Original Article – Urolithiasis
Grand J Urol 2024;4(3):77-82
DOI: 10.5505/GJU.2024.30092

Factors Affecting Emergency Room Admission and Rehospitalization Rates After Supine Percutaneous Nephrolithotomy

Supin Perkütan Nefrolitotomi Sonrası Acil Servise Başvuru ve Rehospitalizasyon Oranlarını Etkileyen Faktörler

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Cite as: Arıkan Y, Karabacak MC, Koraş Ö, Dumanlı E, Keskin MZ. Factors affecting emergency room admission and rehospitalization rates after supine percutaneous nephrolithotomy. Grand J Urol 2024;4(2):77-82

Submission date: 05 May 2024 **Acceptance date:** 27 August 2024 **Online first:** 29 August 2024 **Publication date:** 20 September 2024

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Abstract

Objective: To identify patient- and procedure-related factors that increase the risk of hospital readmissions (HRs) and emergency room (ER) admissions after percutaneous nephrolithotomy (PCNL).
Materials and Methods: Patients who underwent supine PCNL surgery between 2018 and 2023 were retrospectively reviewed. Demographic characteristics of the patients including age, body mass index, ASA scores, stone size, presence of anatomical abnormalities and comorbidities, preoperative and postoperative data, and emergency room visit and readmission rates were analysed. Patients (incl. elective cases) transferred from ERs to the urology wards, and ER admissions for any indication related to the PCNL procedures were primarily analysed. Factors affecting the rate of ER admissions and HRs were analysed using logistic regression analysis.
Results: The mean age of 450 patients who underwent supine PCNL was 42.1 ± 20.8 years. When the stone- free rate (SFR) was defined as the presence of post-PCNL fragments less than 4 mm in size, the SFR rate in our study was 87%. Complications were observed in 19.5% of patients. ER admission rate was 8.8% and HR rate was 7.7%. Anatomical abnormalities, stone complexity, operation time and postoperative complications were statistically significant factors for ER admissions, while comorbidities, higher ASA scores, anomalous kidney, stone complexity, long operation time and postoperative complications were statistically significant factors for HRs.
Conclusion: In our study, higher unplanned hospitalization rates were observed in patients with anatomical abnormalities and complex kidney stones. HRs and ER admissions were more frequent in patients with a history of complications.

Keywords: supine percutaneous nephrolithotomy, emergency room visit, rehospitalization

Özet

Amaç: Perkütan nefrolitotomi (PCNL) sonrası hastaneye tekrar başvuru (HRs) ve acil servise (ER) kabul riskini artıran hasta ve prosedürle ilgili faktörleri belirlemek.
Gereçler ve Yöntemler: 2018-2023 yılları arasında supin PCNL ameliyatı geçiren hastalar retrospektif olarak incelendi. Hastaların yaş, vücut kitle indeksi, ASA skorları, taş boyutu, anatomik anormallik ve komorbidite varlığı gibi demografik özellikleri, ameliyat öncesi ve sonrası verileri, acil servise başvuru ve mükerrer başvuru oranları analiz edildi. Acil servislerden üroloji servislerine transfer edilen hastalar (elektif vakalar dahil) ve PCNL prosedürleri ile ilgili herhangi bir nedenle acil servise başvurular öncelikle analiz edilmiştir. Acil servise (ER) başvuru ve hastaneye tekrar yatış (HR) oranlarını etkileyen faktörler lojistik regresyon analizi kullanılarak analiz edildi.
Bulgular: Supin PCNL uygulanan 450 hastanın ortalama yaşı 42.1 ± 20.8 idi. Taşsızlık oranı (SFR) PCNL sonrası 4 mm'den küçük fragman varlığı olarak tanımlandığında, çalışmamızdaki SFR oranı %87 idi. Hastaların %19,5'inde komplikasyon gözlenmiştir. ER başvuru oranı %8,8 ve HR oranı %7,7 idi. Anatomik anormallikler, taş karmaşıklığı, ameliyat süresi ve ameliyat sonrası komplikasyonlar ER'ye başvuru için istatistiksel olarak anlamlı faktörler iken, komorbiditeler, yüksek ASA skorları, anormal böbrek, taş karmaşıklığı, uzun ameliyat süresi ve ameliyat sonrası komplikasyonlar HR'ler için istatistiksel olarak anlamlı faktörlerdi.
Sonuç: Çalışmamızda, anatomik anormallikleri ve kompleks böbrek taşları olan hastalarda daha yüksek planlanmamış HR oranları gözlendi. Komplikasyon öyküsü olan hastalarda HR'ler ve ER başvuruları daha sıktı.

Anahtar kelimeler: supin perkütan nefrolitotomi, acil servis başvurusu, tekrar hastaneye yatış

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Introduction

According to the American Urological Association / Endourological Society Guidelines, percutaneous nephrolithotomy (PCNL) is recommended for patients with a stone burden greater than 2 cm or staghorn stones in the pelvis [1]. PCNL which is performed by puncturing the renal parenchyma, is more successful in terms of stone removal compared to other endoscopic procedures, but with an increased risk of complications. With the technological developments on PCNL, it has been associated with lower rates of postoperative complications, lesser pain, shorter hospital stay and decreased hospital readmission (HR) rates [2,3]. HRs and emergency room (ER) readmissions after hospital discharge are considered as negative indicators of healthcare quality and are associated with significant economic burden. For these reasons, it is necessary to minimise the rate of HR and ER referrals. [3,4]. In this study, we aimed to determine the patient- and procedure-related factors that increase the risk of HRs and ER admissions after PCNL.

Materials and Methods

Between January 2018 and June 2024, the medical records of 450 patients who underwent supine PCNL for renal calculi in the Urology Clinic of Izmir Tepecik Training and Research Hospital were retrospectively analyzed. This study protocol was approved by the Izmir Tepecik Training and Research Hospital Ethical Review Board (decision date and no: 03.04.2024- 2024/02-05).

Age, gender, body mass index (BMI), American Society of Anesthesiologists (ASA) scores of the patients were retrospectively analyzed. Preoperatively non-contrast computed tomography (NCCT) scans were performed to assess size, burden, density, location and number of the stones. Any anatomical abnormality was also evaluated. All patients underwent PCNL in the supine position. Duration of perioperative period and the number of accesses were recorded. Postoperatively, stone-free status (SFR) was evaluated by kidney-ureter-bladder (KUB) graphy and NCCT scans. Stones measuring >4 mm were considered as residual stones, and those smaller than 4 mm as clinically insignificant stones. The duration of hospitalisation was recorded.

Elective and emergency department, admissions for any indication related to the PCNL procedures were primarily analysed. HRs were defined as PCNL- related rehospitalizations occurring within 30 days of surgery. In addition, rehospitalisations for further treatment were recorded, but patients undergoing a second urological surgery including PCNL and/or ureterorenoscopy, were excluded. All PCNL procedures were performed by surgical teams experienced in endourological methods. PCNL procedures were routinely achieved as a one-step procedure through a percutaneous renal tract created by the urologist. Operative time is the time period elapsed between renal puncture and removal of the percutaneous lithoteiptor from the kidney.

Complications were classified using the Clavien Dindo classification system adapted to the PCNL procedure [5].

PCNL Procedure

All patients were positioned in modified Galdakao position after general anesthesia. A 5F ureteral catheter was inserted over a guidewire under the guidance of ureterorenoscopy. Retrograde pyelography was performed to visualize the pelvicalyceal system. After calyceal dilatation, accessory tract into the appropriate calyx was created under fluoroscopic monitoring. Afterwards, serial dilatations were performed using plastic dilators and then a 30 F Amplatz access sheath was placed. Intra-renal visualization was performed with a 28F nephroscope (KarlStorz GmbH & Co. KG, Tuttlingen, Germany) and the stone was fragmented with a pneumatic lithotripter. The fragments were retrieved with appropriate stone forceps. Before terminating the surgical procedure, a 14F nephrostomy catheter was placed in the renal pelvis. A DJ stent was also placed according to the surgeon's preference and rest stone status.

Statistical Analysis

Data of the study participants were statistically analyzed using statistical package of IBM SPSS version 20.0. Numerical variables are presented as mean and standard deviation, categorical variables as numbers and percentages. Demographic and operative data were compared using chi-square and Mann-Whitney U tests. Independent predictors of HRs and ER admissions were identified by multiple binary logistic regression analysis. A p value <0.05 was considered statistically significant.

Results

The mean age, and BMI of 450 patients who underwent supine PCNL were 42.1 ± 20.8 years and 24.6 ± 6.1 kg/m2, respectively. Most of the patients (70%) were male, and most of them (55.3%) had ASA 2 scores. Anatomical abnormalities were observed in 4.4%, and a comorbidity was present in 46.8% of the patients. Demographic and other data of the patients are shown in **Table 1.**

Table 1. Demographic measures of the patients enrolled into the study

	N: 450
Age (years)	42.1 ± 20.8
BMI (kg/m2)	24.6 ± 6.1
Gender (n, %) Female Male	 135 (30%) 315 (70%)
ASA score (n, %) 1 2 3	 124 (27.5 %) 249 (55.3 %) 77 (17.1 %)
Mean stone size (mm)	38.4 ± 19.7
Stone density (HU)	968 ± 310
Stone configuration (n, %) -Simple - Partial staghorn - Complete staghorn - Multiple calyceal	 267 (59.3 %) 68 (15.1 %) 53 (11.7 %) 63 (14 %)
Anatomic abnormality (n, %)	20 (4.4 %)
Comorbidity (n, %)	211 (46.8 %)

Perioperative and postoperative data showed that the mean operation time was 65.2 ± 30.4 minutes. An average of 1.2 ± 0.5 access tracts were performed for intrarenal access. The mean hospital stay was 2.1 ± 1.3 days. When SFR was defined as residual fragments <4 mm, the SFR rate was 87%. Complications were observed in 19.5% of patients. Rates of ER, and hospital readmissions, were 8.8% and 7.7%, respectively. Perioperative and postoperative variables and outcomes are shown in **Table 2.**

Clavien Grade 1 complications were observed in 36 (7.8%) patients. The majority of these complications consisted of febrile episodes. Clavien grade 2, 3A, 3B, and 4 complications were observed in 31 (6.8%), 12 (2.6%), 4 (0.8%), and 5 (1.1%) patients, respectively. While Clavien Grade 5 complications were not observed in any patient. The data related to complications are shown in **Table 3.**

Univariate analysis of the factors related to ER admissions and HRs showed that comorbidity, anatomical abnormality, stone complexity, operation time and postoperative complications were statistically significant factors affecting ER, while comorbidity, high ASA scores, presence of anomalous kidney, stone complexity, prolonged operation time and postoperative complications were statistically significant factors adversely effecting hospital readmissions. Results of the univariate analysis of the factors affecting the ER admission and HR rates are shown in **Table 4.**

Discussion

The prevalence of kidney stones tends to increase day by day and accordingly the number of surgical methods applied increases. In the guidelines, PCNL is performed for stones >2 cm [6]. With technological developments, various PCNL methods (mini PCNL, ultra- mini-PCNL) are being applied to reduce complication and increase surgical success rates [3]. Many complications may develop after PCNL surgery and even after discharge. Indeed, patients have visited the emergency department for various indications [7]. In a study, the complication rate within 30 days after PCNL operation was reported to be 20%. An increase in ER admission and HR rates was observed after discharge due to these complications [8]. There are limited studies in the literature on the factors causing ER admissions and HRs after PCNL [9-17]. Rambachan et al. [9] reported ER readmission rate of 3.7% after outpatient urological surgery and the indications for readmissions were cancer history, bleeding disorder, male gender, ASA 3 and 4 complications. In another study, Armitage et al., [10] revewed the details of 5750 PCNL procedures and, reported ER readmission rate of 9% within 30 days after surgery. Recently, Beiko et al., [11] reported their ambulatory PCNL series, and reported ER admission, and HR rates of 12% and 4%, respectively. In 2016, Fahmy et al. [12] reported an ER readmission rates of 1.4% after PCNL of 162 patients. Bechis et al. [13], reported average ER readmission rate of 18%, after PCNL, and divided the patients who underwent PCNL into 2 groups as inpstients and outpatients scheduled for PCN with ER readmission rates of 3% and 10%, respectively. Zhao et al. [14] reported the ER readmission rates as 2.3% vs 1.2% for day care vs. inpatient mini PCNL patients. Schoenfeld et al. [15] found the ER readmission and HR rates to be 11% vs 9% and 2% vs 6% in patients undergoing ambulatory and inpatient

Table 2. Perioperative variables and outcomes

	N: 450
Mean access number	1.2 ± 0.5 (1–3)
Mean operation time (min)	65.2 ± 30.4
Mean hospitalization time (days)	2.1 ± 1.3
Stone density (HU)	968 ± 310
Success rate (n, %) - Stone free - Fragments <4 mm - Rest	 372 (82.6 %) 20 (4.4 %) 58 (12.8 %)
Complication (n, %)	97 (21.5 %)
Emergency room visit (n, %)	40 (8.8 %)
Rehospitalization (n, %)	35 (7.7 %)

Table 3. Categorization of the perioperative complications

	N: 450
Clavien grade 1 -Fever -Urine leakage	 24 (5.2 %) 12 (2.6 %)
Clavien grade 2 - Blood transfusion - Urinary tract infection - Atelectasis	 17 (1.6 %) 12 (2.6 %) 11 (2.4 %)
Clavien grade 3A - Hydro/hemothorax - Renal pelvis injury requiring stenting - Urine leakage managed by ureteral stenting	 1 (0.2 %) 6 (1.3 %) 5 (1.1 %)
Clavien grade 3B - Bleeding requiring angioembolization	 4 (1.5 %)
Clavien grade 4 - Urosepsis requiring ICU	 5 (1.1 %)
Clavien grade 5	0

Table 4. Univariate analysis of the factors affecting the ER visit and HR rate

	ER	**HR**
Age	0.78	0.81
Sex	0.44	0.65
BMI	0.83	0.59
Comorbidity	0.01	0.011
ASA score (1, 2, 3)	0.33	0.01
Anatomic abnormality (yes/no)	0.04	0.61
Stone size (cm)	0.11	0.23
Stone complexity	0.01	0.08
Access number	0.12	0.09
Surgery time	0.001	0.24
Presence of postoperative complication	0.001	0.001

PCNL, respectively. Kumar et al., [16] found the readmission rate as 7.1%. Keskin et al [17] indicated the complication rate as 37.5% in patients who readmitted after PCNL operation. These adverse events were hemorrhagic complications requiring blood transfusions in 16.7%, urosepsi in 10.4% patients, while 10.4% of them had experienced other adverse side effects. They also reported that the ER readmission rates were higher in patients with rest stones and in patients who had multiple stones before PCNL. ER readmission rates were significantly higher in patients with ASA score 3 and above. In our study, ER admission was 8.8% and the rate of HR was 7.7%. Admissions to the ER were more common in patients with comorbidities, complex preoperative stone structure, renal anomalies, postoperative complications and prolonged operation time. Hospital readmission rates were higher in patients with comorbidities, higher preoperative ASA scores, preoperative complex calculi and postoperative complications.

Prolonged operation time is one of the factors that increase the duration of complications and readmission rates during the postoperative period. Sugihara et al. reported that the risk of complications increased if the operation time was longer than 60 min in patients undergoing PCNL. They also stated that prolonged operation time increased the risk of postoperative fever and septicemia [18]. Oner et al. [19] examined the factors increasing complications rates in PCNL operations. They indicated that complications were seen more frequently in procedures exceeding the cut-off limit of 67 minutes determined for PCNL surgery. Lopes et al. [20] reported the rate of bleeding after PCNL as 6.7-9.4% and bleeding after PCNL was seen more frequently in patients with prolonged operation time. In our study, the mean operation time was 65.2 ± 30.4 min and readmission rates were higher in patients with longer operation time.

Renal anomalies have been observed 3-11% of the cases. Percutaneous nephrolithotomy in anatomically deformed kidneys is a difficult procedure due to the abnormal orientation of the renal pelvicalyceal system and the unusual course of renal vascularity [21]. Vicentini et al. [22] reported a %72.4 success rate of PCNL performed in patients with anatomically deformed kidneys. Bas et al. [23] indicated that 71 percent of their patients with horseshoe kidneys had SFR after PCNL. In our study, anatomical abnormalities were observed in a total of 20 patients. SFR of 85% was achieved with PCNL in anomalous kidneys. Readmission rates were statistically higher in these patients.

In general, the incidence of major complications after PCNL is low. In a study by Tefekli et al., [24], the overall incidence of a modified Clavien Grade 3 to 5 complication rate was 10.5%, which was even lower than that of PCNL performed for a simple stone (isolated pelvic or calyceal stone). Fahmy et al. [12] found that no patient required readmission to the emergency department except for two patients, one who presented with moderate hematuria 5 days after discharge from the emergency department and was treated conservatively, and the other patient had persistent urine leakage that resolved spontaneously 1 week after removal of the nephrostomy tube. In our study, complication rate was 19.5%. Grade 5 complications were not observed. Patients with complications had higher readmission and rehospitalisation rates after discharge.

The retrospective design of this study is the main limitation. However, we used standardised data collection and complication recording methods to minimise variations and limitations in the study.

Conclusion

We do not expect to encounter readmissions to emergency services, and urology clinics after PCNL surgery. In our study, number of readmissions to emergency services, and urology clinics increased in the presence of comorbidities, stone complexity and postoperative complications. Besides, presence of anatomical abnormalities and prolonged operation tims increased ER, and, high ASA scores hospital readmission rates.

Ethics Committee Approval: Ethics committee approval was received for this study from the ethics committee of University of Health Sciences Izmir Tepecik Training and Research Hospital (Decision date and no: 03.04.2024-2024/02-05).

Informed Consent: An informed consent was obtained from the patients.

Publication: The results of the study were not published in full or in part in form of abstracts.

Peer-review: Externally and internally peer-reviewed.

Authorship Contributions: Any contribution was not made by any individual not listed as an author. Concept – Y.A., M.C.K.; Design – Y.A., M.C.K.; Supervision – Y.A., M.Z.K.; Resources – Ö.K., E.D.; Materials – Ö.K., E.D.; Data Collection and/or Processing – Ö.K., E.D.; Analysis and/or Interpretation – Y.A., M.C.K.; Literature Search – Ö.K., E.D.; Writing Manuscript – Y.A., M.C.K.; Critical Review – Y.A., M.Z.K.

Conflict of Interest: The author declares that there was no conflict of interest.

Financial Disclosure: The authors have declared that they did not receive any financial support for the realization of this study.

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