using a working sheath during nephroscopy and a well-draining nephrostomy tube after the procedure. Proper attention to the technique and intraoperative and postoperative monitoring can detect chest complications, and these can easily be managed with intercostal drainage without serious morbidity or death.[11,12]

Conclusions

In our study, the success rate was found to be better in upper calyceal puncture group than lower calyceal puncture group for the management of complex renal calculi. The safety of both the punctures was same with a better efficacy of upper calyceal puncture. In complex/large staghorn calculi, upper calyceal puncture is a handy technique and should always be kept in mind. In a mobile kidney, upper calyceal puncture through supra 12th rib is a feasible option minimizing lung/ pleural injury and gives a better clearance rate. We suggest that there should not be any hesitation for upper calyceal puncture in indicated patients. Following a few simple precautions, intrathoracic complications can be kept to a bare minimum.

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