

TREATMENT OF RENAL STONES WITH PERCUTANEOUS NEPHROLITHOTOMY IMPROVES RENAL FUNCTIONS IN CHRONIC KIDNEY DISEASE PATIENTS

Ekrem Akdeniz^{*,1}, Mustafa Bolat* and Necmettin Sahinkaya*

*Samsun Training and Research Hospital, Department of Urology, Samsun, Turkey

ABSTRACT

Objective: In this study, we aimed to investigate the impact of percutaneous nephrolithotomy on kidney functions in stage III or higher chronic renal failure patients using glomerular filtration rate and serum creatinine level. **Methods:** Between 2010 and 2014, percutaneous nephrolithotomy was applied to patients who had glomerular filtration rate below 60 mL/min/1.73m². Preoperative demographic features, stone burden, and localization, urine analysis and microbial test, serum creatinine level, open urinary system graphy, and spiral non-enhanced computerized tomography were obtained. Intraoperative renal unit counts, anesthesia and surgery time, and X-ray exposure time were calculated. Early and late postoperative complications, hospitalization time, stone-free rate, and glomerular function rate were evaluated, retrospectively. **Results:** Preoperatively, mean creatinine value was 2.42 ± 0.76 mg/dL, mean glomerular filtration rate was 45.3 ± 3 mL/min/1.73 m², the mean stone burden was 393 ± 40 mm², mean intervention time was 79 ± 34 min, and 12 patients were stone free (70.5%). The decrease of hemoglobin 1.6 g/dL and transfusion was done only two patients (11.8%) due to excessive bleeding. In early and long-term follow-up, mean creatinine values and glomerular filtration rate were 1.98 ± 0.72 mg/dL, 2.16 ± 0.78 mL/dL and 54.1 ± 14 mL/min/1.73 m², 51.8 ± 15 mL/min/1.73 m², respectively. Comparison of preoperative and postoperative creatinine and glomerular filtration rates revealed a significant decrease in creatinine level and increase in glomerular filtration rate. **Conclusion:** Percutaneous nephrolithotomy that eliminates urinary obstruction is safely used in the treatment of kidney stones with minimal damage on kidney functions. Stage III or higher renal failure patients who have obstructive kidney stones or recurrent urinary tract infections can effectively be treated, and this may help patients to prevent progression to end-stage renal failure.

KEYWORDS: Percutaneous nephrolithotomy, renal failure, renal stone

Introduction

The risk of urinary system stone disease depends on geographical climate, ethnic background, diet, and genetic factors. Although the prevalence of urinary stones in population is between

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DOI:10.5455/ijsm.urology02

First Received: October 13, 2015

Accepted: November 04, 2015

Manuscript Associate Editor: George Baitchev (BG)

Editor-in Chief: Ivan Inkov (BG)

Reviewers: Fikret Erdemir (TR); Mustafa Temiz (TR); Megan Schober (US); Karim Saad (EG); Rajan Sinha (IN)

¹Ekrem Akdeniz, Samsun Training and Research Hospital, Department of Urology, Samsun, Turkey

Email:ekremakdeniz@yahoo.com

1.7-14.8% and its prevalence has been rising recently [1]. Renal stones may lead to varying degrees of Renal Failure (RF) by causing urinary stasis and chronic infections [2]. The rate of end-stage renal disease development is between 0.2-3.2% [3]. Although it is not clearly demonstrated, it is believed that there is a strong relation between renal stone disease and RF [4]. According to the EAU 2015 guideline, percutaneous nephrolithotomy (PNL) is the standard surgical treatment for large renal stones [5]. In cases with RF and co-morbid renal stone, information on the clinical course of RF is inadequate [2]. Renal parenchyma is damaged while accessing the stone during PNL. Also, agents taken during anesthesia may show nephrotoxic effect. It may cause progression of RF. However, elimination of obstruction and eradication of chronic infection by removal of renal stones may lead to regression of RF. We aimed to determine the effect of PNL treatment on renal functions in renal stone cases with chronic kidney disease.

Patients and Methods

After approval from local ethics committee, 17 patients (none of the patients had solitary kidney) with stage III or higher RF who had PNL between January 2010 and September 2014 were included in this retrospective study. Glomerular Filtration Rate (GFR) was calculated using Cockcroft-Gault method [6]. Staging for chronic RF was performed, and diagnosis of RF was made for patients with a $GFR \leq 60 \text{ mL/min/1.73m}^2$ [7]. Before surgery, informed consent was obtained from each patient; age, sex, height and length values were recorded, and physical examination was performed. Urine analysis, urine culture, Kidney-Ureter-Bladder (KUB) film, and non-contrast computed tomography were performed. For minimization nephrotoxic effect of the anesthesia, induction was done by using propofol and rocuronium and maintenance was with desflurane and remifentanyl. PNL was performed in standard technique. An open-end catheter was placed into the kidney with the patient in dorsal lithotomy position. Once the catheter was in proper position, the patient was placed in the prone position. Needle access to the appropriate calyx was then performed utilizing fluoroscopic guidance. After dilation, a 24-30 Fr was used for stone fragmentation and removal. One access was performed in 13, and two accesses were in five patients. At the end of the procedure, a 16 Fr re-entry catheter was placed. We did not place double J catheter. In addition to routine work-up, urinalysis, urine culture, serum creatinine, and KUB were performed on a postoperative first day and six months after PNL. Data were retrospectively reviewed.

Statistics

The Statistical Package for Social Sciences 15 (SPSS 15,0, Chicago, IL, USA) software was used for statistical analysis. For data analysis, Kruskal-Wallis variance analysis was used. For comparison between 2 groups, Mann-Whitney U test was used. All values were shown as mean \pm standard deviation (Mean \pm SD). P value <0.05 was accepted as statistically significant.

Findings

PNL was performed to 18 renal units of the 17 patients (ten males and seven females) whose mean age was 59.58 ± 7.85 year (range 39-78). Four patients (23.5%) were taking antihypertensive treatments. Two patients were insulin-dependent diabetes mellitus (11.8%). Seven patients were previously operated for

Table 1 Demographic characteristics, operative and postoperative findings of the patients (n, %)

Characteristics	Findings
Number of Patients	17
Number of Renal Unit	18
Number of Tract	23
One Tract Used Patient	13
Two Tracts Used Patients	5
Age (year \pm SD (min-max))	59.58 \pm 7.85 (39-78)
Gender	
- Male	10
- Female	7
Co-morbidity	
- Diabetes Mellitus	2 (11,8%)
- Hypertension	4 (23,5%)
- Stone Surgery History	7 (41,2%)
- Mean ASA**	2,8
Mean Stone Burden	393 \pm 40 mm ²
Stone Specifications (n,%)	
- Staghorn	4 (23,5%)
- Semistaghorn	4 (23,5%)
- Mixed	7 (41,2%)
- Pelvic	2 (11,8%)
Operation Time (min)	79 \pm 34
Anesthesia Time (min)	126 \pm 48
Floroscopy Time (min)	24 \pm 1.1
Complications	
Decrease of Haemoglobine (gr/dL)	1.6
Blood Transfusion	2 (11.8%)
Fever	2 (11.8%)
Hospital Stay (day \pm SD)	4.88 \pm 1.32
Stone Free Rate	70%

Table 2 Renal Function Parameters (GFR: Glomerular Filtration Rate)

	Preoperative	Postoperative - 1st day	Postoperative - 6th month	p-Value
N	17	17	11	
Creatinine (mg/dL)	2.42 ± 0.76	1.98 ± 0.72	2.16 ± 0.78	0.01
GFR (mL/min/1.73 m ²)	45.3 ± 13	54.1 ± 14	51.8 ± 15	0.05

renal stones. Preoperatively, mean serum creatinine level of the patients was 2.42 ± 0.76 mg/dL, mean GFR level was 45.3 ± 13 mL/min/1.73 m² and mean stone burden was 393 ± 40 mm². Mean operation time was 79 ± 34 minutes. Stone-free rate was achieved in 12 patients (70.5%). At the postoperative period, stone-free rate was achieved by ureterorenoscopy in a patient and by shock-wave lithotripsy in a patient. Subfebrile fever was observed in two patients (11.8%) during the postoperative period. The mean decrease in hemoglobin level was 1.6 gr/dL. Two patients (11.8%) required blood transfusions in the perioperative period. (Table 1). During the perioperative period, mean serum creatinine level was 1.98 ± 0.72 mg/dL and mean GFR level was 54.1 ± 14 mL/min. At a sixth postoperative month, creatinine level was 2.16 ± 0.78 and GFR level was 51.8 ± 15 mL/min/1.73m² (Table 2). At a sixth postoperative month, worsening in renal function was observed in none of the patients. Evaluation of preoperative, perioperative, and sixth-month postoperative creatinine and GFR levels showed a significant decrease in creatinine and a considerable increase in GFR level.

Discussion

Renal stone is a common preventable disease with high morbidity. Renal stone may cause renal damage by obstruction, infection, and surgical interventions [8]. A person who develops renal stone at any time during his life has a significant risk for RF [3]. This damage increases much more during situations like hypertension, diabetes, and obesity [4]. If one of these conditions is expected in patients with RF patients removal of renal stone is critical for renal functions. Although the role of renal stones among causes of RF is relatively small, removal of renal stone is thought to prolong time to reach end-stage renal failure.

According to EAU 2015 guideline, PNL has become the standard surgical method for the treatment of large renal stones currently [5]. This minimally invasive method has high success, and low complication rates and also its morbidity is lower than open surgery [9]. The technique that is used during PNL gives minimal damage to renal parenchyma. It may produce an adverse effect on renal function. Yacyioglu et al. reported that PNL surgery does not cause biochemical deterioration in patients with compromised renal function [10]. Technological advances continually increase success and decrease complication rates of PNL. Miniaturized equipment and visualization systems, including sheaths less than 18 Fr, which were initially manufactured for use in the pediatric population are now being utilized in adults. [11-13]. The aim is to minimize parenchymal damage and functional renal dysfunction due to the sheath. In this study, a significant increase in renal function was observed. More importantly, none of the patients had a decline in renal functions. We believe that six months is adequate for improvement of renal function. Although this finding suggests that negative effect of

the sheath on renal parenchyma may be neglected, miniaturized PNL equipment may be more efficient to protect renal functions due to lower damage it causes on renal parenchyma.

In our study, the stone-free state was achieved in 12 (70.5%) patients after PNL. At the perioperative period, the stone-free rate increased to 82.3% because one patient had ureterorenoscopy and one patient had shock-wave lithotripsy. Residual stone remained in three patients. The mean decrease in hemoglobin level was 1.6 gr/dL. At the early period, blood transfusions were done to 2 (11.8%) patients and also fever was seen in two (11.8%) patients. Kurein et al. performed PNL to 91 patients with RF and found the stone-free rate of 83.7% and blood transfusion rate of 5.9% [14]. We found these rates as 82.3% and 11.8%, and they were consistent with the literature. Kamphuis et al. evaluated 25 articles with large samples and found fever and hemorrhage rates as 10.5% and 7.8%, respectively [15]. We found both of these rates as 11.8%. In our study 47% of these patients had staghorn or semistaghorn stones. Our complication rates were higher than the literature. It may be attributed small number of our patients.

In our study preoperative, perioperative first day and sixth postoperative month GFR levels were 45.3 ± 13 , 54.1 ± 14 and 51.8 ± 15 mL/min/1.73 m², respectively. Bilen et al. performed PNL to 185 patients with GFR levels below 60 mL/min/1.73 m². In 25% of the patients, GFR level was above and in 75% below 60 mL/min/1.73 m² [16]. Regression in renal function occurred only in five patients in their study, but none of these patients required dialysis. In our study preoperative, perioperative first day and postoperative sixth-month creatinine levels were found to be 2.42 ± 0.76 , 1.98 ± 0.72 , 2.16 ± 0.78 mg/dL, respectively. Etemadian et al. performed PNL to 60 patients with a creatinine level higher than 1.5 mg/dL and found that creatinine level significantly decreases creatinine value [17].

Small sample size and retrospective nature are the major limitations of our study. Although the follow-up time in this study was six months, RF is a disease with a chronic course. Kuzgunbay et al. followed RF patients who had PNL for a limited period of 51 months. After these long-term follows up, three patients developed end-stage renal failure. Creatinine level decreased to normal limits in six patients, remained stable in six patients and increased in four patients [18]. Seventy-five percent of the patients either cured or did not progress after four years. Akman et al. followed 177 patients for a limited period of 43 months and reported a regression in renal functions in 16.4% of the patients (19). This rate was 13.2% in Kurien's study [14]. We observed no progression in RF, but our mean follow-up period was lower than these studies.

The renal stone disease may cause rise at risk of progression to end-stage RF. It has been showed in the literature that stone burden may also contribute to the severity of parenchymal inflammation and fibrosis [20]. If the patient has diabetes, hypertension, or generalized stone disease, this risk increases much

more [4]. Renal stone and recurrent urinary tract infections cause deterioration in renal functions [16]. PNL is an effective treatment method for renal stone disease with higher stone-free and lower complication rates. Our study demonstrated that PNL may be chosen as a first-line treatment for RF, and it may safely be applied. Our findings suggest that application of PNL to patients with grade III or higher RF prolongs progression to end stage RF. However, in RF group PNL treatment should be performed more carefully, and selectively. Also, lower complication rates should be targeted in these patients. Additionally, studies with larger samples are required in these patients to describe complication management.

Authors' Statements

Competing Interests

The authors declare no conflict of interest.

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