

Percutaneous nephrolithotomy in patients with a solitary kidney

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Summary *Material and method: The results of percutaneous nephrolithotomy applied to 716 patients in our clinic between January 2008 and January 2014 were retrospectively evaluated.*

Age, gender, urinary calculi size (mm²), urinary calculi localization, ESWL history, operation duration (min), fluoroscopy duration (sec), access type, reason of solitary kidney, hemoglobin drawdown (g/dl) and operation success of the patients with a solitary kidney were recorded. The patients having no preoperative and postoperative non contrast abdominal tomography were excluded from the study.

Results: Fifteen of nineteen patients (79%) were men and 4 of them (21%) were women. The average age of the patients was 42.52 ± 16.72 (14-72). Ten patients had anatomical solitary kidney and nine patients had physiological solitary kidney. In fact counter kidney was non functional in 9 patients (47%) whereas there was agenesis in 2 (11%) and outcome of nephrectomy in 8 (42%) patients. In our study, presence of residual stone less than 4 mm at 1st month postoperative non contrast abdominal tomography was accepted as a successful result and accordingly our success rate was detected as 84%.

Mean urinary calculi size was 405 ± 252.9 mm²; urinary calculi localization was pelvic, lower pole, upper-middle pole, middle-lower pole and staghorn in 11 (58%), 4 (21%), 1 (5%), 1 (5%) and 1 (5%) patients, respectively; previous ESWL history was 16%; operation duration was 55.47 ± 28.1 min and fluoroscopy duration 131.10 ± 87.6 sec; access type was subcostal in 79%, supracostal in 10.5% and multiple in 10.5%; hemoglobin drawdown was 1.75 ± 0.97 mg/dl.

Conclusions: PNL can be effectively and safely administered for the treatment of solitary kidney. In the treatment of large urinary calculi in patients with a solitary kidney, PNL has some advantages such as short surgery duration, less complication, acceptable hemoglobin drawdown and high success rates. According to our study, PNL operation in patients with a solitary kidney is a good option for carefully and poisedly selected cases.

KEY WORDS: Percutaneous nephrolithotomy; Solitary kidney; Urinary calculi.

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INTRODUCTION

Urinary tract calculus disease continues to be a major health problem in our country. In a study conducted in 2011, calculus prevalence was determined as 11.1% and it was emphasized that our country has been among endemic countries (1). It was stated that 2.2% of general population was treated due to urinary tract calculus disease and 16% of them had more than one procedure (2). Percutaneous nephrolithotomy (PNL) in the treatment of urinary calculi was firstly described by Fernström and Johansson in 1976 (3). Since it was first developed, PNL procedure has been refined by means of improvements of optical system, endo-camera, lithotripsy energy systems, design of the nephroscope and advances in its accessories. As a result of all these improvements, need for open surgery in current urology practice is decreased to 0.7-4% and PNL has replaced it as first choice in the treatment of large urinary calculi (4).

In this study, we retrospectively examined the patients with a solitary kidney who underwent PNL operation and we evaluated the results of the treatment.

MATERIAL AND METHODS

The results of percutaneous nephrolithotomy applied to 716 patients in our clinic between January 2008 and January 2014 were retrospectively evaluated. Nineteen patients with a solitary kidney were included in the study. In our clinic, preoperative complete blood count, biochemical tests, including urea and creatinine levels, and urine culture are carried out for all patients who are planned to be treated with PNL. The patients were informed about operation and informed consent was obtained. One hour before the operation, antibiotic prophylaxis was carried out via parenteral administration of second generation cephalosporin. Age, gender, urinary calculi size (mm²), urinary calculi localization, extracorporeal shock wave lithotripsy (ESWL) history, operation duration (min), fluoroscopy duration (sec), access type, reason of solitary kidney, hemoglobin drawdown (mg/dl) and operation success of the patients with a solitary kidney were recorded. The patients having no preoperative and postoperative non contrast abdominal tomography were excluded from the study.

In lithotomy position, a 5 F open-end catheter was inserted in the ureter via a 22 F cystoscope under general anesthesia and set to a Foley catheter by a silk suture. Then, prone position was given to the patient. Collecting system was visualized with fluoroscopy by injection of opaque contrast through the ureteral catheter.

Percutaneous needle access to the urinary tract was obtained by bi-planar planning of the access site. Tract was dilated with Amplatz dilators over guide wire and a 30 F Amplatz sheath was placed. Kidney collecting system was entered by a 22 F rigid nephroscope. Ultrasonic lithotripter was preferred for lithotripsy and pneumatic lithotripter was used when necessary.

After evaluation of the last fluoroscopy images, a 14 F Malecot nephrostomy catheter was placed and the operation was completed. All patients were followed up with non contrast abdominal tomography one month after operation.

RESULTS

Fifteen of nineteen patients (79%) were men and 4 of them (21%) were women.

The average age of the patients was 42.52 ± 16.72 (14-72). Ten patients had anatomical solitary kidney and 9 patients had physiological solitary kidney. In fact counter kidney was non functional in 9 patients (47%) whereas there was agenesis in 2 (11%) and outcome of

nephrectomy in 8 (42%) patients. There was no previous history of surgery of the solitary kidney in all the patients. ESWL was administered to three patients (16%) but it was not successful.

Stones location was pelvic, lower pole, upper-middle pole, middle-lower pole and staghorn in 11 (58%), 4 (21%), 1 (5%), 1 (5%) and 1 (5%) patients, respectively. Average stone size was 405 ± 252.9 mm² (100-1050). Subcostal lower calyx access was performed in 15 of 19 patients (79%). Intercostal upper pole access was carried out in two patients (10.5%) and multiple intercostal and subcostal accesses were required in two patients (10.5%). Average operation duration was 55.47 ± 28.1 (21-139) minutes and average duration of fluoroscopy use was 131.10 ± 87.6 (35-351) seconds. Average decrease in hemoglobin level of patients was 1.75 ± 0.97 (0.3-4.4) g/dl in postoperative period, but blood transfusion was not required.

Three patients developed fever in postoperative period. No further complication developed. At follow-up of the patients, residual stones were detected in 4 patients (21%) at non contrast abdominal tomography one month after operation.

Three of these (75%) were larger than 4 mm and 1% (25%) was less than 4 mm.

Presence of residual stones less than 4 mm was considered as a successful result and therefore our success rate was estimated as 84%.

Table 1.

Characteristics and clinical outcome of percutaneous nephrolithotomy in patients with a solitary kidney.

No	Age	Gender	Stone-size (mm ²)	Stone location	ESWL history	Operation time(min)	Skope time(sec)	Approach time	Why soliter	Decrease of hemoglobine	Operation succes
1	43	M	625	Pelvis	No	67	94	Subcostal	Nonfunctional	1.4	Residue (more than 4 mm)
2	53	M	277	Upper middle Pole	No	90	222	Multiple access	Nonfunctional	3.7	Stonefree
3	20	M	625	Pelvis	No	55	141	Subcostal	Nonfunctional	0.9	Stonefree
4	66	M	280	Pelvis	No	28	82	Subcostal	Nonfunctional	0.5	Stonefree
5	21	M	256	Middle-lower Pole	No	56	86	Subcostal	Nephrectomy	1.2	Stonefree
6	39	F	280	Pelvis	Yes	60	89	Subcostal	Nonfunctional	1,7	Stonefree
7	45	M	900	Pelvis	No	60	354	Subcostal	Nonfunctional	2	Stonefree
8	65	M	500	Pelvis	No	60	138	Subcostal	Nonfunctional	0,7	Stonefree
9	38	M	350	Pelvis	No	60	53	Subcostal	Nonfunctional	1,2	Residue (more than 4 mm)
10	19	F	130	Lower Pole	No	64	105	Subcostal	Agenesis	0,3	Stonefree
11	33	M	300	Pelvis	Yes	77	96	Subcostal	Nephrectomy	2,8	Residue (less than 4 mm)
12	55	M	175	Middle Pole	No	30	139	Intercostal	Nephrectomy	1,9	Stonefree
13	43	M	250	Pelvis	No	65	140	Intercostal	Nonfunctional	1,6	Stonefree
14	72	F	1050	Staghorn	No	139	340	Multiple access	Nephrectomy	4.4	Residue (more than 4 mm)
15	41	M	350	Lower Pole	No	25	45	Subcostal	Nephrectomy	1,8	Stonefree
16	38	M	297	Lower Pole	No	40	150	Subcostal	Nephrectomy	1,2	Stonefree
17	44	M	100	Lower Pole	Yes	21	93	Subcostal	Nephrectomy	2	Stonefree
18	59	M	600	Pelvis	No	27	31	Subcostal	Agenesis	1,5	Stonefree
19	14	F	300	Pelvis	No	30	93	Subcostal	Nephrectomy	1,5	Stonefree

DISCUSSION

The main aim of PNL is to clear more calculi with the least morbidity. Although PNL is accepted as a minimal invasive treatment method, severe complications such as bleeding requiring transfusion, internal organ injuries, hydrothorax and sepsis can occur. Nephrectomy may be necessary due to uncontrollable bleeding. This event in a patient with solitary kidney involve that the patient will become anephric. A multi-center study of complications occurring after PNL was coordinated by the CROES (*Clinical Research Office of the Endourological Society*).

The Global PNL Study Group published it in 2011 reporting that general complication rate of PNL was 25% (1175/5724); 80% of these were minor and 20% major complications and the most common complications were fever and bleeding (5, 6).

Some studies showed that access to calyceal system can lead to a decrease in hemoglobin levels (2.1-3.3 g/dl.) (7). Bleeding after PNL can be prevented by clamping the nephrostomy tube. When bleeding cannot be stopped, selective arterial occlusion may be required (8, 9). Staghorn and large calculi, obesity, prolonged operation time and absence of hydronephrosis were reported as the risk factors causing excessive bleeding during PNL (10). In our study, average decrease in hemoglobin levels in postoperative period was 1.75 g/dl. In the treatment of staghorn calculi, more severe bleeding can occur due to need for multiple access (11). In fact the patient with staghorn calculus and multiple accesses was the patient with the most severe bleeding which caused a < 4.4 g/dl decrease in the hemoglobin level.

It was stated that 28.7% of the patients with negative preoperative urine culture who had prophylactic antibiotic therapy developed fever after PNL and that urgent bacteriological evaluation was not necessary if hemodynamic stability was balanced in patients with negative preoperative urine culture who had fever higher than 38.5°C and started to receive prophylactic antibiotic therapy (12). In our series, 3 of 19 patients (15%) developed fever after PNL, however none of them had sepsis. Pulmonary complications after PNL are usually seen in case of supracostal access. It was stated that pneumothorax and hydrothorax rate after PNL was about 6-12% (6). Four patients needed supracostal access in our study, but we did not face with any pulmonary complication.

Success rate after PNL ranges between 40% and 90% depending on number of stones, location, chemical structure and experience of the surgeon (12). Escape of the calculus or of its fragments to an unapproachable calyx and termination of operation due to bleeding or prolonged time can be the reasons for not providing a complete calculus clearance in PNL. Residual calculus fragments imply postoperative risks such as pain, urinary infection, calculus enlargement, obstruction and need for secondary surgery to patient. Therefore, it is quite important to obtain a stone-free status after PNL and non-contrast abdominal tomography was recommended for evaluation of stone-free situation (13). In our study, our success rate was estimated as 84% at first month postoperative control.

Modern treatment of upper urinary tract calculi of solitary kidneys includes mini-invasive techniques as ESWL,

PNL and *retrograde intrarenal surgery* (RIRS). In solitary kidney calculi, the results of ESWL treatment are promising and it was stated that ESWL was a safe and feasible method with low complications rates in the patients having only one kidney (14). Efficiency of ESWL was reported as 92% for kidney calculi smaller than 10 mm, 59-89% for 10-20 mm calculi and 39-70% for calculi larger than 20 mm (15). RIRS is a good option to remove kidney calculus in the patients having one kidney due to its high success and low morbidity rates. However, more than one procedure can be required for the patients having large urinary calculi (16, 17). Yet, there are limiting factors such as that RIRS is not available everywhere, operation duration is relatively longer, requires experience and is more suitable for 1.5-2 cm calculi.

Although PNL is today accepted as a safe and minimal invasive treatment method for treatment of urinary calculi, it is recommended that it should be always administered in high case-volume centers and by expert urologists in the patients with solitary kidney because of the risk of causing an anephric condition in case of severe complications (18). In the literature, success rates of PNL and its complications in the patients with a solitary kidney were reported in the range of acceptable levels (19, 20).

CONCLUSIONS

PNL can be effectively and safely administered for the treatment of solitary kidney. In the treatment of large urinary calculi in patients with a solitary kidney, PNL has some advantages such as short surgery duration, less complication, acceptable hemoglobin drawdown and high success rates. According to our study, PNL operation in patients with a solitary kidney is a good option for carefully and poisedly selected cases.

REFERENCES

1. Muslumanoglu AY, Binbay M, Yuruk E, et al. Updated epidemiologic study of urolithiasis in Turkey. I: Changing characteristics of urolithiasis. *Urol Res.* 2011; 39:309-14.
2. Akinci M, Esen T, Tellaloglu S. Urinary stone disease in Turkey: an updated epidemiological study. *Eur Urol.* 1991; 20:200-3.
3. Fernstrom I, Johansson B. Percutaneous pyelolithotomy. A new extraction technique. *Scand J Urol Nephrol.* 1976; 10:257-9.
4. Matlaga BR, Assimos DG. Changing indications of open stone surgery. *Urology.* 2002; 59:490-4.
5. Labate G, Modi P, Timoney A, et al. On Behalf Of The Croes Pcnl Study Group. The percutaneous nephrolithotomy global study: classification of complications. *J Endourol.* 2011; 25:1275-80.
6. Türk C, Knoll T, Petrik A, et al. Guidelines on Urolithiasis. *European Association of Urology* 2013.
7. Kessaris DN, Bellman GC, Pardalidis NP. Management of hemorrhage after percutaneous renal surgery. *J Urol.* 1995; 153:604-8.
8. Bedir S, Bozlar U, Tahmaz L, et al. Severe uncontrolled delayed bleeding after percutaneous nephrolithotomy. *24th World Congress of Endourology, August 17-20, Cleveland, Ohio, USA, 2006.*
9. Keoghan SR, Cetti RJ, Rogers AE, Walmsley BH. Blood transfu-

sion, embolisation and nephrectomy after percutaneous nephrolithotomy (PCNL). *BJU Int.* 2013; 111:628-32.

10. Nouralizadeh A, Ziaee SA, Hosseini Sharifi SH, et al. Delayed post percutaneous nephrolithotomy hemorrhage: Prevalance, predictive factors and management. *Scand J Urol.* 2013; 21.

11. Martin X, Tajra LC, Gelet A, et al. Complete staghorn stones: percutaneous approach using one or multiple percutaneous accesses. *J Endourol.* 1999; 13:367-8.

12. Cadeddu Ja, Chen R, Bishoff J, et al. Clinical significance of fever after percutaneous nephrolithotomy. *Urology.* 1998; 52:48.

13. Park J, Hong B, Park T, Park HK. Effectiveness of noncontrast CT. In evaluation of residual stones after percutaneous nephrolithotomy. *J Endourol.* 2007; 21:684-7.

14. Graff J, Diederichs W, Schulze H. Long term follow-up in 1003 extracorporeal shock wave lithotripsy patients. *J Urol.* 1988; 140:479-83.

15. Penn HA, DeMarco RT, Sherman AK, et al. Extracorporeal

shock wave lithotripsy for renal calculi. *J Urol.* 2009; 182 (4 Suppl):1824-7.

16. Giusti G, Proietti S, Cindolo L, et al. Is retrograde intrarenal surgery a viable treatment option for renal stones in patients with solitary kidney?. *World J Urol.* 2014; 1-6.

17. Palmero JL, Castello A, Miralles J, et al. Results of retrograde intrarenal surgery in the treatment of renal stones greater than 2cm. *Actas Urológicas Españolas.* 2014; 38:257-262.

18. Mahboub DMR, Shakibi MH. Percutaneous nephrolithotomy in patients with solitary kidney. *Urology journal.* 2009; 5:24-27.

19. Akman T, Binbay M, Tekinarslan E, et al. Outcomes of percutaneous nephrolithotomy in patients with solitary kidneys: a single-center experience. *Urology.* 2011; 78:272-276.

20. Bucuras V, Gopalakrishnam G, Wolf JS, et al. The clinical research office of the endourological society percutaneous nephrolithotomy global study: nephrolithotomy in 189 patients with solitary kidneys. *J Endourol.* 2012; 26:336-341.

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