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Original Research Article

Outcome of Supracostal Puncture for Percutaneous Nephrolithotomy for Renal Stones: A Retrospective Analysis

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ABSTRACT

Objective: Supracostal superior calyceal puncture is best puncture for staghorn, upper ureter, superior and inferior calyceal stone. The objective of this study is to analyzed the data from single centre regarding. The aim of this retrospective study was to evaluate a single center data regarding the safety and efficacy of this approach for percutaneous renal stone surgery.

Materials and Methods: A total of 597 renal units (597 cases) were treated with percutaneous nephrolithotomy from the March of 2010 to March of 2015. Supracostal approach was selected in 123 cases and infracostal approach in remaining 474 cases. 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. The urologist under C-arm fluoroscopic guidance in the prone position made all punctures. The interspace between 11th and 12th rib was used in 116 patients (94%) and 10th–11th interspace in 7 cases (6%). The operative time, success rate, hospital stay, and complications were evaluated.

Results: The complete and relative success rates were 89.4 and 10.6%, respectively. The total complication rate was 13%. The success rate in the 10th– 11th rib access and 11th–12th inter rib access was 77 and 90%, respectively. Complete success rate was 100% in stone sizes less than 2 cm in diameter of upper ureteral and renal pelvic areas, and 77.4% of staghorn calculi. The total complication rate was 13% (16 cases), in which the most common of it was perioperative bleeding (5.7%; 7 cases).

Conclusion: The supracostal approach was found to be effective as well as safe, with acceptable complications. It gives high stone clearance rates with acceptable morbidity rates and should be attempted in selected cases. The rate of pulmonary complications is higher with the supracostal approach. If the supracostal approach is indicated, it should be used with caution.

Keywords: Percutaneous Nephrolithotomy, Renal Stones, Supracostal Puncture.

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INTRODUCTION

Percutaneous nephrolithotomy (PCNL) is a well-established technique for the treatment of urinary stone disease. Successful stone removal requires the accurate placement of a percutaneous tract that provides direct access for stone manipulation. The optimal access for the staghorn, large upper calyceal, and complex renal stone burden is through the upper-pole posterior calyx, which at times is best accomplished by supracostal puncture.[1] The supracostal approach is usually a concern because of the potential complications of pneumothorax, hydrothorax, and lung injury. We retrospectively evaluated the safety and efficacy of the supracostal approach for the percutaneous removal of staghorn and complex renal stones.

MATERIALS AND METHODS

Between March 2010 and March 2015, a total of 597 consecutive cases underwent PNL in our center**.** From these cases, supracostal approach was obtained in 123 cases. Single tract access was used in 92 cases (75%), but 31 cases (25%) required a second subcostal tract. Ninety-nine cases (80%) were men and 24 cases (20%) were women. Mean age was 39.5 years and range 17–69 years. Hydronephrosis was seen in 104 cases (84.5%), mild hydronephrosis; 20 cases, moderate hydronephrosis; 62 cases, severe hydronephrosis; 22 cases, and no hydronephrosis; 19 cases (15.5%). Twenty-six cases (21%) had ureteropelvic or upper ureteral stones, complex renal pelvis

and lower calyceal stones in 19 cases (15.5%), renal pelvis and upper calyceal stones in 18 cases (14.5%), staghorns in 31 cases (25%), renal pelvic stones in 17 cases (14%), and upper calyceal stones in 12 cases (10%). For evaluation of patients, selection of operation technique and avoiding of intraoperative complications, kidneys and bladder ultrasonography with intravenous pyelography (IVP) were performed in all cases. In the situation of non-opaque stones or non-secretion of kidney (one or two units), retrograde pyelography and/or CT KUB were requested, individually. Single-stage percutaneous nephrolithotomy was done in all patients. After induction of anesthesia, an open-end 6 F ureteral catheter was inserted via transurethral approach into the ureter with the patient in the lithotomy position. The standard percutaneous access was created in all patients. Under fluoroscopic guidance in the prone position and after injection of contrast material through ureteral catheter, the needle was pushed through the diaphragm in full expiration. The interspace between 11th and 12th rib was used in 116 patients (94%) and 10–11th interspace in 7 cases (6%). Working guidewire was inserted after the tip of the needle was inserted in the collecting system. Depending on the absence or presence of hydronephrosis, dilatation was performed by Amplatz facial dilators or telescopic dilation from 8 F to 32 F, with an inserted 30 F or 32 F Amplatz sheath. Safety guidewire is introduced consequently. Using a standard nephroscope (26F), stone lithotripsy was performed with ultrasonic and/or pneumatic lithotripsy. Fluoroscopy and contrast nephrogram were done to evaluate the stone-free status at the end of operation. The nephrostomy site was examined for the presence of active bleeding. The nephrostomy tube-size 24 F was inserted. Before and on the first day of the operation, all patients were tested for complete blood count and any change in the hematocrit level.

Postoperative chest X-ray (CXR) was routinely done in all cases. Symptoms and CXRs were used to evaluate pulmonary complications. If the patients developed chest pain and desaturation in the recovery room and CXR revealed pleural effusion, the chest tube was introduced and fixed immediately. Postoperative KUB at day 1 was done for evaluation of the stone residuals. Postoperative hospital stay ranged from 2 to 7 days (median 2 days). Statistical analysis was done with the SPSS software version 16, and for evaluation of findings, P value less than 0.05 was considered statistically significant.

RESULTS

We evaluated the success rate in our cases. The complete success means access to the renal calyces with removal of all stones, whereas partial success means access to the calyces with retaining of some stones. When access to the calyceal systems was unsuccessful it means failed access. The operative time was 92±37 min. Complete stone-free rate occurred in 110 cases (89.4%) and partial stone-free rate was occurred in 13 cases (10.6%) of whom 10 cases underwent ESWL and 3 cases followed. No case of failed PCNL was seen in our enrolled cases. Total complication rate was occurred in 16 cases (13%). (Table 1) Intraoperative hemorrhage was seen in 7 cases (5.7%), renal parenchymal injury in 5 cases (4.1%), pneumothorax in 3 cases (2.4%), and delayed hemorrhage in 1 case (0.8%). Complete stone-free rate in staghorn was 77.4%, and partial stone-free rate was 22.6%. In stones larger than 2 cm, complete stone-free rate was 93.3%, and partial stone-free rate was 6.7%. In stones less than 2 cm, we had a 100% stone-free rate. (Table 2)

Table 1: Complications of PCNL with supracostal approach

Type of complications	Number of cases	Percent of cases
Perioperative bleeding	7	5.7
Parenchymal injury	5	4.1
Pneumothorax	3	2.4
Late hemorrhage	1	0.8
No complication	107	87

Table 2: Success rate of PCNL on the basis of stone sizes

Stone size	Full success (n)	Partial success (n)
<2cm	17	0
> 2 cm	70	5
Staghorn	24	7

Table 3: Success rate of PCNL on the basis of HDN

Severity of HDN	Full success (n)	Partial success (n)
No	16	3
Mild	18	2
Moderate	54	8
Severe	22	0

Success rate in relation to the stone location was differed. In pelvis or upper ureteral stones, a 100% success rate was seen. In upper calyceal or lower calyceal stones, complete stone-free rate was 89%, and partial stone-free rate was 11%. On the basis of hydronephrosis, we observed a success rate of 100% in severe hydronephrosis. The complete success rate was 84.2%, where no hydronephrosis was present, in mild hydronephrosis 90%, moderate hydronephrosis 87.1%, and severe hydronephrosis 100%. (Table 3) In the situation of hydronephrosis we observed more success rate with more hydronephrosis (P< 0.05).

DISCUSSION

Percutaneous nephrolithotomy is an integral component in the treatment of larger renal calculi, either as monotherapy or in combination with ESWL and it has replaced open stone surgery for large renal or upper ureteral stones as a less invasive technique. Under specific conditions, access to the kidney requires the upper-pole approach. The advantage of upper-pole access for nephrolithotomy is direct access to most of the intrarenal collecting system and upper ureter. Upper-pole access can be achieved either supracostally or subcostally. In the usual method of PCNL, subcostal method, access to the collecting system is from below the 12th rib lateral to the paraspinus muscles. In addition, we have supracostal approach. The indications of supracostal approach are complex staghorns, upper calyceal stones, upper ureteral stones, complex lower calyceal stones, and stones in anatomically unusual kidneys.

Despite high success rates, major concerns in PCNL involve serious complications such as blood loss, organ injuries, and life-threatening infections.[2-5] Stratifying complications of PCNL as major and minor, Lee et al[6] reported major complications including death, bleeding necessitating intervention, and significant infection

in 6% of the patients; and minor complications including postoperative fever, bleeding necessitating transfusion, and prolonged urine drainage from the flank in 50% of patients undergoing PCNL. We observed bleeding as a major complication in 5.7% and minor complications in 10.3%. Comorbidities such as renal insufficiency, diabetes, morbid obesity, or cardiopulmonary diseases increase the risk of complications.[2] There are more complications in supracostal approach due to the presence of important anatomic structures like colon, spleen, and liver in the abdomen and pleura, lungs, intercostal artery, phrenic nerve, and diaphragm in the chest. Bleeding is the most significant complication of PCNL, with transfusion rates varying from less than 1–10%. Bleeding from an Arteriovenous fistulae or pseudoaneurysm requiring emergency embolization is seen in less than 0.5% of patients.[6,7] Most of bleeding is venous in nature, and placement of a nephrostomy tube is usually adequate to control the bleeding.

Clamping the nephrostomy tube for 10 min is helpful in tamponading any persistent bleeding.[8] PCNL can lead to some absorption of irrigation fluid. When a supracostal puncture is performed, extravasation of the irrigant may occur into the pleural cavity. The chest should be examined at the end of PCNL procedures in which a supracostal puncture is used. When supracostal approach is performed, the risk of pneumothorax or pleural effusion requiring drainage is 4–12%.[9,10]

Punctures above the 11th rib result in a tremendously higher intrathoracic complication rate (34.6%) compared with the supra 12th rib access (1.4%).[11] We observed pneumothorax in 2.4% of our cases. These factors corroborate the strategy of avoiding this high approach as much as possible. If the clinical findings suggest either of these complications, placement of a chest tube is mandatory. Immediate aspiration is performed, and the tube is removed within 24 h if indicated. If the hemothorax is extensive, a large chest tube is advisable.

Pardalidis and Smith suggested that in the case of nephrostomy access between the 11th and 12th rib, approximately 10% of patients present with fluid accumulation within the pleural space.[12] In the Lojanapiwat et al[13] study on the 170 cases of supracostal approach, stone-free rate was 82.2%, and hydrothorax was found in 15.3% of cases.

In Sukumar et al[14] study on the 110 cases with supracostal PCNL, overall complication rate was seen in 11.8% and overall stone clearance rate was 86.4%. Our overall complete success rate was 89.4%. Falahatkar et al[15] reported a technique on the 20 cases, in which superior calyx was accessed with subcostal approach synchronous with lung inflation, instead of supracostal approach. Although they reported a stone-free rate of 85% with no pulmonary complication but it needs more cases with a different study design.

CONCLUSION

Based on the literature review, this is the first reported study on the safety and effectiveness of supracostal PCNL from Iran. We found that PCNL with supracostal approach is safe and effective with acceptable complication rate especially if it is performed in its specific situations.

Complications when present may be managed with conservative measures. We advocate its use in centers with good equipment quality and high personal expertise.

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