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RESEARCH ARTICLE

EVALUATION OF SAFETY PROFILE OF SUPRACOSTAL ACCESS IN PERCUTANEOUS NEPHROLITHOTOMY.

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Key words:-
CP = Calyceal puncture
MC = middle calyx
IC = Inferior calyx
RP = Renal pelvis
RS = Residual stone
SC = Superior calyx
UC = Upper calyx
UPJ = Uretro-pelvic junction
US = Uretric stone

Abstract

Aims and objectives:-
To evaluate the safety and efficacy ofsupracostal puncture in PCNL.
Materials and methods:-
This is a retrospective study conducted in the department of Urology at NIMS, Hyderabad from August'2013 to July'2015. A total of 68cases who underwent supracostal puncture during this period were studied. The indications of supracostal approach in our cases were staghorn and complex inferior calyceal stones, and stones in the upper calyx or the upper ureter. All punctures were made by the urologist under C-arm fluoroscopic guidance in the prone position. After tract dilatation with telescopic metal dilators, pneumatic or ultrasound lithotripsy was used for fragmentation. The operative time, success rate, hospital stay, and complications were evaluated.
Results:-
Among 68 cases studied 49 were males and 19 were females withstaghorn being most common indication for supracostal puncture. Only 15 cases needed additional puncture for complete clearance. Post-operative complications were noted in 10cases in which 5 presented with sepsis.
Conclusion:-
Supracostal approach can be ideal for many clinical situations including Stones in more complicated renal systems, such as an upper pole complex lower pole configurations may be more amenable to a supracostal upper calyx approach. Supracostal access above the 11th rib should be avoided when possible. With a good understanding of the anatomy surrounding the upper pole of the kidney and attention to a few technical considerations during the procedure, access through a supracostal approach can be performed safely and efficiently.

Introduction:-

Percutaneous nephrolithotomy (PCNL) is a feasible option for the treatment of large renal stone burden, staghorn calculi, and upper ureteral calculi, lower pole calyceal stones greater than 10 mm, and diverticular stones[1].

Gaining percutaneous access and entering the appropriate calyx are critical to the procedure. The access directly relates to the ease of the procedure and subsequent success of stone clearance[2]. The anatomy of the kidney often

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favors an approach through the superior calyx. Common approach to PCNL access is below the 12th rib, however some cases have better success via a supracostal approach. A subcostal or lower pole approach can result in suboptimal access and reduced stone clearance[3,4].

Usually, the upper pole of the kidney is more posterior and more medial than the lower pole, so access via a superior posterior calyx is more direct to the long axis of the kidney[2,3]. This approach additionally facilitates the access to a lower calyx and the upper ureter. In complex inferior calyceal calculi, complete clearance may often not be possible through a single tract in an inferior calyx because of problems in negotiating the acute angles between calyces..Supracostal puncture is also useful in obese patients and those with high- lying kidneys[3]. Careful preoperative and intraoperative planning is required to determine the renal access for complete stone clearance. This may require a supracostal approach for stone removal.

The supracostal puncture is usually a concern because of the potential complications of pneumothorax, hydrothorax and lung injury[5]. The upper pole is more commonly accessed via a supracostal route, but can be accessed through a subcostal approach. The supracostal route is often under used because of concerns about safety and thoracic complications[5].

Materials and methods:-

Methods:-

Total number of patients who underwent PCNL in the study period was 408. Of which supracostal access was necessary in 68 cases. The decision to use SA was based on the stone location, configuration of the intrarenal collecting system, and the likelihood of maximal clearance using a single tract.

All patients' radiographic images were reviewed. The preoperative assessment included routine laboratory studies, e.g., blood chemistry, complete blood count, coagulation profile, and urine analysis and urine culture.

Radiological evaluation was done by X-ray KUB, USG, and NCCT. Post-procedure KUB radiographs were done in patients who had radiopaque stones based upon the scout preoperative images. Those patients who had radiolucent stones were evaluated with CT scan in the postoperative period. Patients with positive preoperative urine cultures received antibiotics for approximately one week based on culture sensitivity data.

Procedure:-

After induction of general anesthesia, the patient was placed in the lithotomy position and a ureteral catheter was inserted. The patient was then turned to the prone position, and retrograde installation of dye through this catheter was used to select an appropriate calyx to be punctured under fluoroscopic guidance. The puncture was performed above the eleventh rib in 7 procedures and above the twelfth rib in 61 procedures. The puncture was preferably in the lateral half of the intercostal space. The puncture was donein breath holding in full expiration, and the needle was advanced in the middle of intercostal space to avoid the intercostal vessels.

Once the collecting system was entered, a guidewire was passed into ureter. After the passage of the first guide wire, a safety guidewire was placed.

For the patients in whom we believed a second puncture was necessary for complete stone clearance, we preferred to pass another guidewire at this stage of the procedure to be used later for the creation of a second access tract.

Subsequently, our access tract was dilated first using the fascial dilators, and then continuing with the standard Amplatz until an Amplatz sheath of 30 fr was placed. The stones were extracted by an alligator grasper or disintegrated by a standard pneumatic EMS Swiss LithoClast® before extraction by grasper. After stone removal, careful inspection of the accessible calices, the renal pelvis, and the UPJ was performed to exclude the presence of residual stones, injury, or edema of the UPJ. Fluoroscopy was also used to check for any residual stones.

A 14F suction catheter was used as nephrostomy tube and nephrostogram was done to check the integrity of pelvi-calcyeal system. Whenever necessary a DJ stent of 5f was placed in antegrade fashion.

All patients were examined at the end of the procedure for equal air entry on both sides of the chest, and adequate

oxygen saturation was confirmed. Chest radiography was also performed immediately after surgery to exclude pneumothorax or hydrothorax. In the immediate postoperative period, patients were observed for signs of bleeding by recording the vital signs and observing the urine output for gross hematuria. Preoperative and postoperative hemoglobin level and hematocrit were measured, and any drop in hemoglobin level was recorded. Stone clearance was assessed on by plain abdominal radiograph and ultrasound 1or 2 days after surgery. The nephrostomy tube was removed when hematuria resolved. Successful stone removal was defined as complete clearance of the stone. Insignificant residuals were defined as residual fragments 2 mm.

At 30 days after surgery, a plain abdominal film, urinary tract ultrasonography and urine culture were obtained, and at 3 months, patients were assessed using IVU and urine culture. 'Stone-free' was defined as the complete absence of stones or the presence of fragments of <5 mm after the primary procedure.

Results:-

In our study of 68cases 72% were males and 28% were females and in 53% of patients PCNL was done on right side, 47% on left side. In the present study 57% of the patients were in between 3rd and 5th decade. The eldest patient was 65 years of age.

Of the 68 patients 23 patients (34%) had partial stag horn calculi, 21 patients (31%) had complete stag horn calculi. 14 patients (21%) had pelvic stones and 3 patients (4%) in the study group had upper ureteric calculi.

The mean stone burden in this study group was 3.5 ± 0.5 cm. The largest stone was of 6x5 cm. In the cases studied 25% (17) patients had associated comorbid conditions like Diabetes (8), Hypertension (5) and coronary artery disease (2).

In the present study access was either superior calyx in 33(48.5%) cases or mid calyx in 15 cases (22.05%) and inferior calyceal puncture in 5 cases. Multiple accesses were required in 15 cases (22.05%) in view of the stone burden. In one case access was attained through superior, middle and inferior calyces.

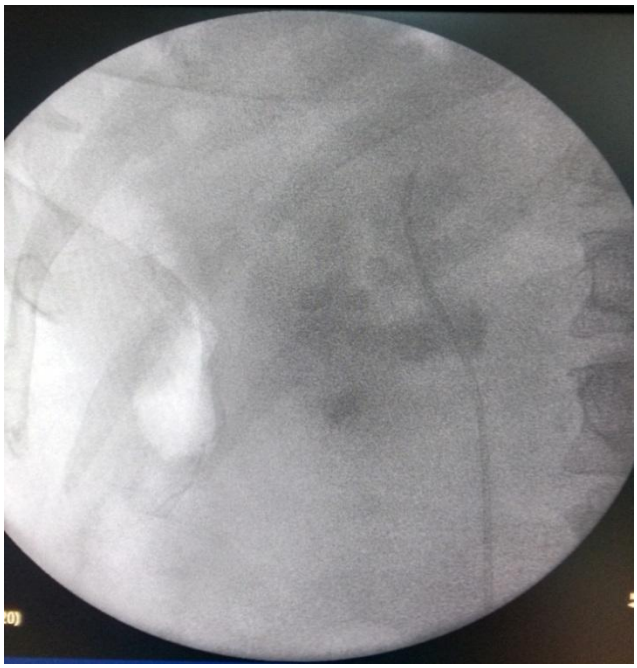
Supracostal 10thintercostalspace puncture was done in 3 cases (4.41%) and 11th intercostal space was used in 65 cases (95.58%) for achieving access. The mean duration of surgery was 65 ± 5 minutes. The duration of surgery was prolongedwhen the stone burden was more than 3.5cm and when there was a need for multiple tracts for access.

Complete clearance was achieved in 51 cases (75%) and residual stone in 17 cases (25%). Of the 17 cases with residual calculi, 9 were treated with ESWL, 4 underwent redo PCNL procedure and remaining 4 cases were treated with medical expulsive therapy. All the 17 cases were rendered stone free after ancillary procedures.Patients with insignificant calculi were not subjected to any ancillary procedures in our study. 10 of the 68 cases had complications like sepsis 7.3%(5), hydrothorax (3) and persistent bleeding in 2 cases. Overall complication rate in the present study was 14.7%. Sepsis was managed with appropriate antibiotics, Intercostal drainage was required for the 3 cases of hydrothorax. Angioembolization was done in the 2 cases of persistent bleeding.

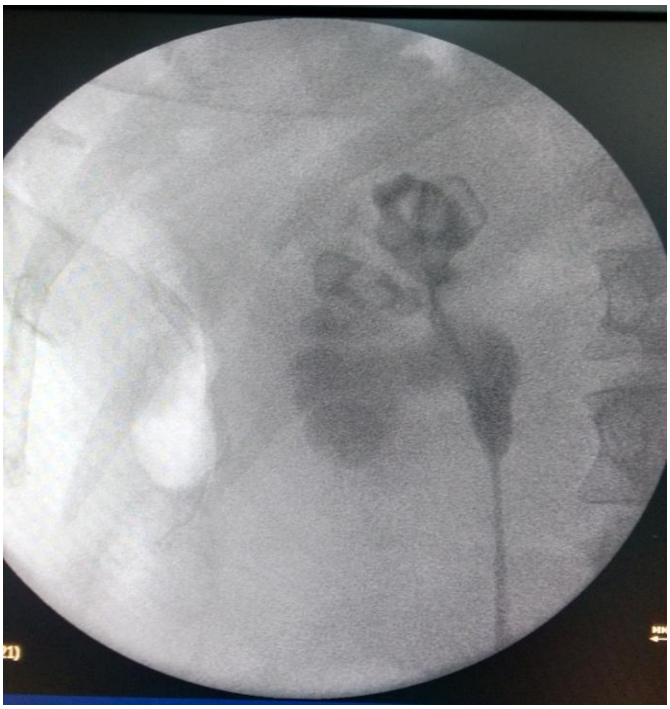
The mean hospital stay was 3.4 days. The maximum duration of stay was for 10 days as the patient had post operative bleeding requiring angioembolization

Plain radiograph KUB with ROD in left renal area

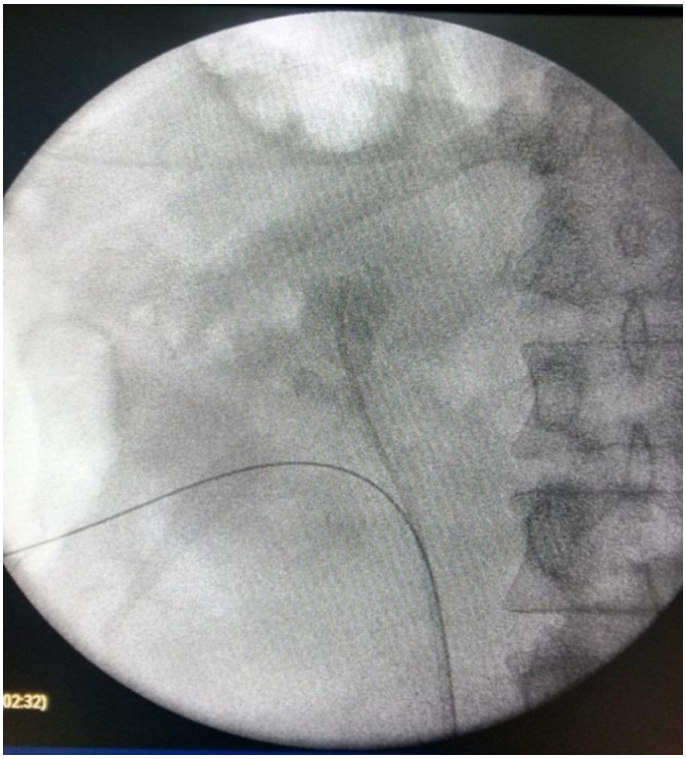
Series of images taken in a patient during multiple supracostal puntures establishing access to the stone via puncture through upper/middle & lower calyces to achieve complete clearance.



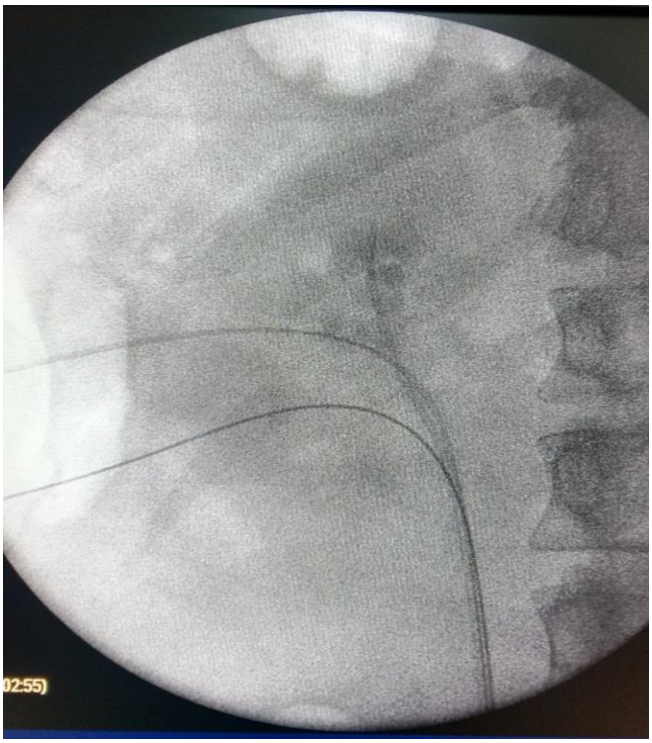
Fluoroscopic image with patient in prone position showing ROD in left renal area with uretric catheter in-situ.



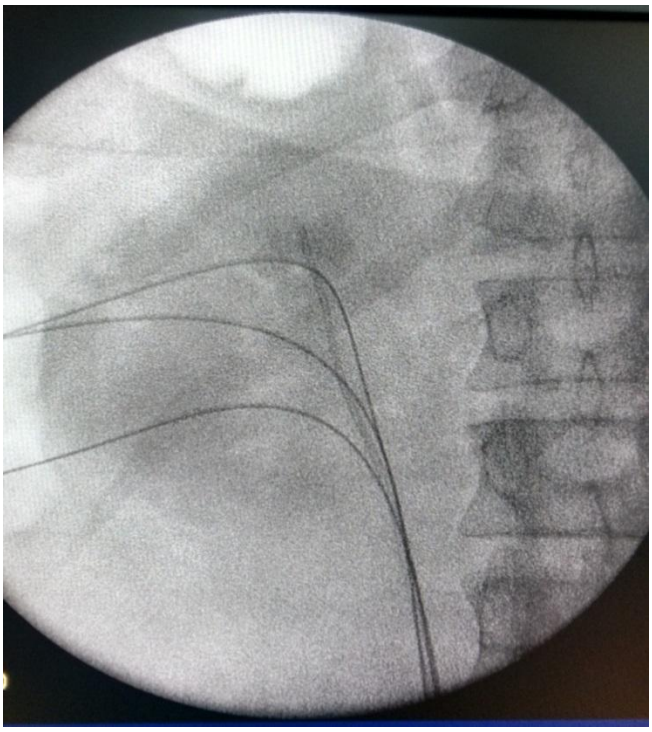
Fluoroscopic image delineating left PCS with uretric catheter in situ.



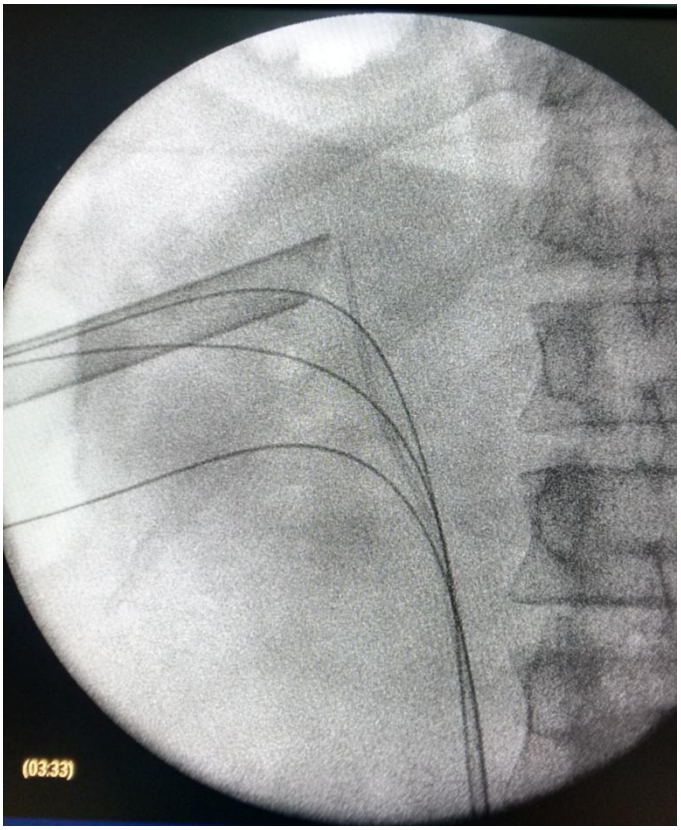
Fluroscopic view after lower calyceal supra costal puncture with guide wire positioned in to the ureter.



Fluoroscopic image after middle calyceal supra costal puncture in same patient with guide wire positioned in to ureter via middle calyx.



Fluoroscopic image after upper calycealsupracostal puncture in same patient with guide wire positioned in to ureter via upper calyx.



Fluoroscopic image post procedure showing complete clearance of stone with sheath insitu along with guide wires during PCNL via Supracostal punctures.

Discussion:-

We have evaluated 68 cases of supracostal PCNL retrospectively for this study to know the safety profile of supracostal PCNL in terms of hospital stay, intrathoracic complications, organ injury, need for blood transfusion, stone clearance rate and need for ancillary procedures.

The superior calyx is considered ideal for approaching the renal system when managing staghorn calculi because the most posterior portion of the kidney is the posterior upper-pole calyx, and thus it provides the most direct access to the renal pelvis, upper ureter and lower-pole calyces. Even the posterior interpolar calyx can be accessible without significant angulation [6]. The superior calyx lies above the 12th rib most of the times, as on full expiration 80% of right renal upper pole calyces and 85% of left renal upper pole calyces lie above the 12th rib[7]. Thus direct access to a superior calyx would require a supracostal puncture in >80% of patients.

The subcostal inferior calyx approach to staghorn stones can induce angulation and torque on the kidney, which can cause trauma and bleeding[8]. Although it is technically more demanding, access through a superior calyx provides a short and straight tract along the axis of the kidney Sudhirsukumar et al[3], N.S.Kakre et al[9].

A staghorn stone was identified as an independent risk factor for severe bleeding after PCNL[10]. El-Nahaset al[11]. reported that using PCNL for staghorn calculi by urologists other than an experienced endourologist, and a positive preoperative urine culture, were independent risk factors for the development of complications. Preoperative planning of the number, site and direction of the access tracts should be determined after a thorough evaluation of all radiological studies. The surgeon must gain a balance between complete stone clearance and acceptable patient morbidity. Therefore, when significant complications develop, the procedure should be terminated[12].

In the present study significant blood loss, which required blood transfusions in 14.7% (10) cases. These results were similar with other studies, Gupta et al [13], Lojanapiwatet al[14],Shah et al[15],Sukumar et al[3]and Shaban et al[16].This

high rate of excessive bleeding was because of more vascularity of upper pole and injury to inter costal vessels. Using Alkens telescopic metallic dilator or single step dilatation of tract can reduce it.

Overall complication rate in the present study was 14.7% which shows similar results with other studies Kekre et al[9] ,Gupta et al[13],Lojanapawit et al1[14],Shah et al[15],Sukumar et al[3] and Shaban et al[16].

Conclusion:-

Establishing good percutaneous renal access is a crucial step in the PCNL technique.While standard PCNL is often performed through a subcostal lower calyceal approach, upper calyceal access through a supracostal approach can be ideal for many clinical situations.Stones in more complicated renal systems, such as an upper pole complex lower pole configurations may be more amenable to a supracostal upper calyx approach.Supracostal access above the 11th rib should be avoided when possible. Intraoperative fluoroscopy of the lung fields should be performed at the conclusion of the procedure, and a strong suspicion for pulmonary injuries should be maintained in the postoperative period.With a good understanding of the anatomy surrounding the upper pole of the kidney and attention to a few technical considerations during the procedure, upper calyceal access through a supracostal approach can be performed safely and efficiently.

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