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Percutaneous Nephrolithotomy in High-Risk Patients: A Single-Center Experience with More than 350 Cases

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Key Words

Percutaneous nephrolithotomy · Surgical complications · Aging · Clavien system

Abstract

Purpose: To assess the surgical outcomes and peri- and postoperative complications following percutaneous nephrolithotomy (PCNL) in high- and low-risk patients according to the American Society of Anesthesiologists (ASA) score. ***Materials and Methods:*** We reviewed the patient records of 2,281 cases older than 18 years who had undergone PCNL in the 3 previous years. The patients were divided into two groups: a low-risk group (ASA score 1, 2: 1,922 cases) and a high-risk group (ASA score 3, 4: 359 cases). ***Results:*** Analysis of the location and size of the stone, number and type of access, surgical approach, post-PCNL serum hemoglobin and decrease in glomerular filtration rate revealed no significant difference between the two groups. The stone-free rate was similar in both groups and the hospital stay in the high-risk patients was significantly greater than in the low-risk cases. 95% of low-risk and 91% of high-risk cases had surgical complications compatible with grade ≤II (Clavien system) and overall distribution of different grades of surgical complications was similar between the two groups (p = 0.177). ***Conclusion:*** Success rate and surgical complications of PCNL in high-risk patients were comparable to low-risk patients. It seems that PCNL may be a safe and effective procedure even in high-risk patients.

Introduction

Percutaneous nephrolithotomy (PCNL) is the standard treatment of large (>2 cm) staghorn stones and stones refractory to extracorporeal shock wave lithotripsy [1]. Previously, different studies assessed the safety and efficacy of PCNL in children and healthy adult patients (with no comorbidity) [1–4], but there are a few reports about surgical outcomes and postoperative complications in high-risk patients (with one or more systemic diseases).

The greatest concern is that as a result of an overall increase in the survival rate there has been an inevitable burden on health services especially in the industrialized countries over the last two decades. Age is not viewed as an illness but the prevalence of systemic diseases increas-

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es with aging. We presented this study according to a retrospective design to assess the surgical outcomes and peri- and postoperative complications in high-risk patients and then compare different variables between the aforementioned patients and low-risk cases. The patients' risk was assessed according to the American Society of Anesthesiologists (ASA) score.

Materials and Methods

We reviewed the records of 2,281 patients older than 18 years who had undergone PCNL from April 2009 to April 2012 in the Labbafinejad Medical Center. All patients were assessed preoperatively by an anesthesiologist and the risk of surgery was determined according to the ASA score. The patients were divided into two groups: the low-risk group (ASA score 1, 2: 1,922 cases) and the high-risk group (ASA score 3, 4: 359 cases). All scoring was assessed by an experienced team of anesthesiologists.

Demographic data, perioperative variables and surgical complications according to the Clavien system were extracted from patient records and compared between these two groups. A decrease in hemoglobin was determined as the difference between the lowest level of postoperative hemoglobin and the preoperative level, and an increase in glomerular filtration rate (GFR) was determined as the difference between GFR at discharge and preoperative GFR.

Urine culture was obtained from all patients 2 weeks before surgery, and if it was positive, antibiotic therapy according to the antibiogram was initiated and urine culture rechecked 1 week later. If the urine was very cloudy or pyonephrotic after nephrostomy insertion, surgery was terminated, nephrostomy was fixed and PCNL postponed by 2 weeks.

All PCNL was performed by two endourologic fellows and one experienced endourologist under general anesthesia. The ureteral catheter was fixed, and then access to the stone was made by using fluoroscopic guidance; the tract was dilated using a single-stage technique up to 28- to 30-Fr, and stones were extracted with a grasper after having broken them by pneumatic lithotripter and holmium laser. The nephrostomy tube was inserted according to the surgeon's preference during the operation; this was not necessary for all procedures.

Statistical analysis was performed using SPSS software version 18. Data were normally distributed according to the Kolmogorov-Smirnov test. Quantitative variables were compared between the study groups using the t test. Comparison of qualitative variables was performed using the χ^2 test. Two-tailed $p < 0.05$ was considered statistically significant.

Results

There were 608 comorbidities in the low-risk group and 730 comorbidities in the high-risk group, and the most common disease in both groups was hypertension [227 (11.8%) in low-risk and 254 (70.7%) in high-risk cases]. 196 cases (10.2%) in the low-risk group and 124 cases (34.5%) in the high-risk group had chronic kidney disease (GFR <60 ml/min/1.73 m^2 for more than 3 months).

The mean age was significantly higher in the high-risk group (60 ± 10.9 vs. 43.9 ± 12.6, $p < 0.001$). Data on mean body weight (74.7 ± 13.6 vs. 74.6 ± 12.7 kg, $p = 0.86$) and a previous history of open stone surgery ($p = 0.25$) or PCNL ($p = 0.29$) parameters were similar in both groups. Analysis of perioperative parameters including position, number of accesses, and surgical approach and type of drainage revealed no significant difference between the high- and low-risk groups, with the exception of tubeless drainage which yielded better results in the low-risk patients ($p = 0.003$).

Mean stone size in the low-risk and high-risk patients was 971.54 and 1,108.36 mm^2, respectively, and the analysis of this variable between the two groups revealed no significant difference ($p = 0.18$), even though the prevalence of complete staghorn stones was slightly higher in the high-risk group (15.7 vs. 12.3%, $p = 0.082$). Likewise, distribution of stone location was comparable in the low-risk and the high-risk group [pelvic stone: 333 (17.6%) vs. 58 (16.5%), $p = 0.61$ and complete staghorn: 232 (12.3%) vs. 55 (15.7%), $p = 0.082$].

The stone-free rate (SFR) was similar in both groups (81.3% in the low-risk and 80.2% in the high-risk patients, $p = 0.76$). There was no significant difference between the mean operative time of these cases (96.6 ± 30 min in the low-risk group vs. 98 ± 31 min in the high-risk group, $p = 0288$). The hospital stay in the high-risk patients was significantly longer than in the low-risk cases (4 vs. 3.4 days, $p < 0.001$).

Preoperative GFR (67.6 ± 25.7 in the high-risk vs. 88.8 ± 26.9 in the low-risk patients, $p < 0.001$) and GFR at discharge (62.1 ± 23.9 in the high-risk vs. 82.7 ± 25.1 in low-risk patients, $p < 0.001$) were significantly lower in the high-risk patients but there was no significant difference between the low-risk and the high-risk group in the decrease in GFR as a result of the surgical procedure (5.7 vs. 6.4, $p = 0.46$).

The preoperative hemoglobin level (13.5 ± 1.6 in the high-risk vs. 14.1 ± 1.7 in the low-risk patients, $p < 0.001$) and the hemoglobin level at discharge (11.5 ± 1.5 in the high-risk vs. 12 ± 1.7 in the low-risk patients, $p < 0.001$) were significantly lower in the high-risk patients, but there was no significant difference in the decrease of hemoglobin between the low-risk and the high-risk group as a result of the surgical procedure (2.3 ± 1.4 vs. 2.3 ± 1.6, $p = 0.64$).

By using the Clavien system, 67% of the low-risk patients and 61% of the high-risk patients had no peri- and postoperative surgical complications. 95% of the low-risk and 91% of the high-risk cases had surgical complications compatible with grade ≤II. The requirement for blood transfusions was significantly higher in the high-risk group (15.6 vs. 11%, p = 0.014). Pleural injury, colonic perforation and urosepsis were rare in both groups and there was no significant difference (1.1 vs. 0.6%). The overall distribution of different grades of surgical complications was similar between the two groups (p = 0.177). Medical complications, which included cardiovascular events, neurologic complications, gastrointestinal bleeding, renal insufficiency and thromboembolic phenomena, were significantly higher in the high-risk group (6.4 vs. 3%, p = 0.0001).

Discussion

There are few studies on PCNL in high-risk patients and some of them assessed this procedure in a limited number of patients. It is to be expected that the rate of systemic diseases increases as the patients become older. Kuzgunbay et al. [5] revealed that no cases with a mean age of 18–36 years had underlying diseases but 73% of the patients with a mean age greater than 65 years had at least one systemic disease; thus, it seems that the assessment of surgical outcomes and complications in elderly patients can also show the prognosis of this surgery in high-risk patients.

Our center is a tertiary referral center, and approximately 760 PCNL have been performed in the previous 3 years (2,281 operations in 3 years). This large group of cases helps us to present more definitive data about differences in the outcome of PCNL in high-risk patients. The average number of underlying diseases in our high-risk patients was two but in the report of Patel et al. [6], this rate was 5.4 diseases per case.

Our demographic data revealed that while the male-to-female age ratio was 2/1 in the low-risk patients, it was 1/1 in the high-risk group. Also, Sahin et al. [7] after evaluation of PCNL in patients older than 60 years demonstrated that 61% of them were female while only 33% of the younger cases were female.

Basic factors including stone location and estimated stone burden were similar in both groups, even though the prevalence of complete staghorn stones was higher in the high-risk patients (15.7 vs. 12.3%, p = 0.082). Okeke et al. [8] showed that the prevalence of staghorn stones was higher in older patients in an unmatched analysis (27.8 vs. 21.8%), but this rate was nearly similar in a matched analysis. Likewise, they reported that the stone burden is significantly larger in older patients.

Possible theories for the higher prevalence of staghorn stones in elderly patients and high-risk cases are the following: a greater desire of surgeons and older patients to choose conservative management; this approach may lead to stone particle growth and then staghorn stone formation. A certain type of stone composition has a higher prevalence in high-risk and older patients, and this type of stones has a greater capacity for staghorn stone formation. Patel et al. [6] revealed that struvite stones have a significantly higher prevalence in older patients, and Stoller et al. [9] reported a higher rate of uric acid stone in elderly cases.

PCNL in the supine or lateral position under regional anesthesia had acceptable surgical outcomes and negligible complications in high-risk patients in earlier reports by El-Husseiny et al. [10] and Falahatkar et al. [11]. 2.2% of low-risk and 3.1% of high-risk patients in our study underwent PCNL in the supine position; it was, therefore, not possible to analyze the success rate and surgical complications in these two groups because of the small sample size.

Preoperative and postoperative GFR in the high-risk patients in our study were lower than in the low-risk cases. A higher average age and the prevalence of systemic diseases in patients with an ASA score of 3, 4 may explain the lower GFR rate in these patients. Nevertheless, the decrease in GFR after PCNL was very similar in both groups, and no significant difference was detected (p = 0.46). According to these results, PCNL has comparable outcomes in early post-PCNL renal function.

There are some paradoxical reports about perioperative bleeding and requirement for blood transfusion after PCNL in high-risk and aged patients. Resorlu et al. [12] demonstrated that when the Charlson Comorbidity Index (an index for the determination of the number and degree of underlying diseases) increases, the chance of bleeding will also increase (p = 0.011), and Unsal et al. [13] confirmed the findings of Resorlu et al. [12]. In a paradoxical report, Patel et al. [6] did not find any significant difference between low-risk and high-risk patients as regards perioperative bleeding and requirement for blood transfusions. In our patients, the blood transfusion rate was higher in the high-risk group (p = 0.014) but the decrease in hemoglobin after PCNL was very similar, and no significant difference was found (p = 0.64). Thus, a higher transfusion rate in the high-risk patients may be

related to a lower level of their preoperative hemoglobin (13.5.±1.6 vs. 14.1 ± 1.7, $p < 0.001$) and a lower threshold of surgeons for blood transfusions in high-risk patients and the elderly. A lower level of preoperative hemoglobin in high-risk patients may be related to a higher prevalence of chronic diseases in this group such as diabetes mellitus and chronic kidney disease.

Previous studies reported different findings as regards the effect of comorbidities and old age on the SFR after PCNL, while Duvdevani et al. [14] revealed that the success rate of PCNL in diabetic and nondiabetic patients is similar. Dore et al. [15] found that diabetes mellitus was the only systemic disease which had a significant effect on final SFR. Karami et al. [16] reported that there is no significant difference (85 vs. 90%, $p = 0.45$) in the success rate between the patients older than 65 years and younger ones, and another study by Kurien et al. [17] revealed that PCNL has an acceptable SFR (84%) in patients with chronic kidney disease. In the study of Resorlu et al. [12], the final SFR decreased significantly with an increase in Charlson Comorbidity Index (90.8% in patients with no comorbidities, 95.4% in patients with score 1 and 83.9% in patients with score ≥2, $p = 0.049$). It seems that according to the similar distribution of the stone burden ($p = 0.18$) and a very similar SFR ($p = 0.76$) in the two groups, comorbidities may have no significant effects on the final success rate of PCNL.

We found paradoxical results in different articles about operation time and hospital stay. In our study there was no significant difference in operation time between the two groups ($p = 0.238$). In a study by Patel et al. [6], the total operation time was longer in high-risk cases but pure operation time was similar. They concluded that monitoring and induction prolong the operation time and not PCNL. In our study, the hospital stay in the high-risk group was longer than in the low-risk patients, and this may be due to a higher number of minor complications such as fever and a transient rise in creatinine and, likewise, a higher rate of medical complications.

We did not detect any noticeable differences in the overall surgical complications and the distribution of different grades of complications according to the Clavien system ($p = 0.177$). Only one life-threatening event occurred in a 78-year-old woman with a previous history of Parkinson's disease and congestive heart failure who died in the recovery room after an uneventful PCNL. Serious medical complications were significantly higher in the high-risk cases ($p = 0.001$). A hypertensive crisis is a life-threatening emergency with high morbidity especially in patients with preoperative intermittent uncontrolled hypertension. A hypertension crisis is often managed using diuretics and nitroglycerin (TNG). Likewise, cardiac dysrhythmia was controlled using medical agents and usually improved during the first postoperative day. Resorlu et al. [12] revealed after the assessment of 283 patients aged more than 60 years that 7.6% of patients with no comorbidity, 12% of patients with one systemic disease such as cerebrovascular accident or myocardial infarction and 29% of patients with a more severe underlying disease such as severe hepatic dysfunction experienced life-threatening medical events. We think that these results may be slightly higher than expected; for example, 7.6% serious medical complications in elderly patients with no comorbidity after a minimally invasive procedure are not acceptable.

Our findings revealed that tubeless drainage yields better results in the low-risk group ($p = 0.003$). We have no definitive hypothesis that explains this finding, but this difference may be the result of surgeons paying more attention to comorbidities and the higher mean age of high-risk patients. Thus, surgeons preferred to perform PCNL with nephrostomy insertion instead of tubeless PCNL in high-risk cases. We accept that a higher rate of nephrostomy insertion in high-risk patients may be a confounding factor to assess the rate of surgical complications, and it is a limitation of our retrospective study.

Spinal anesthesia, using the supine or lateral decubitus position, proper control of preoperative comorbidities such as hypertension, diabetes mellitus and cardiovascular diseases, and effective conservative management are our recommendations for PCNL in high-risk and elderly patients. It seems that PCNL in high-risk cases can be performed with acceptable safety and efficacy in experienced hands.

Conclusion

The success rate of PCNL in high-risk patients with multiple comorbidities was comparable to that in low-risk patients. Our findings revealed that the overall surgical complication rate was very similar in both groups but high-risk patients had a higher rate of minor medical complications, even though life-threatening surgical events were uncommon in these cases. Thus, it seems that PCNL may be a safe and effective procedure even in high-risk patients.

References

1 De la Rosette J, Assimos D, Desai M, Gutierrez J, et al; CROES PCNL Study Group: The Clinical Research Office of the Endourological Society Percutaneous Nephrolithotomy Global Study: indications, complications, and outcomes in 5,803 patients. J Endourol 2011; 25:11–17.

2 Guven S, Frattini A, Onal B, Desai M, et al; CROES PCNL Study Group: Percutaneous nephrolithotomy in children in different age groups: data from the Clinical Research Office of the Endourological Society (CROES) Percutaneous Nephrolithotomy Global Study. BJU Int 2012;111:148–156.

3 Kumar R, Anand A, Saxena V, Seth A, Dogra PN, Gupta NP: Safety and efficacy of PCNL for management of staghorn calculi in pediatric patients. J Pediatr Urol 2011;7:248–251.

4 Schuster TK, Smaldone MC, Averch TD, Ost MC: Percutaneous nephrolithotomy in children. J Endourol 2009;23:1699–1705.

5 Kuzgunbay B, Turunc T, Yaycioglu O, Kayis AA, Gul U, Egilmez T, Aygun C, Ozkardes H: Percutaneous nephrolithotomy for staghorn kidney stones in elderly patients. Int Urol Nephrol 2011;43:639–643.

6 Patel SR, Haleblian GE, Pareek G: Percutaneous nephrolithotomy can be safely performed in the high-risk patient. Urology 2010;75:51–55.

7 Sahin A, Atsü N, Erdem E, Oner S, Bilen C, Bakkaloğlu M, Kendi S: Percutaneous nephrolithotomy in patients aged 60 years or older. J Endourol 2001;15:489–491.

8 Okeke Z, Smith AD, Labate G, D'Addessi A, Venkatesh R, Assimos D, Strijbos WE, de la Rosette JJ, CROES PCNL Study Group: Prospective comparison of outcomes of percutaneous nephrolithotomy in elderly patients versus younger patients. J Endourol 2012;26: 996–1001.

9 Stoller ML, Bolton D, St Lezin M, Lawrence M: Percutaneous nephrolithotomy in the elderly. Urology 1994;44:651–654.

10 El-Husseiny T, Moraitis K, Maan Z, Papatsoris A, et al: Percutaneous endourologic procedures in high-risk patients in the lateral decubitus position under regional anesthesia. J Endourol 2009;23:1603–1606.

11 Falahatkar S, Allahkhah A, Soltanipour S: Supine percutaneous nephrolithotomy: pro. Urol J 2011;8:257–264.

12 Resorlu B, Diri A, Atmaca AF, Tuygun C, et al: Can we avoid percutaneous nephrolithotomy in high-risk elderly patients using the Charlson Comorbidity Index? Urology 2012; 79:1042–1047.

13 Unsal A, Resorlu B, Atmaca AF, Diri A, et al: Prediction of morbidity and mortality after percutaneous nephrolithotomy by using the Charlson Comorbidity Index. Urology 2012; 79:55–60.

14 Duvdevani M, Nott L, Ray AA, Ko R, Denstedt JD, Razvi H: Percutaneous nephrolithotripsy in patients with diabetes mellitus. J Endourol 2009;23:21–26.

15 Dore B, Conort P, Irani J, Ferriere JM, Glemain P, et al: Percutaneous nephrolithotomy in subjects over the age of 70: a multicenter retrospective study of 210 cases. Prog Urol 2004;14:1140–1145.

16 Karami H, Mazloomfard MM, Golshan A, Rahjoo T, Javanmard B: Does age affect outcomes of percutaneous nephrolithotomy? Urol J 2010;7:17–21.

17 Kurien A, Baishya R, Mishra S, Ganpule A, et al: The impact of percutaneous nephrolithotomy in patients with chronic kidney disease. J Endourol 2009;23:1403–1407.