

Effect of Age on Percutaneous Nephrolithotomy for Staghorn Renal Stones

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Abstract

Objective: To evaluate the effect of age on the success and complications of percutaneous nephrolithotomy(PCNL) in staghorn renal stones. **Material and Methods:** The files of 182 patients who underwent single-access PCNL for staghorn renal stones between 2012 and 2017 were retrospectively analyzed. The patients were divided into two groups according to their age: those aged <65 years were defined as Group-1 and those aged ≥65 years as Group-2. The demographic characteristics and perioperative and postoperative results of the patients were compared between the two groups. Postoperative detection of stones >4 mm was defined as residual stones. Complications were classified according to the Clavien scoring system. **Results:** Of the patients with staghorn renal stones, 139 were in Group-1 and 43 were in Group-2. The mean age of the patients was 43.9±10.6 years for Group-1 and 67.8±2.1 years for Group-2 (p=0.001). The mean stone size in Group-1 and Group-2 was 899±292 and 1,008±208 mm², respectively (p=0.736). When we evaluated the postoperative results, we observed that the amount of hemoglobin drop was statistically significantly higher in Group-1 (p=0.001). However, the need for blood transfusion was higher in Group-2 than in Group-1 (18.6% and 7.2%, respectively). The stone-free rate was 54.7% in Group-1 and 67.4% in Group-2 (p=0.139). According to the evaluation of the overall complication rates, 34.5% of the patients in Group-1 and 46.5% of those in Group-2 developed complications (p=0.206). When we examined the subgroups of complications according to the Clavien scoring system, the rate of minor complications was found to be 22.3% in Group-1 and 41.9% in Group-2, and the difference was statistically significant (p=0.012). The major complication rates were determined as 4.7% and 12.2% for Group-1 and Group-2, respectively (p=0.155). The number of patients with Clavien grade-2 complications was statistically higher in the elderly patient group (p=0.019). **Conclusion:** PCNL can be used as an effective and safe treatment method in the treatment of complex stones in elderly patients

ABSTRACT

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groups. Postoperative detection of stones >4 mm was defined as residual stones. Complications were classified according to the Clavien scoring system.

Results:

Of the patients with staghorn renal stones, 139 were in Group-1 and 43 were in Group-2. The mean age of the patients was 43.9 ± 10.6 years for Group-1 and 67.8 ± 2.1 years for Group-2 ($p=0.001$). The mean stone size in Group-1 and Group-2 was 899 ± 292 and $1,008 \pm 208$ mm², respectively ($p=0.736$).

When we evaluated the postoperative results, we observed that the amount of hemoglobin drop was statistically significantly higher in Group-1 ($p=0.001$). However, the need for blood transfusion was higher in Group-2 than in Group-1 (18.6% and 7.2%, respectively). The stone-free rate was 54.7% in Group-1 and 67.4% in Group-2 ($p=0.139$). According to the evaluation of the overall complication rates, 34.5% of the patients in Group-1 and 46.5% of those in Group-2 developed complications ($p=0.206$).

When we examined the subgroups of complications according to the Clavien scoring system, the rate of minor complications was found to be 22.3% in Group-1 and 41.9% in Group-2, and the difference was statistically significant ($p=0.012$). The major complication rates were determined as 4.7% and 12.2% for Group-1 and Group-2, respectively ($p=0.155$). The number of patients with Clavien grade-2 complications was statistically higher in the elderly patient group ($p=0.019$).

Conclusion:

PCNL can be used as an effective and safe treatment method in the treatment of complex stones in elderly patients.

Keywords: Percutaneous nephrolithotomy, Staghorn renal stone, Clavien scoring system, Age

What's already known about this topic?

Currently, percutaneous nephrolithotomy are the most favored treatment option for staghorn renal stones. However, there are concerns related to the safe applicability of PCNL in geriatric patients with staghorn stones, who have bleeding tendency and low cardiopulmonary performance.

What does this article add?

This study showed that PCNL could be effectively and safely applied in the elderly population for the treatment of staghorn renal stones. However, since minor complications after PCNL are seen at a higher rate in this patient group.

Introduction:

Globally, individuals aged 65 and over are defined as the 'elderly population' (1). Especially in developed and developing countries, the decrease in birth rates, as well as the prolongation of life expectancy at birth and advanced age have led to a relative increase in the elderly population and its share in the total population. As a result of this increase, more elderly patients require treatment due to urinary system stones. Staghorn stones are of particular concern in this age group because the treatment of such stones may require lengthy and multiple procedures and has a high complication rate.

Staghorn stones are branching and usually infected stones that cover a large part of the collecting system (2). Failure to achieve stone-free status may lead to the complete loss of function and sepsis in the kidney by destroying the renal parenchyma. Guidelines recommend percutaneous nephrolithotomy (PCNL) as the gold standard treatment modality for renal stones > 2 cm (3). Overall stone-free rates in patients with PCNL reach 96.1% (4). However, since multiple percutaneous accesses may be required to remove all stone branches in staghorn stones, it is very difficult to achieve stone-free status in a single session in these patients (5). Therefore, as reported in previous studies, stone-free rates in staghorn stones can decrease to 56.9% (6). In addition to these low stone-free rates after PCNL, staghorn stones also have high complication rates. In a prospective randomized study, the intraoperative complication rate of PCNL applied in the treatment of

staghorn stones was found to be 16.3%, and the postoperative major complication rate was determined as 18.6% (7)

There are concerns related to the safe applicability of PCNL in geriatric patients with staghorn stones, who have bleeding tendency and low cardiopulmonary performance. Therefore, in this study, we aimed to compare the results between elderly and younger patients who underwent PCNL for treatment of staghorn renal stones.

Material and Methods:

This is a retrospective analysis of patients who underwent PCNL for staghorn renal stones at the Ministry of Health Izmir Bozyaka Training and Research Hospital between April 2011 and January 2017. All the data of the patients were obtained from their electronic medical records. Patients with a history of neuromuscular disease, congenital kidney anomalies, coagulopathy, skeletal deformity, and solitary kidneys, cases requiring multiple accesses, and patients without staghorn stones were excluded from the study. A total of 182 staghorn stones were divided into two groups according to patient age: those aged <65 years old were defined as Group-1 and those aged ≥65 years as Group-2. The demographic, perioperative and postoperative data were compared between these two groups.

All the patients were evaluated preoperatively using standard non-contrast abdominal computed tomography (CT). The patients' demographic characteristics such as gender and body mass index, and preoperative characteristics, including operation side and history, stone burden, metabolic syndrome (presence of at least two of the following diseases: diabetes mellitus, hypertension, hyperlipidemia and/or obesity), and stone density were recorded. In addition, intraoperative and postoperative results (operation time, fluoroscopy time, nephroscopy time, length of hospital stay, calyx accessed, complications, and stone-free status) were examined. Postoperative complications were evaluated according to the Clavien scoring system (8) and divided into two groups as minor (grades I and II) and major (grades III to V).

After the urine culture of the patients was confirmed to be negative, they were taken to the operation room. Ceftriaxone was administered to the patients as prophylaxis before the operation and continued until the nephrostomy tube was removed. No nephrotoxic drug was used in any of the patients before, during or after the operation.

Stone burden was calculated in square millimeters in all patients (length x width x π x 0.25, where 3.14 was taken as the mathematical constant) (9). For staghorn stones, this calculation was performed separately for each calyceal stone and the sum of all values was accepted as the result. All PCNL operations were performed by experienced urologists. Success was considered as complete stone-free status or detection of <4 mm stones on control CT performed at the first postoperative month.

PCNL procedure

After placing 5 or 6 F ureter catheters in the renal pelvis in the lithotomy position under general anesthesia, subcostal or intercostal access was achieved in all patients with an 18-gauge needle under fluoroscopy in the prone position depending on the location of the stone and the anatomy of the kidney. The entry site was dilated up to 30 Fr using Amplatz dilators, and the collecting system was entered with a nephroscope. The stones were fragmented with a pneumatic lithotripter (Vibrolith; Elmed, Ankara, Turkey). A 14 F nephrostomy tube was inserted postoperatively and antegrade pyelography was performed in all patients. If fever or significant hematuria was not detected, nephrostomy was clamped on the first or second postoperative day. After clamping, the nephrostomy tube was removed if there was no leakage from the nephrostomy edges and no renal colic.

Statistical Analysis

Statistical Package for the Social Sciences (SPSS IBM Corp.; Armonk, NY, USA) version 22 software package was used to analyze the data. The independent-samples t-test, chi-square test, and Fisher's exact test were used to compare the two groups. Quantitative data were expressed as mean $\pm$ standard deviation values in

tables. Categorical data were presented as numbers (frequency) and percentages (%). Data were analyzed at a 95% confidence level, and p value was considered significant if less than 0.05.

Results:

There were 139 patients in Group-1 and 43 patients in Group-2. The mean ages of the patients were 43.9 ± 10.6 and 67.8 ± 2.1 years in Group-1 and Group-2, respectively ($p = 0.001$). The mean stone size was $899 \pm 292 \text{ mm}^2$ in Group-1, it was $1,008 \pm 208 \text{ mm}^2$ in Group-2 ($p = 0.736$). The two groups were similar in terms of patient and stone characteristics (gender, body mass index, presence of metabolic syndrome, operation side, operation history, and stone density). Demographic data and stone characteristics are shown in detail in Table 1.

When we examined the operative data, we determined that the durations of operation, nephroscopy and fluoroscopy were similar between the groups ($p = 0.968$, $p = 0.149$, and $p = 0.342$ respectively). The calyx used for entry also did not significantly different between the two groups ($p = 0.479$). Detailed operative data are shown in Table 2.

When we evaluated the postoperative results, we observed that the amount of hemoglobin drop was statistically higher in Group-1 ($p = 0.001$). However, the need for blood transfusion was found to be higher in Group-2 than in Group-1 (18.6% and 7.2%, respectively). There was no significant difference between the two groups in terms of length of hospital stay and duration of nephrostomy tube use ($p = 0.855$ and $p = 0.352$, respectively). The stone-free rate was calculated as 54.7% in Group-1 and 67.4% in Group-2. No statistically significant difference was found between the two groups in terms of the stone-free rate ($p = 0.139$). Concerning the overall complication rates, 34.5% of patients in Group-1 and 46.5% of those in Group-2 were observed to develop complications. There was no statistically significant difference between the two groups in relation to the overall complication rates ($p = 0.206$). Postoperative complications and related results are shown in detail in Table 3.

When we examined the subgroups of complications according to the Clavien scoring system, the rate of minor complications was found to be 22.3% in Group-1 and 41.9% in Group-2, indicating a statistically significant difference ($p = 0.012$). The major complication rates were determined as 4.7% and 12.2% in Group-1 and Group-2, respectively ($p = 0.155$). In addition, the rate of Clavien grade-2 complications was statistically higher in the elderly group ($p = 0.019$). The details of the complications according to the Clavien scoring system are shown in Table 4.

Discussion:

The increase in the average life expectancy and aging population has resulted in more renal stones being detected in geriatric patients. It is important to determine the most appropriate method when treating renal stones in elderly patients due to age-related cardiovascular and pulmonary system deterioration and presence of multiple comorbidities. In elderly patients with multiple comorbidities, observation may be an option for asymptomatic small stones. However, in elderly patients, stone growth is observed to occur over a shorter time, and urinary tract infection causes pain that requires obstruction and analgesics (10), adversely affecting their kidney functions. Although PCNL is accepted as an effective and safe method in large renal stones, it can result in major complications. Skolarikos and de la Rosette reported that the rate of major complications after PCNL was 0.9-4.7% for septicemia, 0.6-1.4% for renal bleeding requiring an intervention, 2.3-3.1% for pleural injury, and 0.2-0.8% for colonic injury (11). Changes in the cardiorespiratory reserve of elderly patients make them less tolerant to bleeding or septic complications (12). Therefore, a detailed evaluation and a careful approach are required in the treatment of renal stones in elderly patients.

Despite advances in instrumentation and technology, staghorn stones are difficult to manage. In a study retrospectively reviewing 42 PCNL procedures performed on 33 patients aged 65 years and older compared with younger patients (47% of the stones were staghorn), 82% (27/33) of the patients were determined to achieve stone-free status or have fragments smaller than 5 mm at three months after surgery. In this study, PCNL was shown to be a safe and effective treatment for elderly patients, even in the presence of complex

renal stones; however, a higher rate of transfusion was required in this group (13). Şahin et al. reported the PCNL results of 27 patients aged over 60 years and compared them to 178 PCNL procedures performed in 166 younger patients at the same time interval (14). Only 25% of the patients had staghorn renal stones, and the success rate (stone-free status or fragments smaller than 4 mm) was 89% for the elderly and 92% for the younger patients. In contrast to previous studies reporting higher stone-free rates (78-93%) after PCNL in staghorn renal stones (5,15), the success rates obtained from the current study including only complete staghorn stones were found to be 67.4% and 54.7%, for the elderly and younger groups, respectively. This lower rate of success can be explained by technical limitations, such as the exclusion of partial staghorn stones, use of only one access point for each patient, lithotripsy being performed only with a pneumatic lithotripter, and not using a flexible nephroscope. Similar to our study, Kuzgunbay et al., who performed 47 PCNL procedures in 45 patients aged 65 years with complete staghorn stones and compared their data to 37 younger patients, found the success rate after the first procedure as 53% in the elderly group and 37.8% in the control group (16).

In our study, in which only complete staghorn stones were included, there was no significant difference between the stone sizes of the elderly and younger patients, which shows the comparability of the two groups in terms of stone burden. Furthermore, length of hospital stay, operation and fluoroscopy durations, and success rate were found to be similar in the elderly and younger groups. Therefore, we consider that advanced age does not have a negative effect on intraoperative parameters and postoperative outcomes in complex stones. However, in our study, while the decrease in hemoglobin was significantly higher in younger people (1.9 ± 1.3 g/dl versus 1.3 ± 1.2 g/dl, $p = 0.001$), the rate of transfusion requirement was moderately higher in the elderly (7.2% versus 18.6 %). This suggests that the rate of transfusion was higher in the elderly relative to the decrease in hemoglobin. The higher transfusion rate in the elderly indicates that they have lower tolerance to hemoglobin drop. Stoller et al. found higher blood transfusion rates after PCNL in elderly patients with complex renal stones (13). Şahin et al. reported the transfusion rates after PCNL as 21% in elderly patients and 18% in younger patients (14). In another study, the transfusion rate after PCNL in staghorn renal stones was detected as 10.6% in the elderly and 13.5% in the younger group, while the hemoglobin change was 1.46 ± 1.29 g/dl and 1.70 ± 1.33 g/dl, respectively (16).

Percutaneous nephrolithotomy is recognized as an effective and safe treatment option for large renal stones. Although the efficacy of the procedure has been proven, complication rates of up to 83% have been reported in the literature, including bleeding requiring transfusion (7%), organ damage (0.4%), and infectious events (up to 33%) (17,18). Elderly patients tend to have more comorbidities, making them more vulnerable to fatal bleeding and septic complications (19). In a study by Okeke et al., the overall complication rate after PCNL was significantly higher in elderly patients compared to younger patients (20). However, Karami et al. reported that age alone was not a predictive factor for high complication rates (21). In another study, no major complications were observed after PCNL in staghorn renal stones in the elderly and younger population, and their minor complication rates were similar (16). In contrast, in our study, there was a higher rate of minor complications, such as bleeding requiring transfusion in eight and postoperative fever requiring antibiotic change in seven of the 43 patients in the elderly group, while sepsis, pneumothorax and bowel injury were not observed in either group. This suggests that elderly patients are less tolerant of bleeding and less resistant to infectious events because they are more prone to having comorbidities. To our knowledge, this is the first study to separately evaluate post-PCNL complications in elderly patients with staghorn renal stones according to the Clavien-Dindo classification.

There are some limitations to our study. First, it had a retrospective design and a limited number of patients. Second, there was no long-term comparison of surgical complications. Finally, there is a need for prospective studies with a larger series of geriatric patients with staghorn stones, focusing specifically on complications, as well as evaluating their medical complications.

Conclusion:

This study showed that PCNL could be effectively and safely applied in the elderly population for the treatment of staghorn renal stones. However, since minor complications after PCNL are seen at a higher rate

in this patient group, it is necessary to be more cautious in terms of possible complication development.

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Conflict of interest: None

Ethical Standards: Informed consent was obtained pre-operatively from all of our patients which were included in our study.

Ethical compliance: All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

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