Role of Percutaneous Ureteroscopic Manipulation for Multiple Calyceal Stones in PCNL for Staghorn Stones

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ABSTRACT

Introduction: Renal staghorn stones are challenging for urologists to ensure maximum stone clearance and minimal morbidity. Percutaneous nephrolithotomy (PCNL) has become the standard gold treatment for renal staghorn stones. To assess the safety and efficacy, percutaneous ureteroscopic manipulation to clear multiple calyceal stones in PCNL for renal staghorn stones. We present our initial experience with this new technique.

Material and methods: We prospectively analysed 50 patients with staghorn stones admitted and underwent PCNL in our institute for over two years. Patients were evaluated clinically, radiologically and with laboratory investigations before subjecting to PCNL. Following standard PCNL, for inaccessible calyceal stones, a ureteroscope was introduced percutaneously through the secondary puncture. The calyceal stones were disintegrated into fragments by pneumatic lithotripsy and pushed into the pelvis; from there, fragments retrieved by a nephroscope. The operating time, stone-free rates (SFR), postoperative haemoglobin drop, complications, length of hospitalisation were recorded.

Results: 0ut of 50 cases in 4 cases, we used this technique and attained complete stone clearance. Our procedural stone-free rate (SFR) improved to 90% from 82% using this technique. There were no complications in these 4 cases except for one patient who needed antibiotic change for fever.

Conclusion: As the second puncture for ureteroscope manipulation was only dilated to 12F, the complications were lesser. This has its unique advantages by increasing procedural stone-free rate (SFR); hence there is less morbidity as it does not require additional staged ancillary procedures.

Keywords: Staghorn Calculi, Ureteroscopy, Percutaneous Nephrolithotomy, Combined Approach

INTRODUCTION

Nephrolithiasis is a common cause of morbidity, with a lifetime prevalence of 5-10%.[1] Moreover, kidney stones are a recurrent disorder, with lifetime recurrence risks reported to be as high as 50%.[2] Percutaneous Nephrolithotomy (PCNL) is an established procedure used primarily to treat patients with renal calculi. It is a relatively safe and less invasive approach than open surgery. Fernstrom and Johansson first described percutaneous nephrolithotomy in 1976. PCNL is a popular, well-established, minimally invasive procedure that is considered the standard treatment for staghorn and large-volume renal calculi (size of more than 2 cm) and upper tract calculi refractory to other modalities, difficult lower pole stones. PCNL is a very safe and well-tolerated procedure, but as with any surgical intervention, it is associated with a specific set of complications2003.[3,4]

Some of the complications seen with PCNL are bleeding, infection, sepsis, injury to the pelvis, renal parenchyma and surrounding viscera like colon, liver and spleen. The most common among these is bleeding. Bleeding can be managed conservatively or by blood transfusion or, in some intractable cases, may require angiographic embolisation or even require a procedure like a nephrectomy to save the patient. Key recommendations to improve reporting of complications include using a standardised system; the Clavien-Dindo grading system was highly recommended.[5]

To improve clearance in staghorn stones with PCNL as monotherapy, urologists have used multiple calyceal punctures with dilatation up to 24F using 20F or a larger nephroscope. Some urologists used miniaturised instruments like in mini PCNL, micro PCNL for left out fragments in the secondary tract to improve clearance. Some used flexible nephroscope through the same tract to reach calyces inaccessible by a rigid nephroscope, improving support. Some used simultaneous RIRS or ancillary procedures like ESWL to improve clearance.

Objectives: To evaluate the efficacy and safety of percutaneous nephrolithotomy (PCNL) for managing staghorn stones and our technique of dealing multiple calyceal stones with percutaneous ureteroscopic manipulation to clear multiple calyceal stones.

MATERIAL AND METHODS

This is a prospective, observational study of 50 cases of staghorn stone who had undergone PCNL over two years.

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Inclusion Criteria are all staghorn stone cases, including partial staghorn stones.

Exclusion Criteria are staghorn stones associated with markedly deformed calyceal anatomy, Presence of urinary sepsis (pyonephrosis), Solitary Kidney, patients with congenital anomalies of kidney, patients with bleeding diathesis, Pregnancy, Paediatric patients (age less than 12 years). All patients underwent routine preoperative work, including complete blood count, coagulation profile, renal function tests, Ultrasound of KUB, and X-ray KUB. The urine culture was done in all cases to make sure urine was sterile before the procedure. All patients had imaging study with CT KUB (without contrast). All percutaneous nephrolithotomy was done with the patient in the prone position. Nephrostomy, if placed, was removed on the 2nd post-operative day (POD), Foleys removed on the 3rd POD. Post-operative pain score was calculated (visual analogue scale), and a change in haemoglobin and serum creatinine was noted. The number of days stayed in the hospital was recorded. All patients underwent X-Ray KUB before discharge. All patients were followed up at 1st week, 2nd week and 3rd week and pain scores were calculated. Post-operative complications noted on their visit to the hospital and treated accordingly. They are graded using a modified clavien score. Any interventions like ancillary procedures for retained fragments, angioembolisation for haematuria noted. The number of days required to return to normal/routine activity was noted. DJ stent removal was done three weeks after surgery.

RESULTS

The mean age for males and females were 40.25 and 36.5, respectively, and the mean age for all the patients was 38.3, with a standard deviation of 1.49. The mean difference between genders was not statistically significant (P = 1.268). Out of 50 patients, 26 means 52 % of the patients were females and 24 means 48% were males. Out of 50 patients, 44% of the patients were lying in the age group of 30-40 years, followed by 22% in the age group of 20-30 years and 40-50 years[Table-1]. There were no pediatric age group patients.

Comorbidities: 6% of patients had diabetes who were all females, while 10% of the males and 6% of females had hypertension; overall, 16% of the patients were hypertensive.

Gender	No (%)	Mean Age	SD	P-Value
Male	24(48%)	40.25	9.3	1.268
Female	26(52%)	36.5	11.56	
Total	50(100%)	38.3	1.49	

Table-1: Age and Gender Distribution

Stone Location	Male	Female	Total
Pelvis	24(48%)	26(36%)	50(100%)
Upper	7(14%)	13(26%)	20(40%)
Middle	10(20%)	11(22%)	21(42%)
Lower	22(44%)	23(46%)	45(90%)

Table-2: Distribution of Stone Location associated with Gender.

Variables	Measures	Gender		P-Value
		Male	Female	
	No.	24	26	
Stone Size(mm)	Mean	30.79	30.96	0.937
	SD	8.15	6.919	
Stone Area(mm)^2	Mean	30.79	30.96	0.88
	SD	8.15	6.919	
No of Punctures	Mean	1.08	1.08	0.935
	SD	0.282	0.272	
Duration(min)	Mean	73.33	74.43	0.876
	SD	22.82	26.75	
Haemoglobin Drop(gm%)	Mean	2.029	1.785	0.213
	SD	0.763	0.584	
Hospital Stay(days)	Mean	4.29	4.31	0.931
	SD	0.55	0.736	
Return to Normal(days)	Mean	8.08	7.92	0.795
	SD	2.2	2.13	
Sr. Creat change (mg/dl)	Mean	0.0613	-0.0669	0.075
	SD	0.213	0.277	

Table-3: Mean Comparison of Various variables associated with Gender

Intervention for Complication	Gender		Total	P-Value
	Male	Female		
None	11(22%)	10(20%)	21(42%)	0.816
Observation	4(8%)	5(10%)	9(18%)	
Antibiotic Change	4(8%)	7(14%)	11(22%)	
Angio embolisation	2(4%)	0(0%)	2(4%)	
Antiemetic	2(4%)	2(4%)	4(8%)	
Blood Transfusion	1(2%)	1(2%)	2(4%)	
URSL under SA	0(0%)	1(2%)	1(2%)	

Table-4: Distribution of Intervention for complications in Gender

Pain Score	Mean ± SD	Min	Max
Day 0	5.32 ± 1.15	3	7
Day 1	4.38 ± 1.26	2	7
Day 2	3.48 ± 1.31	1	6
Day 7	2.14 ± 0.857	1	4
Day 14	1.44 ± 0.644	1	4
Day 21	1.08 ± 0.274	1	2

Table-5: Mean Distribution of Pain Score(Visual Analogue Scale) among the patients.

Complication Score	None	Grade 1	Grade 2	Grade 3	Grade 4	Grade 5
Day 0	28(56%)	21(42%)	1(2%)	0(0%)	0(0%)	0(0%)
Day 1	35(70%)	7(14%)	2(4%)	0(0%)	0(0%)	0(0%)
Day 2	42(84%)	3(6%)	5(10%)	0(0%)	0(0%)	0(0%)
Day 7	49(98%)	0(0%)	1(2%)	0(0%)	0(0%)	0(0%)
Day 14	48(96%)	0(0%)	0(0%)	2(4%)	0(0%)	0(0%)
Day 21	48(96%)	0(0%)	1(2%)	1(2%)	0(0%)	0(0%)

Table-6: Distribution of Complication Score (Modified Clavien Score) among the patients.

In 29 (58%) patients, stones located were on the right side and 21(42%) patients on the left side. Of the 29 right sided stones,11 were males, and 18 were females. Of the 21 left sided stones, 13 were male, and 8 were female[Table-2].

90% of the patients, the staghorn stone has an extension on the lower pole from the pelvis, followed by 42% on to the middle pole, 40% on to the upper pole. So lower pole calyx was our mostly punctured calyx. 86% of the time, we got good clearance, and the rest, 8% gone for a secondary puncture, in the 6% was an upper pole, and 2% was the middle pole. In 4% of the patients, the upper pole selected for a primary puncture, and 2% of patients middle pole selected for primary puncture.96% of the patients puncture site was subcostal, and each 2% of the time puncture site was Intercostal and both(Subcostal and Intercostal).

There was no statistically significant difference in the stone size, stone Area, number of punctures, duration of surgery, haemoglobin drop, hospital stay, return to normal, serum creatinine change in both the genders[Table-3].

Out of 50 patients, there were no complications in 21 (42%); 11 were male, 10 were female. The rest of the patients (58%) experienced some grade of complications that were managed as listed in Table-4.

Mean distribution of Pain Score(Visual Analogue Scale) were 5.32 ± 1.15, 4.38 ± 1.26, 3.48 ± 1.31, 2.14 ± 0.857, 1.44 ± 0.644 and 1.08 ± 0.274 on post operative day 0,1,2,7,14 and 21 respectively[Table-5].

Complications were graded according to Modified Clavien Classification and are listed in Table 6.

DISCUSSION

In the present study, we attained maximum possible clearance through a primary puncture using standard PCNL. Under fluoroscopy, we checked for any retained fragment. The secondary puncture was done for ureterorenoscopy(URS) manipulation for clearance if required. The indications we found for URS manipulation are any calyx not reached by nephroscope through the primary puncture, infundibular angle very acute, narrow, long infundibulum, any calyceal entry that produce a lot of torque on nephroscope and instrumentation is not possible. The requirements for a successful URS manipulation are retained fragment that was well picked on fluoroscopy, an excellent calyceal trans-papillary puncture, able to place a guidewire into PCS. Some of the difficulties we faced are stone puncture not possible, ability to place a guidewire, guidewire pulled out while passing URS percutaneously under fluoroscopy and video monitor guidance, poor vision due to clots inside the system, working with outstretched hands leading to surgeon fatigue. Advantages of URS manipulation are when it is done well, clearance is 100%, the pushback of stone is done under vision, stones can be fragmented into small pieces, and pushback tried. (for bigger stones).

In our study, out of 50 patients, 52 % of patients were females,

and 48% were males. We had patients age ranging from 22 to 65 years. Among them, 44% of the patients were lying in the age group of 30-40 years, followed by 22% in the age group of 20-30 years and 40-50 years. In our study, about 29 (58%) patients located on the right side and 21(42%) were on the left side. About 90% of the time, the staghorn stone had an extension onto the lower pole, followed by 42% onto the middle pole, 40% onto the upper pole. So lower pole calyx was our most often selected calyx for primary puncture and dilatation. 94% of the time, we selected the lower pole for primary puncture. 86% of the time, we got good clearance, and the rest 8% (out of 94%) gone for a secondary puncture; in them, 6% was an upper pole, and 2% was the middle pole. In these 8% cases, URS manipulation was used through the secondary puncture, and a stone-free rate of 100% was achieved in them. 96% of the time, our puncture site was subcostal, and in (2%) 1 patient puncture site was Intercostal that was a primary puncture, and in (2%) 1 patient, both Subcostal and Intercostal punctures were done. The intercostal puncture here was a secondary puncture for URS manipulation. In the present study, in 48 pts (96%), tubeless PCNL. 2 pts had a nephrostomy tube inserted; in one, it was for bleeding, and in another, it was for redo PCNL.

In this study, the mean stone size was 30.88 mm with SD± 7.46, comparable to Kadyan B and et al.[6], which was 39.02±6.27. The mean stone area was 905 mm^2 with SD± 410.86, comparable with Marguet CG and et al.[7], 666mm^2.

In this study, the mean operative time was 73.9 minutes with SD± 24.70, comparable with Kadyan B and et al.[6], which was 71.7±8.53, The mean Drop-in Hb was 1.90 g% with SD± 0.68, which was comparable with Kadyan .B and et al[6] of 1.64±0.59.

The mean Hospital Stay was 4.3 days with SD± 0.64, which was comparable with Kadyan .B and et al[6] of 4.74±1.33. Secondary puncture required in 8% of cases is comparable with Kadyan B and et al.[6] of 13.9%. The Stone free rate following PCNL was 90%, comparable with Alkohlany K and et al.[8], 72.7%. Xu et al.[9] presented a series of patients undergoing staged salvage ureteroscopy after primary single-tract mini-PNL for treatment of patients with a solitary kidney and staghorn calculi. After salvage ureteroscopy, SFR was 83%. The authors justified this strategy in light of the possibly fatal consequences of bleeding complications associated with the number and size of percutaneous access tracts. Similarly, Zeng et al.[10] performed up to two single-tract mini-PNL sessions followed by a salvage ureteroscopy. The SFR after 3 months was 89%.

Out of 50 patients, there were no complications in 21 (42%); 11 were male, 10 were female. The rest of the patients (58%) experienced complications. 9(18%) had grade 1 complications like a fever managed by observation.11(22%) had grade 2 complications like fever managed by antibiotic change. 2(4%) had grade 3b complication that was bleeding not controlled even after conservative measures and blood transfusion, they were taken for angioembolisation. Both of them were males. 4(8%) patients were given anti-emetics for grade 1 complication vomiting. 2(4%) patients had a blood transfusion for grade 2 complication bleeding. Only one patient presented with ureteric colic on the 21st day of follow up that was managed by a URSL (grade 3a).

Complications were graded according to Modified Clavien Classification. On postoperative day 0, 22 patients (44%) experienced complications managed conservatively except for one patient, which required blood transfusion. On postoperative day 1, 15(30%) patients experienced complications managed conservatively except for 4 patients who required blood transfusion. On postoperative day 2, 8 (16%) patients experienced complications that were managed conservatively. On postoperative day 7, only 1 (2%) patient came back with fever that needed antibiotic change. On postoperative day 14, 2 (4%) patients presented with postoperative bleeding with retention of clots, bladder wash was given, and irrigation started. The following day as the bleeding continued, both patients underwent angioembolisation. On postoperative day 21, 48(96%) patients had no complications, and they underwent stent removal. 1 (2%) patient had fever managed with antibiotics and stent removal did the following day. One patient presented with ureteric colic following stent removal. The patient was investigated with CT KUB (as X-ray KUB was normal), which showed 8 mm lower ureteric calculus, and was subjected to URSL under spinal anaesthesia(Grade-3a). There was no solid organ injury, pleural or lung injury. No injuries of the duodenum or colon occurred. No death (Grade 5) of any patient had happened in our study. Study by Landman et al.[11] reported no major complications and 78% complete stone clearance of staghorn stones in 9 patients treated with combined URS and lower pole single-tract PCNL.

CONCLUSION

The key to a successful PCNL is a good transpapillary puncture. The miniaturisation of PCNL instruments made the complications lesser. When these mini PCNL instruments are not available, the routinely used URS can produce similar stone clearance. In addition, future studies should include more centres and more surgeon's experiences with larger sample size.

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