JoCASS
Çukurova Anestezi ve Cerrahi Bilimler Dergisi
2018 Adana

# OPERATIVE OUTCOMES OF PERCUTANEOUS NEPHROLITHOTOMY IN DIFFERENT CHRONIC KIDNEY DISEASE STAGES

## FARKLI KRONİK BÖBREK HASTALIĞI EVRELERİNDE PERKÜTAN NEFROLİTOTOMİNİN OPERATİF SONUÇLARI

Nebil Akdogan[1], Mutlu Deger[1], Volkan Izol[1], Yıldırım Bayazıt[1], Ibrahim Atilla Aridogan[1]

*1 Department of Urology, Faculty of Medicine, University of Çukurova, Adana, Turkey*

*Sorumlu Yazar/Corresponding Author:Mutlu Değer E-mail: drmutludeger@gmail.com*

*Geliş Tarihi/Received: 15.12.2020 Kabul Tarihi-Accepted: 25.12.2020 Available Online Date/Çevrimiçi Yayın Tarihi: 31.12.2020*

*Cite this article as:* Akdogan N, Deger M, Izol V, Bayazıt Y, Atilla Aridogan I. Operative Outcomes of Percutaneous Nephrolithotomy in Different Chronic Kidney Disease Stages. *J* Cukurova Anesth Surg. 2020;3(3):223-9. *Doi:* 10.36516/jocass.2021.59

*0000-0001-9756-8775, 0000-0002-8357-5744, 0000-0001-5007-6781, 0000-0001-7598-9667, 0000-0002-3805-7817*

Abstract

Objective: We aimed to compare the results of percutaneous nephrolithotomy (PCNL) performed in patients with nephrolithiasis at different stages of chronic kidney disease (CKD).

Materials and Methods: Two hundred eighty patients with preoperative eGFR levels below 90 ml/min / 1.73 m2 and underwent PCNL were analyzed retrospectively. The patients were divided into three groups according to their GFR levels.

Group A: eGFR 60-90 ml / min / 1.73 $m^2$, stage II CKD,

Group B: eGFR = 30-59 ml / min / 1.73 $m^2$, stage III CKD,

Group C: eGFR <30 ml / min / 1.73 $m^2$, stage IV / V CKD.

PCNL results were compared between groups.

Results: In groups A, B, and C, the stone-free rates of clinically nonsignificant stones were 91.4%, 88.9%, and 86.6%, respectively, and there was no significant difference among the groups (p=0.56, 0.40, and 0.67, respectively). No significant difference was observed among the three groups in terms of complications, and the most common complications were bleeding requiring transfusion (12.5%) and fever (12.1%) (p> 0.05). In all three groups, one patient each underwent angioembolization due to uncontrolled hematuria.

Conclusion: CKD and urinary stone disease are significant public health problems, and more studies are needed to learn more about this group of patients.

Keywords: Kidney stones, chronic kidney disease, percutaneous nephrolithotomy

©Copyright 2020 by Çukurova Anestezi ve Cerrahi Bilimler Dergisi - Available online at http://dergipark.gov.tr/jocass

Öz
Amaç: Kronik böbrek hastalığının (KBH) farklı evrelerinde yapılan perkütan nefrolitotomi (PCNL) sonuçlarını karşılaştırmayı amaçladık.
Gereç ve Yöntemler: Preoperatif eGFR düzeyleri 90 ml / dak / 1.73 $m^2$'nin altında olan ve PCNL uygulanan 208 hasta retrospektif olarak incelendi. Hastalar GFR düzeylerine göre üç gruba ayrıldı.
Grup A: eGFR 60-90 ml / dak / 1.73 $m^2$, aşama II CKD,
Grup B: eGFR = 30-59 ml / dak / 1.73 $m^2$, evre III CKD,
Grup C: eGFR <30 ml / dak / 1.73 $m^2$, aşama IV / V CKD.
PCNL sonuçları gruplar arasında karşılaştırıldı.
Bulgular: A, B ve C gruplarında klinik olarak anlamlı olmayan taşsızlık oranları sırasıyla%91,4, %88,9 ve %86,6 idi ve gruplar arasında anlamlı fark yoktu (p = 0,56, 0,40 ve 0.67, sırasıyla). Üç grup arasında komplikasyonlar açısından anlamlı fark görülmedi ve en sık görülen komplikasyonlar transfüzyon gerektiren kanama (%12,5) ve ateş (%12,1) idi (p> 0,05). Her üç grupta da birer hastaya kontrolsüz hematüri nedeniyle anjiyoembolizasyon yapıldı.
Sonuç: KBH ve üriner taş hastalığı önemli halk sağlığı problemleridir. Bu hasta grubu hakkında daha fazla bilgi edinmek için daha fazla çalışmaya ihtiyaç vardır.

Anahtar Kelimeler: Böbrek taşı, kronik böbrek hastalığı, perkütan nefrolitotomi

## Introduction

Kidney stone disease is commonly seen in different geographical regions, with an incidence ranging from 7-13% in North America, 5-9% in Europe, and 1-5% in Asia. It has a high level of acute and chronic morbidity[1]. The prevalence of nephrolithiasis in patients with chronic kidney disease (CKD) is estimated to be 17.5%[2]. Percutaneous interventions seem to be the most appropriate treatment option with minimal morbidity and mortality[3]. Some conditions, such as chronic kidney disease (CKD), obesity, staghorn stones, spinal deformity, and previous surgery, are also known to further complicate this procedure[4]. CKD is a significant public health problem with higher anesthesia and postoperative complications[5].

Surgical interventions used in the treatment of kidney stones should provide a good stone cleansing and preserve maximum kidney function. Management of nephrolithiasis in CKD patients requires careful consideration of benefits versus risks.

In this study, we aimed to compare the results of PCNL applied in patients with nephrolithiasis at different CKD stages.

## Material and Methods

The data from 2,660 patients who underwent PCNL in our clinic between September 2007 and April 2019 were retrospectively evaluated, and 280 patients with preoperative eGFR levels less than 90 ml/min/1.73 m2 were included in the study. The patients with eGFR value of higher than 90 ml/min/1.73 m2, those who underwent a secondary PCNL procedure, children (under 16 years of age), and patients with incomplete data were excluded from the study. All steps of the study were planned and conducted under the principles of the Declaration of Helsinki. Written informed consent on admittance to the hospital was obtained from all individuals who permitted their respective medical information in clinical studies. Before the procedure, the patients' medical history was obtained, and physical examination, urinalysis, urine culture, complete blood count, serum biochemistry, coagulation tests, plain urinary radiography, or ultrasonography

©Copyright 2020 by Çukurova Anestezi ve Cerrahi Bilimler Dergisi - Available online at http://dergipark.gov.tr/jocass

were performed. All patients underwent non-contrast computed tomography (CT) preoperatively to assess the kidney's anatomy and the stone's localization and size in terms of percutaneous access. The K/DOQI guidelines of the National Kidney Foundation for the diagnosis and classification of CKD recommend using the equation of modification of diet in renal disease (MDRD) in predicting kidney function and diagnosing CKD[6]. The eGFR was calculated according to the MDRD formula based on the serum creatinine level of the patients, and the patients were divided into the following three groups (Table 1):

Group A: eGFR 60-90 ml/min/1.73 $m^2$, stage II CKD,

Group B: eGFR = 30-59 ml/ min/1.73 $m^2$, stage III CKD,

Group C: eGFR < 30 ml/ min/1.73 $m^2$, stage IV/V CKD.

The patients with a urinary tract infection were treated with appropriate antibiotics before the operation. A percutaneous nephrostomy tube (single or multiple) or double-J (DJ) stents were placed before surgery in patients with renal obstruction. PCNL was performed after the patients' serum creatinine level was stabilized.

*Operation Technique*

All operations were performed under general anesthesia by urologists with PCNL experience. Prophylactic antibiotics were administered to the patients one hour before surgery. Under cystoscopic guidance, a 5F or 6F open-ended ureteral catheter was inserted into the ureter and fixed to the Foley catheter in the lithotomy position. The patients were placed in the prone position, and an 18 G needle puncture through the appropriate calyx was performed by the urologist under fluoroscopic guidance while moving the C-arm. A 0.038-inch super-stiff polytetrafluoroethylene-coated guidewire was placed in the collecting system, and after performing 24-30F dilatation using Amplatz dilators, a suitable Amplatz sheath (Boston Scientific, USA) was established. A 26F rigid or flexible nephroscope was used in all patients. The stones were fragmented using a pneumatic lithotripter and extracted with percutaneous forceps. At the end of the operation, the residual fragments were evaluated by fluoroscopy, a 14-20F reentry catheter was placed in the renal pelvis, and the procedure was terminated. An antegrade nephrostogram was performed two to three days after the operation when deemed necessary. The reentry catheter was removed if there was no hematuria, fever, extravasation, or ureteral obstruction.

For each procedure, the following were examined:

- The operation data, including stone size and location
- Duration of surgery and fluoroscopy
- Number and location of renal access sites
- Intraoperative and postoperative complication rates
- Nephrostomy withdrawal time
- Length of hospital stay

The stone size was calculated based on the digitized surface area as previously described and was calculated as the sum of products with a maximum stone size on plain X-ray[7]. The presence of residual stones was evaluated with a postoperative nephrostogram and abdominal ultrasonography. In cases of suspicious findings, non-contrast CT was performed. Fragments larger than 3 mm were considered to be significant residues. Finally, the effect of PCNL on the eGFR

©Copyright 2020 by Çukurova Anestezi ve Cerrahi Bilimler Dergisi - Available online at http://dergipark.gov.tr/jocass

was analyzed by comparing the eGFR values obtained from the preoperative period, postoperative first month, and postoperative 12th month. The complications were classified according to the modified Clavien system[8].

*Statistical Analysis*

SPSS® program version 20.0 was used for statistical analysis. The chi-square test, independent samples t-test, and one-way analysis of variance were utilized for these analyses. The rate of vital variables was obtained for descriptive statistics. For quantitative variables, the mean (minimum-maximum) values were calculated for nonparametric test results, and the mean ± standard deviation values were calculated for parametric test results. Statistical significance was accepted as $p < 0.05$.

## Results

The mean age of 280 patients who underwent PCNL was 51.98±15.94 years: 212 (75.7%) were male, and 68 (24.2%) were female. When the distribution of cases was evaluated according to the groups, there were 81 patients (29%) in group A (stage II), 154 (55%) in group B (stage III), and 45 (16%) in group C (stage IV/V). The patients' demographic data in all groups are summarized in Table 1, and the operational data are given in Table 2. In groups A, B, and C, the stone-free rates of clinically nonsignificant stones were 91.4%, 88.9%, and 86.6%, respectively, and there was no significant difference among the groups (p=0.56, 0.40, and 0.67, respectively) (Table 2).

**Table 1.** Patients' characteristics by CKD stages

| | | | | p value | | |
|---|---|---|---|---|---|---|
| | **STAGE II (Grup A)** | **STAGE III (Grup B)** | **STAGE IV/V (Grup C)** | **II vs III** | **II vs IV/V** | **III Vs IV/V** |
| **Patients N** | 81 | 154 | 45 | | | |
| **Mean Age (Years)** | 45.9±15.7 | 54.48±15.9 | 54.36±13.6 | 0.00 | 0.00 | 0.96 |
| **Gender:** | | | | | | |
| **Male** | 80 | 105 | 27 | | | |
| **Female** | 1 | 49 | 18 | | | |
| **Mean Body Mass Index ($Kg/M^2$)** | 27.2±4.2 | 28±5.2 | 27.1±4.7 | 0.21 | 0.93 | 0.29 |
| **Mean Preoperative Creatinine (Mg/Dl)** | 1.26±0.7 | 1.58±0.3 | 2.94±0.9 | 0.00 | 0.00 | 0.00 |
| **Mean Stone Burden ($Mm^2$)** | 581.48±464.3 | 618.1±806.8 | 637.3±516.8 | 0.70 | 0.53 | 0.88 |
| **Prior Nephrostomy N (%)** | 1(1.2) | 3(1.9) | 3(6.7) | 0.68 | 0.10 | 0.13 |
| **Prior Double-J Stent N (%)** | 9(11.1) | 26(16.9) | 3(6.7) | 0.22 | 0.40 | 0.06 |
| **Diabetes Mellitus N (%)** | 2(2.5) | 6(3.9) | 1(2.2) | 0.55 | 0.93 | 0.50 |

©Copyright 2020 by Çukurova Anestezi ve Cerrahi Bilimler Dergisi - Available online at http://dergipark.gov.tr/jocass

**Table 2.** Operative Outcomes of Percutaneous Nephrolithotomy in Different CKD

| | | | | p value | | |
|---|---|---|---|---|---|---|
| | **STAGE II (Grup A)** | **STAGE III (Grup B)** | **STAGE IV/V (Grup C)** | **II vs III** | **II vs IV/V** | **III vs IV/V** |
| **NUMBER OF ACCESSES:** | 65(80.2) | 115(74.7) | 36(80) | 0.33 | 0.97 | 0.45 |
| **SINGLE N (%)** | 16(19.8) | 39(25.3) | 9(20) | 0.21 | 0.57 | 0.30 |
| **MULTIPLE N (%)** | | | | | | |
| **MEAN OPERATIVE TIME (MINS)** | 81.6±40.6 | 83.4±45.7 | 85.2±40.2 | 0.77 | 0.63 | 0.80 |
| **MEAN SCOPY TIME (MINS)** | 10.5±5.8 | 10.8±6.2 | 10.9±7 | 0.69 | 0.72 | 0.94 |
| **MEAN NEPHROSTOMY WITHDRAWAL TIME (DAYS)** | 2.02±1.2 | 2.12±1.4 | 3.13±3.5 | 0.62 | 0.01 | 0.04 |
| **MEAN HOSPITAL STAY (DAYS)** | 4.06±3.8 | 4.2±3.2 | 5.0±3.8 | 0.76 | 0.19 | 0.16 |
| **SF+CIRF N (%)** | 74(91.4) | 137(88.9) | 39(86.6) | 0.56 | 0.40 | 0.67 |
| **FEVER N (%)** | 8(9.9) | 19(12.3) | 7(15.6) | 0.57 | 0,.35 | 0.58 |
| **BLOOD TRANSFUSION N (%)** | 9(11.1) | 19(12.3) | 7(15.6) | 0.78 | 0.48 | 0.58 |
| **CLAVIEN SCORE: N (%)** | 16(19.8) | 38(24.6) | 14(31.1) | 0.39 | 0.15 | 0.38 |
| **II** | 1(1.2) | 2(1.3) | 2(4.4) | 0.96 | 0.27 | 0.22 |
| **IIIA** | 0 | 6(3.9) | 1(2.2) | 0.02 | 0.15 | 0.57 |
| **IIIB** | 0 | 1(0.6) | 0 | 0.19 | 1.16 | 0.22 |
| **IVA** | | | | | | |

No significant difference was observed among the three groups in terms of complications, and the most common complications were bleeding requiring transfusion (12.5%) and fever (12.1%) ($p > 0.05$). In all three groups, one patient each underwent angioembolization due to uncontrolled hematuria. DJ stents were placed in six patients in group B (3.8%) and two patients in group C (4.4%) due to prolonged urinary leakage from the nephrostomy tract. In group B, hemodialysis was initiated for one patient who developed postoperative anuria, but no additional dialysis was required for this patient in the follow-up period. Colon injury occurred in one patient (detected postoperatively) who was conservatively treated using tube colostomy and DJ stent placement and was discharged on the eighth day.

## Discussion

Kidney stone disease is a risk factor for CKD. The incidence of renal dysfunction or the need for renal replacement therapy in this patient group is approximately twice that of the general population[9,10]. The etiology of renal failure in patients with kidney stones includes renal obstruction, urinary tract infections, frequent surgical interventions, and concomitant diseases[2,11,12]. The duration

©Copyright 2020 by Çukurova Anestezi ve Cerrahi Bilimler Dergisi - Available online at http://dergipark.gov.tr/jocass

of stone disease, the presence of multiple procedures, and stone recurrence have been shown to have a negative effect on renal function[2]. PCNL has been safely applied for a long time in the treatment of patients with comorbid conditions, such as CKD, as well as the treatment of kidney stones larger than 2 cm in size[6]. In this study, we evaluated patients with different stages of CKD who underwent PCNL for kidney stones.

In patients with CKD, PCNL provides a high stone-free rate[13,14]. Kurien et al. reported a high stone-free rate (83.7%) in 91 patients with CKD[6]. Similarly, Etemadian et al. calculated a high stone-free rate of 83.3% in CKD patients[15]. In the current study, we divided the patients into three groups according to the CKD stage and found high and similar stone-free rates in all groups ($p = 0.56$, 0.4, and 0.67 for groups A, B, and C, respectively).

Patients with CKD have impaired platelet function, leukopenia, anemia, and increased bleeding tendency during surgical interventions[6,16]. They also become more susceptible to infections. Also, excessive fluid overload, electrolyte imbalance, pulmonary edema, and cardiac dysfunction are common in patients with extreme renal dysfunction[16,17]. Therefore, patients with CKD are at high risk for any anesthesia and surgery[16]. These patients are more vulnerable to infectious and hemorrhagic complications during PCNL procedures. One of the essential concerns when treating stone disease in patients with CKD is the risk of complications.

Sairam et al reported a significant difference in total complication rate comparing PCNL in CKD 0-2 and CKD 4/5 groups (18.5% vs. 33.8%, $p<0.001$)[18]. Seitz et al. recorded a typical transfusion rate of 7% for PCNL procedures in populations with normal function[19]. In the CROES study, the transfusion rate for patients with CKD 4/5 was 18.4% compared to 6.1% for the patient with CKD 3 ($p<0.001$)[18].

In our study, the patients were divided into three groups according to the eGFR. A high eGFR did not affect bleeding requiring blood transfusion, fever, or other complications associated with the PCNL procedure.

The limitations of the current study include its retrospective nature and the fact that multiple surgeons performed the PCNL procedures.

## Conclusion

PCNL is an effective and applicable method for patients with chronic kidney failure. Care should be taken in patient selection to achieve successful results. CKD and urinary stone disease are significant public health problems, and more studies are needed to learn more about this group of patients.

## Ethics approval

The study's ethics committee approval was obtained from the ethics committee of the University of Çukurova (approval number-April 5,2019;87/53).

## Conflict of Interest

The authors declare that they have no conflict of interest

## Funding

None

©Copyright 2020 by Çukurova Anestezi ve Cerrahi Bilimler Dergisi - Available online at http://dergipark.gov.tr/jocass

# References


1. Sorokin I, Mamoulakis C, Miyazawa K, Rodgers A, Talati J, Lotan Y. Epidemiology of stone disease across the World.World J Urol. 2017 Sep;35(9):1301-1320. doi: 10.1007/s00345-017-2008-6.
2. Marangella M, Bruno M, Cosseddu D et al. Prevalence of chronic renal insufficiency in the course of idiopathic recurrent calcium stone disease: risk factors and patterns of progression. Nephron. 1990 Jul 1;54(4):302-6.
3. Kukreja R, Desai M, Patel SH, et al. Nephrolithiasis associated with renal insufficiency: Factors predicting outcome. J Endourol. 2003;17:875-879
4. Yanaral F, Ozgor F, Savun M, Sahan M, Sarilar O, Binbay M. Comparison of CROES, S.T.O.N.E, and Guy's scoring systems for the prediction of stone-free status and complication rates following percutaneous nephrolithotomy in patients with chronic kidney disease. Int Urol Nephrol. 2017 Sep;49(9):1569-1575. doi: 10.1007/s11255-017-1631-x
5. Akman T, Binbay M, Aslan R et al. Long-term outcomes of percutaneous nephrolithotomy in 177 patients with chronic kidney disease: a single center experience. The Journal of urology. 2012 Jan 31;187(1):173-7.
6. Kurien A, Baishya R, Mishra S, et al. The impact of percutaneous nephrolithotomy in patients with chronic kidney disease. J Endourol. 2009;23:1403-7.
7. Raj GV, Auge BK, Weizer AZ, Denstedt JD, Watterson JD, Beiko DT, Assimos DG and Preminger GM. Percutaneous management of calculi within horseshoe kidneys. J Urol 2003; 170: 48-51
8. Dindo D, Demartines N, Clavien PA (2004) Classification of surgical complications: a new proposal with evaluation in a cohort of 6336 patients and results of a survey. Ann Surg 240:205–213
9. Rule AD, Bergstralh EJ, Melton LJ, et al.Kidney stones and the risk for chronic kidney disease. Clin J Am Soc Nephrol. 2009;4:804-811.
10. Gambaro G, Croppi E, Bushinsky D, Jaeger P, Cupisti A, Ticinesi A, Mazzaferro S, D'Addessi A, Ferraro PM. The Risk of Chronic Kidney Disease Associated with Urolithiasis and its Urological Treatments: A Review. J Urol. 2017 Aug;198(2):268-273. doi: 10.1016/j.juro.2016.12.135. Epub 2017 Mar 10.
11. Gupta M, Bolton DM, Gupta PN, Stoller ML. Improved renal function following aggressive treatment of urolithiasis and concurrent mild to moderate renal insufficiency. J Urol. 1994;152:1086-90.
12. Gambaro G, D'Angelo A, Favaro S. Risk for renal failure in nephrolithiasis. Am J Kidney Dis. 2001;37:233-43.
13. Bilen CY, Inci K, Kocak B, et al. Impact of percutaneous nephrolithotomy on estimated glomerular filtration rate in patients with chronic kidney disease. J Endourol. 2008;22:895-900.
14. Yaycioglu O, Egilmez T, Gul U, Turunc T, Ozkardes H. Percutaneous nephrolithotomy in patients with normal versus impaired renal function. Urol Res. 2007;35:101-5.
15. Etemadian M, Maghsoudi R, Shadpour P, Ghasemi H, Shati M. Outcomes of tubeless percutaneous nephrolithotomy in patientswith chronic renal insufficiency. Iran J Kidney Dis. 2012 May;6(3):216-8.
16. Lukaszyk E, Lukaszyk M, Koc-Zorawska E, Bodzenta-Lukaszyk A, Malyszko J (2016) GDF-15, iron, and inflammation in early chronic kidney disease among elderly patients. Int Urol Nephrol 48:839–844
17. Cader RA, Ibrahim OA, Paul S, Gafor HA, Mohd R (2014) Left ventricular hypertrophy and chronic fluid overload in peritoneal dialysis patients. Int Urol Nephrol 46:1209–1215
18. Sairam K, Scoffone CM, Alken P et al. Percutaneous nephrolithotomy and chronic kidney disease: results from the CROES PCNL Global Study. The Journal of urology. 2012 Oct 31;188(4):1195-200.
19. Seitz C, Desai M, Häcker A, et al. Incidence, prevention, and management of complications following percutaneous nephrolitholapaxy. European urology. 2012 Jan 31;61(1):146-58.


©Copyright 2020 by Çukurova Anestezi ve Cerrahi Bilimler Dergisi - Available online at http://dergipark.gov.tr/jocass