ORIGINAL ARTICLE

OUTCOME OF PERCUTANEOUS NEPHROLITHOTOMY IN RENAL ANOMALIES: SINGLE CENTER EXPERIENCE

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ABSTRACT

Background: PCNL is standard surgical treatment for renal stone > 2.0 cm and stone resistant to Extracorporeal Shock Wave Lithotripsy. This study was conducted to evaluate the outcome of percutaneous nephrolithotomy in renal anomalies.

Methods: This cross sectional study was conducted at The Kidney Center postgraduate training institute Karachi from January 2010 to June 2017, comprised of 60 patients of stone size (median, IQR) 2.75,1.2. Percutaneous nephrolithotomy was done under general anesthesia; intra operative flouroscopy was done for stone clearance. Post-operative x-ray KUB was done to verify the clearance of stone.

Results: Out of the 60 patients, most patients had horseshoe kidney 35 (58.3%) with right sided renal stone and majority of the stones are located in pelvis 37 (61.7%). 48 (80.0%) patients required nephrostomy while only 24 (40%) required Double J Stent insertion. In 42 (70%) patients 100% clearance was achieved and only 20 (33.3%) patients needed secondary procedures. Double J Stent insertion was done in both types of renal abnormality. In case of 100% clearance Double J Stent was inserted in 3 (33.3%) patients with malrotation while 7 (46.7%) horseshoe kidneys required Double J Stent insertion.

Conclusion: Percutaneous nephrolithotomy is a safe treatment option in renal anomalies patients with renal stones.

KEYWORDS: Percutaneous, nephrolithotomy, renal anomalies, horseshoe kidney, malrotation

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INTRODUCTION

Horseshoe kidney is among the most common renal fusion anomalies.[1] It is a mixture of malrotation, ectopia and fusion anomalies.[2] Most of patients with horseshoe kidney remain asymptomatic, few presents with urolithiasis, who necessitate any surgical intervention.[3] 1 in 5 patient with horseshoe kidney have renal stone [1,3,4] due to the fusion anomalies, malrotation and ectopia, Percutaneous Nephrolithotomy (PCNL) in horseshoe kidney is technically demanding and slight alteration in PCNL is required [5,6] .The increased incidence of renal stone in horseshoe kidney is due to urinary stasis [7]. PCNL, Extracorporeal Shock Wave Lithotripsy (ESWL) and Pyelolithotomy are standard treatment options for renal stone [8]. Extracorporeal Shock Wave Lithotripsy (ESWL) is associated with low stone free rate in Horseshoe kidney due to anatomic abnormalities because the stone is fragmented but due to anatomical changes the stone can't be able to pass [9]. Generally the stone clearance rate of Extracorporeal Shock Wave Lithotripsy (ESWL) is around

59%. Retrograde approach is much more difficult and not exercised frequently [9-12]. PCNL is standard surgical treatment for renal stone > 2.0 cm and stone resistant to ESWL [7]. In our study, 60 patients with abnormal kidney underwent PCNL. We are sharing our experience with renal anomalies, which underwent PCNL and their outcomes.

METHODS

Total number of patients in our study who underwent PCNL from 2010 to 2017 was 60. Out of which 35 had horseshoe kidneys and 25 had malrotated kidney. The mean age in our population was 35.7±17.37. Out of 60 patients 44 (73.3%) were male and 16 (26.7%) were female. The Stone Size (median, IQR) was 2.75, 1.2. Before going for PCNL patient's laboratory workup including urine culture, urinalysis, renal function profile, complete blood count uric acid and calcium levels. Radiological evaluations include ultrasound kidney ureter and bladder, X-ray KUB and intravenous pylogram. Prophylactic antibiotic was given to all patients, Patient with a positive urine culture was treated first and after having sterile urine the patient was operated. PCNL was done under standard general anesthesia. 5.0 French ureteric catheter placed retrogradely and retrograde urethrogram done to review the anatomy and stone location, ureteric catheter was fixed with foleys catheter. Patient position changed to prone position and all pressure pads were applied, puncture was done under fluoroscopy guidance. Puncture was done by 18 gauge nephrostomy needle, after urine is aspiration contrast was injected to confirm the puncture placement into the system and guide wire was placed. Tract was dilated through metallic dilator. 26 french phroscope was used and 30 french Amplatz sheath was used. Stone was fragmented with pneumatic lithoclast and stone retrieve by forceps. DJ was placed 24 (40.0%) of patients. After the end of procedure Percutaneous Nephrostomy (PCN) was placed 48 (80.0%) patient which was of 22 french and secured with prolene suture. Normal saline was used as irrigation fluid. Intra operative fluoroscopy was done for stone clearance. Post-operative X-Ray KUB was done to verify the clearance of stone.

Statistical Analysis: Data analyses were perform by using software IBM SPSS license version 21. Cleaning and coding of the data will be done prior to analysis. Descriptive analysis of variables was presented in form of frequencies and percentages. Cross tabulation were done for renal anomalies with different variables.

RESULT

IWe have included total 60 patients in our study in which 44 (73.3%) were male and 16 (26.7%) were female. Mean age was 36 with standard deviation of 17, minimum was 2 years and maximum was 73 years.

The clinical parameters of patients with abnormal kidneys are described in Table 1, which shows that most patients had horseshoe kidney 35 (58.3%) with right sided renal stone 35 (58.3%) and majority of stones were located in pelvis 37 (61.7%). 48 (80.0%) patients needed nephrostomy while only 24 (40%) required DJ insertion. In 42 (70%) patients 100% clearance was achieved and only 20 (33.3%) patients needed secondary procedures (Table 1).

Table 1: The clinical parameters of patients with abnormal kidneys

Demographic and clinical parameters		*n* with (%)
Gender	Male	44 (73.3)
	Female	16 (26.7)
Age (mean±std)		35.7±17.37
Renal Abnormality	Malrotation	25 (41.7)
	Horseshoe	35 (58.3)
Stone Side	Right	35 (58.3)
	Left	25 (41.7)
Stone Size (median, IQR)		2.75, 1.2
Number of Tract	Single	53 (88.3)
	Double	7 (11.7)
Stone Location	Upper Pole	2 (3.3)
	Lower Pole	4 (6.7)
	Pelvis	37 (61.7)
	Pelvis & Upper Pole	6 (10.0)
	Pelvis & Lower Pole	11 (18.3)
Puncture Type	Upper Pole	34 (56.7)
	Lower Pole	19 (31.7)
	Upper & Lower Pole	7 (11.7)
Amplatz Size	22	5 (8.3)
	26	19 (31.7)
	30	36 (60.0)
Nephrestomy	No	12 (20.0)
	Yes	48 (80.0)
DJ Insertion	No	36 (60.0)
	Yes	24 (40.0)
Clearance	100%	42 (70.0)
	<100%	18 (30.0)
Post-Operative Complication	No	48 (80.0)
	Hematuria	7 (11.7)
	Leakage	1 (1.7)
	Pleural Effusion	2 (3.3)
	Sepsis	1 (1.7)
	Fever	1 (1.7)
Secondary Procedure	No	40 (66.7)
	ESWL	15 (25.0)
	URS	0 (0.0)
	Chest Intibution	2 (3.3)
	ESWL & URS	3 (5.0)

IQR:Interquartile Range; DJ: Double J Stent; ESWL: Extracorporeal Shock Wave Lithotripsy; URS: Ureteroscopy

OWe did cross tabulation of renal abnormality with different variables and found that most of stones were located in pelvis in malrotated kidney 19 (70%)

as well as in horseshoe kidney 18 (51.4%). In malrotated kidney, lower pole was punctured more frequently (14.56%) while in horseshoe kidney, upper pole was puncture in majority 24 (65.6%).

In both abnormalities, nephrostomy was done in most of the cases.

Almost same numbers of patients need DJ insertion in both types of renal abnormality (16 in malrotation and 20 in horseshoe). Similarly there was equal rate of clearance in the two types (68% in malrotation and 71.4% in horseshoe) only 5 (20%) patients with malrotated kidneys required ESWL while 10 (28.6%) of horseshoe kidneys needed ESWL. Pre and post Hemoglobin was not statistically different in both malrotated and horseshoe kidneys (p value > 0.05). The median drop in hemoglobin in malrotated kidneys is 1.7 (IQR 1.25) while in horseshoe it was 1.2 (IQR 1.7) (Table 2).

growth of any organisms. Other diagnostic tests such as sputum gram staining indicated the presence of Gram negative rods and Gram positive cocci in 36.6% of all cases. The Acid Fast Bacilli (AFB) smear test was positive in 22% of the 41 cases. Sputum for routine culture and sensitivity (C/S) was done and Pseudomonas Aeruginosa was found to be the most common organism (in 29.3% of all cases).

When the presenting symptoms of all the cases were taken into consideration, 90.2% of the patients presented with productive cough and 82.9% of all patients also presented with fever.

A radiological investigation of all the cases revealed that bilateral lung involvement was common and the most common site of involvement of a lung abscess is the lower lobe of the right lung. An assessment of predisposing factors showed that poor oral hygiene was a possible common cause. Some history of smoking (past or current) and a history of alcoholism have also been correlated with the formation of lung abscess. An investigation of chronic diseases revealed that from the 41 patients assessed, Diabetes and tuberculosis were common while sinusitis, Pneumonia and a history of malignancy were also associated with lung abscess patient.

Table: 2. Pre and post Hemoglobin in both malrotated and horseshoe kidneys

Variables		Renal Abnormality	
		Malrotation	Horseshoe
		n with (%)	*n* with (%)
Stone Location	Upper Pole	2 (8.0)	0 (0.0)
	Lower Pole	3 (12.0)	1 (2.9)
	Pelvis	19 (76.0)	18 (51.4)
	Pelvis & Upper Pole	0 (0.0)	6 (17.1)
	Pelvis & Lower Pole	1 (4.0)	10 (28.6)
Puncture Type	Upper Pole	10 (40.0)	24 (68.6)
	Lower Pole	14 (56.0)	5 (14.3)
	Upper & Lower Pole	1 (4.0)	6 (17.1)
Nephrostomy	No	7 (28.0)	5 (14.3)
	Yes	18 (72.0)	30 (85.7)
DJ Insertion	No	16 (64.0)	20 (57.1)
	Yes	9 (36.0)	15 (42.9)
Clearance	100%	17 (68.0)	25 (71.4)
	<100%	8 (32.0)	10 (28.6)
Secondary Procedure	No	16 (64.0)	24 (68.6)
	ESWL	5 (20.0)	10 (28.6)
	URS	0 (0.0)	0 (0.0)
	Chest Intibution	2 (8.0)	0 (0.0)
	ESWL & URS	2 (8.0)	1 (2.9)
Pre and post-operative difference in HB(median,IQR)		1.7,1.25	1.2,1.7

IQR: Interquartile range; DJ: Double J Stent; ESWL: Extracorporeal Shock Wave Lithotripsy

We observed stone clearance with need of DJ insertion in respect of renal abnormalities and found that among the malrotated kidneys, 8 patients had clearance of < 100% in which 6 needed DJ insertion while in patients with horseshoe kidneys total of 10 patients had < 100% clearance among them 8 required DJ insertion.

On the other hand, in case of 100% clearance DJ was inserted in 3 (33.3%) patients with malrotation while 7 (46.7%) horseshoe kidneys required DJ insertion (Table 3).

Table 3: Double J Stent insertions with malrotation and horseshoe kidneys

Table 3: DJ Insertion * Clearance * Renal Abnormality Cross Tabulation					
Renal Abnormality	DJ Insertion		Clearance		Total
			100% *n* with (%)	<100% *n* with (%)	
Malrotation	DJ Insertion	No	14 (87.5)	2 (12.5)	16 (100.0)
		Yes	3 (33.3)	6 (66.7)	9 (100.0)
	Total		17 (68.0)	8 (32.0)	25 (100.0)
Horseshoe	DJ Insertion	No	18 (90.0)	2 (10.0)	20 (100.0)
		Yes	7 (46.7)	8 (53.3)	15 (100.0)
	Total		25 (71.4)	10 (28.6)	35 (100.0)

DJ: Double J Stent

DISCUSSION

The horseshoe kidneys are well known and common urological anomalies. Morgagni reported first case of horseshoe kidneys in 1828. Incidence of horseshoe kidneys is 1 to 4 in 1,000 cases with male to female ratio 2 to 3: 1[8]. Combination of malrotation, ectopia and fusion of the lower pole is seen in horseshoe kidneys.[2] Due to merging of the lower pole metanephricblastema at isthmus prevents migration of kidney to the normal position and kidney lies lower than the normal position.[9] Due to combination of malrotation, ectopia and fusion of lower pole results in multiple renal arteries and deviant vessels.[8] Arteries in a horseshoe kidney are of three type ,distal aorta, bifurcation of aorta and common iliac give rise to accessory arteries, other is aberrant that arises from the renal artery, aorta, bifurcation of aorta, common iliac ,middle sacral artery and normal renal arteries The diameter of arteries in horseshoe kidney are relatively smaller as compare to the normal kidney ,the vessels are found on the ventral surface of the kidney with exemption of the arteries of the isthmus. In Horseshoe kidney the anterior lying calices are angulated dorsomedially whereas the ventral lying calices are angulated dorsolaterally kidney which leads to pelvis lying in more ventral position [13]. Association of high ureter in horseshoe kidney leads to urinary stasis, stone formation and urinary tract infection.[2,10].Horseshoe kidney have association with anomalies of other organs like cardiovascular system, central nervous system, anorectal malformation and skeletal abnormalities [13]. There are number of treatment option for urolithiasis ESWL, Ureteroscopy (URS), PCNL and open/laparoscopic pyelolithotomy.[8]The short coming ESWL is due to the location of the kidney which leads to difficult to target the stone and lower calcies is not a suitable option for Extracorporeal shock wave lithotripsy (ESWL) due to overlying of bone and difficult stone passage per ureter.[11, 12] This leads to unsatisfactory outcome of ESWL and need for secondary procedure. PCNL is treatment of choice for large stone and upper ureteric stone in horseshoe kidney requiring minor alteration to standard technique.[12,13]For PCNL the prime feature which discriminate from the normal kidney are the blood supply and the alignment of the calyceal system [14].Upper pole puncture is suitable option for PCNL in horseshoe kidney with better access to pelvi-calyceal system and decreased chances of bleeding due to less torque.1In Case of a vertical puncture it is troublesome to visualize the dilatation of the tract under fluoroscopy .Due to the abnormal position and malrotation sometimes it requires an extra-long Amplatz sheath and nephroscope. Regardless of the Abnormal anatomy almost all of the vascular supplies are situated on the ventral aspect of the kidney with an exception from the isthmus and the isthmus is protected by the spine and is far away from the nephrostomy tract. Upper pole puncture allows the excess to the upper calices, lower calices, renal pelvis and upper ureter [13].Incidence of hydrothorax and pneumothorax is low due to lower placement of kidney.[1]

It is suggested to do the CT scan before going for the procedure to review the anatomy , stone location, radiolucent stone and to see the position of colon [13, 15]. The stone free rate have increased with the introduction of flexible nephroscope. The study suggests the stone free rate of around 84% in case with flexible nephroscope[13, 16].

Mosavi-Bahar et al. describe their experience of PCNL in renal anomalies with sample size of 16 patients (7 horse shoe, 5 malrotated, 3 ectopic and 1 small kidneys). In contrast our study has a larger sample size.

Shokeir et al. have a sample size of 34 patients with greater hospital stay as compare to our study we didn't experience any bowel injury as reported by different studies. In comparison to previous studies 11.7% of our patient underwent double puncture out of which 17% of the total were in horseshoe kidney. No patient undergoes secondary PCNL. Secondary procedure was mostly ESWL for the residual stone done in 25% of the patient. Limitation of our study was that we didn't use CT scan post operatively for the actual visualization of stone as mentioned in other studies but x-ray and ultrasound combine have the sensitivity of 65-95% as presented by other studies. The sample size doesn't represent specific renal anomalies specifications. It is retrospective study and helps the future prospective study which will yield more conclusive result.

CONCLUSION

PCNL in renal anomalies appears to be a safe and effective approach of treatment for large renal calculi with no increase in complication found and revealing good results.

REFERENCES

1. Raj GV, Auge BK, Weizer AZ, Denstedt JD, Watterson JD, Beiko DT, et al. Percutaneous management of calculi within horseshoe kidneys. J Urol 2003;170(1):48- 51.
2. Ryan JM, Murphy BL, Lee MJ, Boland GW, Mueller PR. Percutaneous ultrasonic lithotripsy in a patient with horseshoe kidney. AJR. American journal of roentgenology. 1997;169(2):447-51.
3. Evans WP, Resnick MI. Horseshoe kidney and urolithiasis. J Urol. 1981;125(5):620-1.
4. Pitts WR, Muecke EC. Horseshoe kidneys: a 40-year experience. J Urol 1975;113(6):743-6.
5. Yohannes P, Smith AD. The endourological management of complications associated with horseshoe kidney. J Urol 2002;168(1):5-8.
6. Gallucci M, Vincenzoni A, Schettini M, Fortunato P, Cassanelli A, Zaccara A. Extracorporeal shock wave lithotripsy in ureteral and kidney malformations. Urol Int 2001;66(2):61-5.
7. Gupta NP, Mishra S, Seth A, Anand A. Percutaneous nephrolithotomy in abnormal kidneys: single-center experience. Urology 2009;73(4):710-4.
8. Al-Otaibi K, Hosking DH. Percutaneous stone removal in horseshoe kidneys. J Urol 1999;162(3):674-7.
9. Kirkali Z, Esen AA, Mungan MU. Effectiveness of extracorporeal shockwave lithotripsy in the management of stone-bearing horseshoe kidneys. J Endourol 1996;10(1):13-5.
10. Lampel A, Hohenfellner M, Schultz-Lampel D, Lazica M, Bohnen K, Thüroff JW. Urolithiasis in horseshoe kidneys: therapeutic management. Urology 1996;47(2):182-6.
11. Smith JE, Van Arsdalen KN, Hanno PM, Pollack HM. Extracorporeal shock wave lithotripsy treatment of calculi in horseshoe kidneys. J Urol 1989;142(3):683-6.
12. Esuvaranathan K, Tan EC, Tung KH, Foo KT. Stones in horseshoe kidneys: results of treatment by extracorporeal shock wave lithotripsy and endourology. J Urol 1991;146(5):1213-5.
13. DJ, Wickham JE, Kellett MJ. Percutaneous nephrolithotomy for calculi in horseshoe kidneys. J Urol 1991;145(3):481-3.
14. Baskin LS, Floth A, Stoller ML. The horseshoe kidney: therapeutic considerations with urolithiasis. J Endourol 1989;3(1):51-8.
15. Serrate R, Regue R, Prats J, Rius G. ESWL as the treatment for lithiasis in horseshoe kidney. Eur Urol 1991;20:122-5.
16. Lojanapiwat B. Percutaneous nephrolithotomy (PCNL) in kidneys with fusion and rotation anomalies. J Med Assoc Thai 2005;88(10):1426.
17. El-Kenawy MR, El-Kappany HA, El-Diasty TA, Ghoneim MA. Percutaneous nephrolithotripsy for renal stones in over 1000 patients. Brit J Urol 1992;69(5):470-5.
18. Barbaric ZL. Percutaneous nephrostomy for urinary tract obstruction. Am J Roentgenol 1984;143(4):803-9.
19. Mosavi-Bahar SH, Amirzargar MA, Rahnavardi M, Moghaddam SM, Babbolhavaeji H, Amirhasani S. Percutaneous nephrolithotomy in patients with kidney malformations. J Endourol 2007;21(5):520-4.
20. Shokeir AA, El-Nahas AR, Shoma AM, Eraky I, El-Kenawy M, Mokhtar A, El-Kappany H. Percutaneous nephrolithotomy in treatment of large stones within horseshoe kidneys. Urology 2004;64(3):426-9.