

Effect of obesity on percutaneous nephrolithotomy outcomes in Staghorn stones

Staghorn taşlarda obezitenin perkütan nefrolitotomi sonuçları üzerine etkisi

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Özet

Amaç: Bu çalışmada, staghorn böbrek taşlarında, obezitenin perkütan nefrolitotomi (PCNL) başarısı ve komplikasyonları üzerine etkisini değerlendirmeyi amaçladık.

Gereç ve Yöntemler: 2012 ile 2017 yılları arasında staghorn böbrek taşı nedeniyle tek akses PCNL uygulanan 183 hastanın dosyaları retrospektif olarak incelendi. Hastalar vücut kitle indekslerine (VKİ) göre iki gruba ayrıldı. VKİ < 30 kg/mm² olan hastalar Grup-1, > 30 kg/mm² olan hastalar ise Grup-2 olarak tanımlandı. Bu iki grup arasında hastaların demografik özellikleri, perioperatif ve postoperatif sonuçları karşılaştırıldı.

Operasyon sonrası >4 mm taş saptanması rezidü olarak tanımlandı. Komplikasyonlar Clavien skorlama sistemine göre sınıflandırıldı.

Bulgular: Çalışmaya dahil edilen 183 staghorn böbrek taşı olan hastanın 127'si Grup-1 de 56'sı ise Grup-2'deydi. Hastaların ortalama VKİ leri grup-1 ve grup-2'de sırasıyla 24.5±2.7 kg/mm² ve 32.3±2.2 kg/mm² idi (p=0.001). Metabolik sendrom saptanan hasta sayısı da anlamlı olarak grup-2'de daha fazlaydı (p=0.001). Grup-1 ve Grup-2'deki ortalama taş büyüklüğü sırasıyla 848±302 mm² ve 1020±197 mm² idi (p=0.535). Operasyon verilerine baktığımızda, gruplar arasında operasyon, nefroskopi ve skopi süreleri benzerdi (sırasıyla p=0.800, p=0.123, p=0.107). Postoperatif sonuçları değerlendirdiğimizde, Grup-1'de taşsızlık % 55.6 olarak saptanırken grup-2'de bu oran % 62.5 idi (p=0.381). Total komplikasyon oranlarına baktığımızda ise grup-1'de % 38.9 hastada komplikasyon saptanırken, grup-2'de % 33.9 hastada komplikasyon saptandı (p=0.523).

Abstract

Objective: In this study, we aimed to compare the success and complication rates of percutaneous nephrolithotomy (PCNL) in obese patients with staghorn renal stones.

Material and Methods: Between January 2012 and December 2017, 183 patients who had single access PCNL for staghorn renal calculi were evaluated retrospectively. Patients were divided into two groups according to body mass index (BMI). The patients with BMI < 30 kg/mm² and >30 kg/mm² were defined group-1 and group-2, respectively. Among the groups, we compared demographic characteristics, perioperative and postoperative datas.

Postoperatively, >4 mm stone was identified as residual fragment. Complications were classified according to the Clavien scoring system.

Results: In our study, there were 127 and 56 patients with staghorn renal calculi in the Group-1 and Group-2, respectively. The mean BMI were 24.5±2.7 kg/mm² and 32.3±2.2 kg/mm² in the Group-1 and Group-2, respectively (p=0.001). The number of patients with metabolic syndrome was also statistically significant higher in group-2 (p=0.001). The mean stone size were 848±302 mm² and 1020±197 mm² in the Group-1 and Group-2, respectively (p=0.535). Operation, nephroscopy and fluoroscopy times were similar between the groups (p=0.800, p=0.123, p=0.107 respectively). When we evaluated the postoperative results, stone-free rates were 55.6% and 62.5% in group-1 and group-2, respectively (p=0.381). Total complication rates were 38.9% and 33.9% in group-1 and group-2, respectively (p = 0.523).

The study was approved by the Ethics Committee of İzmir Bozyaka Training and Research Hospital (Approval number: 2021/126. Date: 2021, July 28). All research was performed in accordance with relevant guidelines/regulations, and informed consent was obtained from all participants.

Clavien skorlama sistemine göre komplikasyonların alt gruplarını incelediğimizde minör komplikasyon oranı grup-1'de % 27.6 iken grup-2'de % 25.0 olarak saptandı ve bu fark istatistiksel olarak anlamlı değildi ($p=0.697$). Majör komplikasyon oranı ise grup-1 ve grup-2'de sırasıyla %11.0 ve % 8.9 olarak bulundu ($p=0.657$).

Sonuç: PCNL, obez hastalarda da kompleks taşların tedavisinde etkin ve güvenilir bir tedavi yöntemi olarak kullanılabilir.

Anahtar Kelimeler: Perkütan nefrolitomi, Staghorn böbrek taşı, Clavien skorlama sistemi, obezite, vücut kitle indeksi.

Investigating the subgroups of complications according to the Clavien scoring system, the rate of minor complications were 27.6% and 25.0% in the group-1 and group-2, respectively and this difference was not statistically significant ($p = 0.697$). Major complication rates were 11.0% and 8.9% in the group-1 and group-2, respectively ($p=0.657$).

Conclusion: PCNL is an effective and safe treatment method for staghorn stones in obese patients.

Keywords: Percutaneous nephrolithotomy, Staghorn renal calculi, Clavien scoring system, obesity, body mass index.

INTRODUCTION

Staghorn stones are branching and usually infected stones that cover a large part of the collecting system (1). Obesity has been shown to increase the risk of nephrolithiasis (2,3). Failure to achieve stone-free status may lead to the complete loss of function and sepsis in the kidney by destroying the renal parenchyma (4). The success of PCNL is up to 96.1% (5). However, since multiple percutaneous accesses may be required to remove all stone branches in staghorn stones, it is very difficult to achieve success in these patients (6). Therefore, as reported in previous studies, stone-free rates in staghorn stones can decrease to 56.9% (7). 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 for staghorn stones was found to be 16.3%, and the postoperative major complication rate was determined as 18.6% (8)

Individuals with a high body mass index (BMI) are at high risk for cardiovascular complications, malignancies, metabolic disorders and premature death (9). In addition, many studies have shown obesity is an independent risk factor for anesthetic and surgical complications (10-13). The presence of obesity in the patient reveals various treatment difficulties during PCNL. These patients cannot easily tolerate the prone position for a long time and it can be seen that the maneuverability and height of the nephroscope are insufficient due to the thicker subcutaneous fat layer (14).

Because of these difficulties, urologists are hesitant to operate on patients with high BMI and staghorn stones. In this study, we aimed to compare the outcomes and complications of PCNL in patients with BMI less

and more than 30 kg/mm² to determine PCNL's safety and success in obese patients with staghorn stones.

MATERIAL AND METHODS

This retrospective study was conducted between April 2012 and January 2017 (approved by the Ethics Committee of İzmir Bozyaka Training and Research Hospital, approval number: 2021/126). Patients with a skeletal deformity, congenital kidney anomalies, coagulopathy, and solitary kidneys, cases requiring multiple accesses, and patients without staghorn stones were excluded from the study. BMI <30 kg/m² were defined as Group-1 and those BMI ≥30 kg/m² as Group-2.

All the patients were evaluated preoperatively using computed tomography (CT). The patients' demographic and preoperative characteristics, including operation side and history, stone burden, gender, metabolic syndrome, and stone density were recorded. In addition, intraoperative and postoperative results (operation and fluoroscopy time, nephroscopy time, calyx accessed, complications, and stone-free status) were examined. Complications were detailed according to the Clavien scoring system (15).

After the urine culture of the patients was confirmed to be negative, they were taken to the operation room.

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) (16). 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 stoneless or detection of <4 mm stones on control CT performed at the first postoperative month.

Operation Technique

After placing 5 or 6 F ureter catheters under general anesthesia, subcostal or intercostal access was achieved in all patients with an 18-gauge needle with fluoroscopic guidance 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. Lithotripsy was performed with a pneumatic lithotripter (Vibrolith; Elmed, Ankara, Turkey).

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.

RESULT

There were 127 patients in Group-1 and 56 patients in Group-2. The mean BMI of the patients was 24.5 ± 2.7 kg/m² and 32.3 ± 2.2 kg/m² in group-1 and group-2, respectively ($p=0.001$). The number of patients with metabolic syndrome was also significantly

higher in group-2 ($p=0.001$). The mean ages of the patients were 48.4 ± 14.4 and 52.1 ± 12.5 years in Group-1 and Group-2, respectively ($p = 0.069$). While the mean stone burden was 848 ± 302 mm² in group-1, it was 1020 ± 197 mm² in group-2 ($p=0.535$). Patient and stone characteristics (gender, operation side, operation history, and stone density) were similar (Table-1).

When we examined the operative data, we determined that the duration of operation, nephroscopy and fluoroscopy were similar ($p = 0.800$, $p = 0.123$, and $p = 0.107$, respectively) (Table 2).

When we evaluated the postoperative results, we observed that the hospitalization time and duration of nephrostomy tube were similar ($p=0.735$, $p=0.484$, respectively). While the number of patients requiring blood transfusion was 13 in group-1, it was 9 in group-2 ($p=0.325$). The mean creatinine change values was similar for both groups ($p=0.091$).

The stone-free rate were 55.6 % in Group-1 and 62.5% in Group-2 ($p = 0.381$). Concerning the total complication rates, 38.9 % of patients in Group-1 and 33.9 % of those in Group-2 were observed to develop complications ($p=0.523$) (Table 3).

Examination of the subgroups of complications, the rates of minor complications were found to be 27.6 % in Group-1 and 25.0 % in Group-2 ($p = 0.697$). The major complication rates were determined as 11.0 % and 8.9 % in Group-1 and Group-2, respectively ($p = 0.657$) (Table-4).

Table 1. Comparison of demographic data and stone characteristics

	Group-1	Group-2	p
Number of patients (n)	127	56	
Gender (female/male)	28/98	29/27	0.001
Age (year)*	48.4 \pm 14.4	52.1 \pm 12.5	0.069
Body mass index (kg/m ²)*	24.5 \pm 2.7	32.3 \pm 2.2	0.001
Metabolic syndrome	1 (0.8%)	8 (14.3%)	0.001
History of operation(n,%)	39 (31.0%)	24 (42.9%)	0.119
Stone size (mm ²)*	848 \pm 302	1020 \pm 197	0.535
Hounsfield unit (HU)*	1092 \pm 351	1021 \pm 305	0.304
Operation side (right/left) (n/n)	59/67	24/32	0.620

*mean \pm standard deviation

Table 2. Comparison of operative data between the study groups

	Group-1	Group-2	p
Number of patients(n)	127	56	
Duration of operation (min)*	124.2±47.7	121.7±36.7	0.800
Duration of nephroscopy (min)*	59.2±36.1	64.4±31.8	0.123
Duration of fluoroscopy (sec)*	79.3±64.0	91.1±61.5	0.107
Access localization			0.315
Lower calyx	71 (56.3%)	36 (64.3%)	
Middle calyx	55 (43.7%)	20(35.7%)	

*mean ± standard deviation

Table 3. Comparison of complications and postoperative outcomes

	Group-1	Group-2	p
Number of patients(n)	127	56	
Overall complication	49 (38.9%)	19 (33.9%)	0.523
Clavien-Dindo classification			
Grade 1/2	35 (27.6%)	14 (25.0%)	0.697
Grade 3/4	14 (11.0%)	5 (8.9%)	0.657
Blood ransfusion requirement (n,%)	13(10.3%)	9 (16.1%)	0.325
Hemoglobin drop (gr/dl)*	1.8±1.3	1.8±1.3	0.998
Creatinine change (mg/dl)*	0.2±0.2	0.1±0.2	0.091
Duration of nephrostomy (day)*	2.4±1.1	2.2±0.8	0.484
Duration of hospitalization (day)*	4.4±3.0	4.0±2.0	0.735
Success	70(55.6%)	35 (62.5%)	0.381

*mean ± standard deviation

Table 4. Classification of complications according to the Clavien scoring system

Grade	Complication	Group-1 (n=127)	Group-2 (n=56)	p
0	Total:	78 (61.4%)	37 (66.1%)	0.523
1	- Postoperative pain that regresses with opioid therapy	2	1	0.569
	- Bleeding that does not require blood transfusion	2	1	
	- Postoperative fever that does not require antibiotic change (>38 °C)	3		
	Total:	7 (5.5%)	2 (3.6%)	
2	- Bleeding requiring blood transfusion	11	8	0.905
	- Postoperative fever requiring antibiotic change (>38 °C)	17	4	
	Total:	28 (22.0%)	12 (21.4%)	
3A	- Hydrothorax requiring tube thoracostomy under local anesthesia	2	-	0.719
	- Nephrostomy under local anesthesia due to urinoma	-	1	
	- Double-J stent insertion under local anesthesia due to urinary leakage from the tract	9	3	
	Total:	11(8.7%)	4 (7.1%)	
3B	- Bleeding controlled by angioembolization	1	-	0.800
	- Double-J stent placement under general anesthesia due to urinary leakage from the tract	2	1	
	Total:	3 (2.4%)	1 (1.8%)	

DISCUSSION

Obesity is a chronic disease that occurs with the accumulation of excess fat in the body as a result of the energy taken into the body by food is more than the energy spent (17). In the last three decades, an increase in the incidence of obesity has been observed worldwide, and it has been demonstrated in various studies that obesity is an important etiological factor responsible for metabolic syndrome, malignancies, and cardiovascular diseases, and it is strongly associated with the formation of urinary system stone disease (18,19).

Obesity can cause various difficulties in surgery. Previous studies have reported that obese patients have higher postoperative morbidity. Obesity has been associated with an increase in the frequency and severity of complications in various surgical procedures, and also leading to significantly higher rates of all-cause mortality (10,20). Staghorn stones are difficult to manage despite advances in instrumentation and technology. Although PCNL is an effective and safe method for renal stones, major complications can be seen. Urologists have some reservations in the management of these patients due to the addition of obesity to the difficulty of this surgical procedure.

The effect of BMI on outcomes of urological procedures has been investigated in previous studies, longer operative times and increased blood loss have been reported in patients with high BMI (21,22). In contrast, Carson et al. showed that the operative time, hospitalization time, complication and stone-free rates in obese patients following PCNL were similar to non-obese patients (23). In our study, the operation time, length of hospital stay, blood loss, stone-free and complication rates were similar in both groups.

Although previous studies reported higher stone-free rates (78-93%) after PCNL in staghorn kidney stones (6,24), the success rate in our study was 55.6% and 62.5% in patients with BMI<30 kg/m² and BMI≥30 kg/m², respectively. This low rate of success can be explained by technical limitations such as single access for each patient, performing lithotripsy only with a pneumatic lithotripter, and lack of flexible nephroscope. In addition, the thick subcutaneous

adipose tissue in patients with a BMI above 30 kg/m² may cause insufficient nephroscope or amplatz sheath length and restrict maneuverability. This may affect the success by causing difficulties to reach the renal collecting system or stone.

Similar to previous studies, our findings suggest that BMI has no adverse effect on PCNL outcomes. Bagrodia et al. stated their results after PCNL in 70 patients with BMI<30 kg/m² (29 of them with staghorn stones) and 80 patients with BMI≥30 kg/m² (33 of them with staghorn stones), and they found similar transfusion, complications and residual stones rates (25). Simsek et al. evaluated the effect of BMI on the success of PCNL. In the study, approximately half of the groups (BMI<25 kg/m², 25-29.9 kg/m², 30-39.9 kg/m², and >40 kg/m²) had complete or partial staghorn stones, and between the groups there was no significant difference in terms of success, hospital stay, operation time, complications, and fluoroscopy time (26). Our results provides consistency with these studies.

There are some limitations in 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, further prospective studies are needed with a larger series, focusing specifically on complications.

CONCLUSION

PCNL is an effective and safe method with higher success and acceptable complication rates in the treatment of staghorn kidney stones in obese patients.

Conflict of Interest

All authors declared that there is no conflict of interest.

Financial Disclosure

The authors declared that this study has received no financial support.

Ethical Approval

The study was approved by the Ethics Committee of İzmir Bozyaka Training and Research Hospital (Approval number: 2021/126) (Date: 2021, July 28). The study protocol conformed to the ethical guidelines of the Helsinki Declaration.

Author Contributions

Conception and design; MŞ, data acquisition; OE, data analysis and interpretation; MŞ, drafting the manuscript; OE, critical revision of the manuscript for scientific and factual content; OE, statistical analysis; MŞ, supervision; MŞ.

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