Smyrna Tıp Dergisi ***Araştırma Makalesi***

Complications of Percutaneous Nephrolithotomy and Effecting Factors
Perkütan Nefrolitotomi Komplikasyonları ve Etkileyen Faktörler

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Summary
Objective: Aim of this study is to analyze the complications that occurred during or following percutaneous nephrolithotomy and factors that affect these complications.
Material and Methods: A total of 126 patients has been retrospectively analyzed. Demographic data of patients, comorbidities, hospitalization time, stone localization, entry site, entry type, number of tracts, stone size, laboratory parameters were recorded. Patients with normal serum urea and creatinine values were evaluated. Preoperative abdominal tomography was performed. Only patients with sterile urine cultures were taken into operation.
Results: One entry was obtained in 116 (92.1%) cases and two entries were obtained in 10 (7.9%) cases. Subcostal entries were performed in 103 (81.7%) cases, intercostal entries were performed in 13 (10.3%) cases and both subcostal and intercostal entries were performed in 10 (7.9%) cases. Major complications were seen in 4.8% and minor complications were seen in 27.8% of the cases. Statistically significant effect of prior renal surgery history, mai mic, hematocrit fall, stone free rate, post-operative Hg, WBC, BUN and creatinine were detected respectively ($p=0.013$; $p=0.001$; $p<0.0001$; $p<0.0001$ $p<0.0001$; $p<0.0001$; $p<0.0001$ and $p=0.001$).
Conclusion: Examining the complications of the PCNL operation will not only provide the surgeon with an idea and a chance to predict the possible results, but also will provide the chance to influence the result by taking some precautions in the preoperative period.
Key words: Complications, kidney stones, percutaneous nephrolithotomy

Özet
Amaç: Bu çalışmanın amacı perkütan nefrolitotomi sırasında ve sonrasında gelişen komplikasyonları ve bu komplikasyonları etkileyen faktörleri incelemektir.
Gereç ve Yöntem: Toplam 126 hasta retrospektif olarak incelendi. Hastaların demografik verileri, ek hastalıkları, hastanede kalış süreleri, taşın lokalizasyonu, giriş yeri, giriş şekli, trakt sayısı, taş boyutu, laboratuvar parametreleri kaydedildi. Serum üre ve kreatinin değerleri normal olan hastalar değerlendirildi. Preoperatif karın tomografisi tüm hastalara yüzüstü pozisyonda çekildi. Sadece steril idrar kültürü olan hastalar operasyona alındı.
Bulgular: 116 (%92,1) vakada bir, 10 (%7,9) vakada iki kayıt elde edildi. 103 (%81,7) olguya subkostal giriş, 13 (%10,3) olguya interkostal giriş ve 10 (%7,9) olguya hem kostal hem de interkostal giriş yapıldı. Olguların %4,8'inde majör, %27,8'inde minör komplikasyonlar görüldü. Önceki böbrek cerrahisi öyküsü, maimi, hematokrit düşüşü, taşsızlık oranı, ameliyat sonrası Hg, WBC, BUN ve kreatinin sırasıyla istatistiksel olarak anlamlı etkisi saptandı ($p=0.013$; $p=0.001$; $p<0.0001$; $p<0.0001$ $p< 0,0001$; $p<0,0001$; $p<0,0001$ ve $p=0,001$).
Sonuç: PCNL operasyonunun komplikasyonlarını incelemek cerraha sadece bir fikir ve olası sonuçları tahmin etme şansı sağlamakla kalmayıp; aynı zamanda ameliyat öncesi dönemde gerekli önlemleri alarak sonucu etkileme şansı da sağlar.
Anahtar kelimeler: Komplikasyonlar, böbrek taşları, perkütan nefrolitotomi

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Introduction

Urinary system stones are considered to be among the first diseases affecting the life of human beings since ancient times (1). Current

treatment of stone disease has made great progress in the last 30 years. It is reported that the probability of encountering this disease in any period of people's lives is 10% (2).

About 3 decades ago, open surgery was the only option in the treatment of kidney and ureteral stones above the size of spontaneous fall (3). However, today, external shock wave therapy (ESWL), percutaneous nephrolithotomy (PCNL), rigid or flexible ureterorenoscopy (fURS), laparoscopy and open surgery are among the current treatment alternatives for kidney stones. Major advances in these methods in recent years have made it possible to treat urinary tract stones without the need for open surgery (4). It has been shown in large series that the success of this method is over 90% (5).

The anatomy of the kidney, the size, location and structure of the stone, the anatomical and social factors of the patient, surgical experience and technique are among the factors affecting the success (6). Despite the high success rate, this technique can occasionally develop complications that can be considered serious (7).

In this study, it was aimed to analyze the complications in percutaneous nephrolithotomy and the factors that are thought to affect the development of complications. Thus, it is aimed to inform the cases to be treated with this method in detail about the treatment and its results.

Material and Method

A total of 126 patients has been retrospectively analyzed. Individuals who have applied to the urology outpatient clinic and underwent percutaneous nephrolithotripsy operation have been enrolled. The study has been approved by the ethics committee at 01.04.2021 with protocol number 2021/32.

Demographic data of patients, comorbidities, hospitalization time, stone localization, entry site, entry type, number of tracts, stone size, preoperative and postoperative hematocrit values, hydronephrosis degree, operation time, scopy duration, amount of residual stone, if any, postoperative ESWL or DJ, the need for insertion, the time of nephrostomy removal, the presence of opaque or non-opaque stones, whether through-through access was provided, whether triangulation was performed and complications were recorded and examined. All patients were evaluated with preoperative total blood count, serum urea, creatinine, SGOT, SGPT, Na, K values, bleeding and coagulation parameters, serological tests (HBV, HCV, HIV), complete urinalysis and urine culture. Patients using anticoagulant drugs were discontinued one week before the operation after consultation with the relevant departments. Patients with bacterial growth in urine cultures were treated with antibiotics for at least one week before the operation and were operated when their urine cultures were sterile.

Patients with normal serum urea and creatinine values were evaluated by prone abdominal CT at the preoperative stage. Direct urinary system radiographs were taken on the morning of the operation of the patients whose stone localization could change in the collecting system. The degree of hydronephrosis in the kidney was defined as no, mild, moderate and advanced. According to the radiological findings, the stones of the patients; divided as opaque and non-opaque. Stones were classified according to their location as lower, middle, upper calyx, pelvis or their combinations. The size of the stones was calculated in mm^2 by measuring the largest diameter and the diameter that cuts it perpendicularly with the help of a ruler and multiplying the values. In multiple stones, all stones were measured individually and the total size was obtained. In all cases, an attempt was made to clear the stones in a single session. The amount of bleeding was determined by evaluating the hematocrit change and the need for transfusion.

Antibiotic prophylaxis was performed by using cephalosporin group until the nephrostomy tube was removed, and fever exceeding 38°C was considered significant. Urine and blood cultures were obtained from patients with fever, and these patients were treated according to the causative pathogen. The patients were evaluated with DUSG and abdominal CT after the 4 first week of the operation. Postoperative complications were recorded.

Statistical Analysis

Data analysis was conducted using SPSS 23.0 package program. Frequency and percentage were given for categorical data, and median, minimum, and maximum descriptive values for continuous data. Categorical variables were evaluated with

chi-square or fisher's exact probability test. The effects of risk factors, which were thought to have a significant effect on the development of complications as a result of univariate statistical analyzes, were investigated with logistic regression analysis. Odds ratio, 95% confidence interval for each risk factor was calculated. P value less than 0.05 was considered statistically significant.

Results

Within the scope of the study, 126 patients aged between 18 and 79 years (median 45) were included in the evaluation. Distribution of demographic and clinical characteristics of individuals were given in table 1.

The distribution of the laboratory data of the patients before and after the operation was given in table 2. When the table was examined, the hemoglobin level of the patients showed a slight

Table 1. *Distribution of demographic and clinical characteristics of individuals*

Characteristics (N=126)		**Median (Min-Max) or n (%)**
Age, years		45 (18-79)
Gender (Male/Female)		91 (72.2) / 35 (27.8)
Comorbidity	None	80 (63.5)
	Diabetes Mellitus	15 (11.9)
	Hypertension	16 (12.7)
	Hyperlipidemia	3 (2.4)
	Coronary artery disease	12 (9.5)
Operation Number	Primary	102 (81.0)
	Secondary	19 (15.0)
	Tertiary	5 (4.0)
Previous ESWL		19 (15.1)
Side	Right	54 (42.9)
	Left	72 (57.1)
Localization of Stone	Kidney upper poles	3 (2.4)
	Kidney medium poles	23 (18.3)
	Kidney renal pelvis	68 (54.0)
	Kidney lower poles	21 (16.7)
	Stanhorn stone	11 (8.7)
Stone size, mm^2		745.7 (286.4-1980.6)
Punc number	1st entry	116 (92.1)
	2nd entry	10 (7.9)
Punc Site	Kidney upper poles	2 (1.6)
	Kidney medium poles	34 (27.0)
	Kidney renal pelvis	8 (6.3)
	Kidney lower poles	82 (65.1)
Number of entries:	Intercostal entry	13 (10.3)
	Subcostal entry	103 (81.7)
	Subcostal+intercostal entry	10 (7.9)
Pnm. Number		765 (70-3630)
Mai Mic		20 (6-30)
Operation time, minutes		124 (45-280)
Scopy time, minutes		6.2 (0.4-17.9)
Hematocrit drop		1.9 (0.2-7.4)
Degree of hydronephrosis	None	10 (7.9)
	Mild	19 (15.1)
	Moderate	68 (54.0)
	Severe	29 (23.0)
Stone Free Rate		16 (12.7)
Nephrostomy withdrawal time, days		3 (2-5)
Duration of hospital stay, days		4 (3-16)

decrease after the operation compared to before. WBC, BUN and creatinine values increased after the operation compared to before the operation.

Table 2. *Distribution of individuals' laboratory parameters*

Variables (N=126)	Median (Min-Max)
Pre-op Hg	13.6 (10.8-17.8)
Post-op Hg	11.4 (6.5-17.3)
Pre-op WBC	8.1 (5.2-11.2)
Post-op WBC	14.1 (10.4-28.9)
Pre-op BUN	15.0 (6.0-27.0)
Post-op BUN	16.0 (7.0-82.0)
Pre-op Creatinine	0.8 (0.1-9.0)
Post-op Creatinine	0.9 (0.4-3.4)

The distribution of minor and major complications seen in 126 patients evaluated within the scope of the study is given in Table 3.

Table 3. *Distribution of major and minor complications*

Variables (N=126)	n (%)
Minor Complications	**35 (27.8)**
Post-operative Fever (>38°C)	13 (10.3)
Symptomatic UTI	6 (4.8)
Post-op Urine Culture	6 (4.8)
Infiltration after nave	5 (4.0)
Post-op DJ hanging out	11 (8.7)
Clot colic	1 (0.8)
Post-op Ureteral stone	4 (3.2)
No post-op surgery	4 (3.2)
Bleeding after naphtha	2 (1.6)
Post-op trasfusion	11 (8.7)
Major Complications	**6 (4.8)**
urosepsis	1 (0.8)
need for Open Exploration	1 (0.8)
hemothorax	1 (0.8)
bronchospasm	1 (0.8)
Resistant Hypotension	1 (0.8)
Atrial Fibrillation	1 (0.8)
Total complication	**35 (27.8)**

The distribution of demographic and laboratory parameters affecting the development of complications was given in Table 4. When the table was examined it was seen that having a second operation compared to a single operation caused 3.6 times more complications. Due to the small number of patients who underwent a third operation, it did not pose a statistical risk in the development of complications compared to a single operation. Considering the laboratory parameters, it was determined that while the increase in hemoglobin level after the operation reduced the development of complications 0.46 times, the increase in BK, and BUN value and the increase in creatinine value by 3.05, 1.1 and 7.2 times respectively for the development of complications.

The distribution of demographic and laboratory parameters affecting the development of minor complications was given in Table 5. Considering the laboratory parameters, it was determined that while the increase in hemoglobin after the operation decreased the complication development by 0.51 times, the increase in BK and BUN values increased the rate of minör complications 2.93 and 1.09 times respectively.

The distribution of demographic and laboratory parameters affecting the development of major complications was given in Table 6. When the table was examined having a second operation compared to a single operation caused 13 times more complications. Due to the small number of patients who underwent a third operation, it did not pose a statistical risk in the development of complications compared to a single operation. The increased number of punches caused 7.08 times more than those with only one entry and each increase in the number of mai mic caused 1.31 times more major complications. Additionally, each increase in stone-free rate caused 45 times, and each increase in nephrostomy withdrawal time caused 10.26 times more major complications.

Discussion

One of the most important problems in the treatment of urinary system stone disease can be elaborated as that although the stones detected in patients can be successfully treated using effective methods. The probability of requiring new operations in the same patient in the future due to the high stone recurrence rate is high. Urinary system stones recur at an average rate of 50% within 10 years if no precautions are taken (8). This demonstrates the importance of endoscopic and minimally invasive methods in the treatment of stone disease (9). Today, stone fragments that are smaller than 4 mm, not infected, and do not cause pain or obstruction are considered clinically insignificant fragments, and

Table 4. *Investigation of the effects of demographic and laboratory parameters on complication development*

Characersitics (N=126)	No (n=91) Median (Min-Max) or n (%)	Yes (n=35) Median (Min-Max) or n (%)	P value	OR (95% CI)
Age, years	44 (20-79)	48 (18-79)	0.385	1.013 (0.984-1.042)
Gender				
Male	65 (71.4)	26 (74.3)	-	1.000[a]
Female	26 (28.6)	9 (25.7)	0.749	0.865 (0.358-2.095)
Operation number				
Primary	78 (85.7)	24 (68.6)	-	1.000[a]
Secondary	**9 (9.9)**	**10 (28.6)**	**0.013**	**3.611 (1.315-9.916)**
Tertiary	4 (4.4)	1 (2.9)	0.856	0.813 (0.087-7.621)
Previous ESWL	13 (14.3)	6 (17.1)	0.688	1.241 (0.431-3.573)
Stone size, mm^2	745.2 (324.8-1980.6)	746.2 (286.4-1650.2)	0.310	1.000 (0.998-1.002)
Punc number				
1st entry	85 (93.4)	31 (88.6)	-	1.000[a]
2nd entry	6 (6.6)	4 (11.4)	0.374	1.828 (0.483-6.914)
Entry site				
Subcostal entry	76 (83.5)	27 (77.1)	-	1.000[a]
Intercostal entry	9 (9.9)	4 (11.4)	0.727	1.251 (0.356-4.397)
Subcostal + intercostal entry	6 (6.6)	4 (11.4)	0.357	1.877 (0.492-7.161)
Pnm. Number	750 (70-3630)	850 (300-1850)	0.202	1.001 (1.000-1.002)
Mai Mic	**18 (6-30)**	**22 (12-28)**	**0.001**	**1.153 (1.062-1.252)**
Operation time, minutes	136 (45-280)	120 (45-260)	0.172	0.995 (0.987-1.002)
Scopy time, minutes	6.2 (0.4-17.9)	6.1 (0.4-17.9)	0.636	1.023 (0.930-1.126)
Hematocrit fall	**1.7 (0.2-3.4)**	**2.6 (0.8-7.4)**	**<0.0001**	**3.272 (1.897-5.641)**
Degree of hydronephrosis				
None	6 (6.6)	4 (11.4)	-	1.000[a]
Mild	10 (11.0)	9 (25.7)	0.750	1.350 (0.286-6.379)
Moderate	57 (62.6)	11 (31.4)	0.087	0.289 (0.070-1.198)
Severe	18 (19.8)	11 (31.4)	0.908	0.917 (0.211-3.990)
Stone Free Rate	**1 (1.1)**	**15 (42.9)**	**<0.0001**	**67.5 (8.4-5411)**
Nephrostomy withdrawal time, days	3 (2-3)	3 (2-5)	0.574	1.246 (0.579-2.683)
Duration of hospital stay, days	4 (3-4)	6 (4-16)	0.993	1.951 (1.000-2.100)
Pre-op Hg	13.8 (10.8-17.8)	13.3 (11.2-17.2)	0.123	0.805 (0.611-1.061)
Post-op Hg	**12.2 (9.9-17.3)**	**10.2 (6.5-14.9)**	**<0.0001**	**0.464 (0.334-0.643)**
Pre-op WBC	8.0 (5.2-11.2)	8.1 (5.5-10.4)	0.538	1.098 (0.815-1.480)
Post-op WBC	**13.5 (1.4-16.8)**	**17.8 (12.8-28.9)**	**<0.0001**	**3.051 (1.990-4.678)**
Pre-op BUN	14.0 (6.0-27.0)	15.0 (8.0-25.0)	0.439	1.036 (0.948-1.132)
Post-op BUN	**15.0 (7.0-40.0)**	**20.0 (11.0-82.0)**	**<0.0001**	**1.101 (1.045-1.160)**
Pre-op Creatinine	0.8 (0.1-9.0)	0.8 (0.4-9.0)	0.742	1.050 (0.787-1.400)
Post-op Creatinine	**0.9 (0.4-1.7)**	**1.0 (0.6-3.4)**	**0.001**	**7.222 (2.191-23.81)**

OR: Odds Ratio, CI: confidence interval, a: referance cathegory

it is accepted that 85% of these fragments will spontaneously fall off and do not cause pain (10, 11). In our study, we evaluated patients with clinically insignificant fragments in the successful patient group.

The success of percutaneous nephrolithotomy operation varies between 72-98% in published series. Although PCNL is a treatment alternative that attracts attention with its high success rates, it should be noted that serious complications may develop during or after this operation, and may even reach life-threatening dimensions (12).

In our study, complications seen in patients who underwent PCNL were classified as according to Modified Clavien Classification system. While major complications developed in 27.8% of the patients who underwent PCNL operation, minor complications occurred in 4.8%. Bleeding was observed in 2 patients (1.6%) of the patients as a major complication, and open exploration was

Table 5. *Investigation of the effects of demographic and laboratory parameters on the development of minor complications*

Characersitics (N=120)	No (n=91)	Yes (n=29)		
	Median (Min-Max) or n (%)	**Median (Min-Max) or n (%)**	**P value**	**OR (95% CI)**
Age, years	44 (20-79)	45 (18-79)	0.895	1.002 (0.971-1.034)
Gender				
Male	65 (71.4)	21 (72.4)	-	1.000[a]
Female	26 (28.6)	8 (27.6)	0.918	0.952 (0.375-2.420)
Operation number				
Primary	78 (85.7)	22 (75.9)	-	1.000[a]
Secondary	9 (9.9)	7 (24.1)	0.069	2.758 (0.922-8.245)
Tertiary	4 (4.4)	-	NA	NA
Previous ESWL	13 (14.3)	6 (20.7)	0.413	1.565 (0.535-4.578)
Stone size, mm^2	745.2 (324.8-1980.6)	689.6 (286.4-1460.2)	0.075	1.000 (0.998-1.002)
Punc number				
1st entry	85 (93.4)	27 (93.1)	-	1.000[a]
2nd entry	6 (6.6)	2 (6.9)	0.955	1.049 (0,200-5,507)
Entry site				
Subcostal entry	76 (83.5)	23 (79.3)	-	1.000[a]
Intercostal entry	9 (9.9)	3 (10.3)	0.891	1.101 (0.275-4.411)
Subcostal + intercostal entry	6 (6.6)	3 (10.3)	0.501	1.652 (0.383-7.131)
Pnm. Number	750 (70-3630)	840 (300-1250)	0.566	1.000 (0.999-1.001)
Mai Mic	**18 (6-30)**	**22 (12-28)**	**0.006**	**1.127 (1.035-1.228)**
Operation time, minutes	136 (45-280)	110 (45-260)	0.076	0.992 (0.983-1.001)
Scopy time, minutes	6.2 (0.4-17.9)	5.6 (0.4-16.2)	0.746	0.982 (0.879-1.097)
Hematocrit fall	**17 (0.2-3.4)**	**2.4 (0.8-7.4)**	**<0.0001**	**2.839 (1.602-5.031)**
Degree of hydronephrosis				
None	6 (6.6)	2 (6.9)	-	1.000[a]
Mild	10 (11.0)	8 (27.6)	0.354	2.400 (0.377-15.27)
Moderate	57 (62.6)	9 (31.0)	0.402	0.474 (0.082-2.720)
Severe	18 (19.8)	10 (34.5)	0.573	1.667 (0.282-9.856)
Stone Free Rate	**1 (1.1)**	**13 (44.8)**	**<0.0001**	**73.1 (8.93-598.5)**
Nephrostomy withdrawal time, days	3 (2-3)	3 (2-3)	0.546	0.76 (0.31-1.852)
Duration of hospital stay, days	4 (3-4)	6 (4-6)	0.995	4.879 (2.100-6.165)
Pre-op Hg	13.8 (10.8-17.8)	13.6 (11.4-17.2)	0.328	0.866 (0.648-1.156)
Post-op Hg	**12.2 (9.9-17.3)**	**10.4 (6.5-14.9)**	**<0.0001**	**0.513 (0.366-0.719)**
Pre-op WBC	8.0 (5.2-11.2)	8.2 (5.5-10.4)	0.601	1.087 (0.795-1.488)
Post-op WBC	**13.5 (10.4-16.8)**	**17.4 (12.8-25.4)**	**<0.0001**	**2.934 (1.896-4.539)**
Pre-op BUN	14.0 (6.0-27.0)	16.0 (8.0-25.0)	0.287	1.052 (0.958-1.156)
Post-op BUN	**15.0 (7.0-40.0)**	**19.0 (11.0-59.0)**	**0.003**	**1.090 (1.029-1.154)**
Pre-op Creatinine	0.8 (0.1-9.0)	0.8 (0.4-9.0)	0.672	1.065 (0.795-1.426)
Post-op Creatinine	0.9 (0.4-1.7)	0.9 (0.6-1.8)	0.131	3.225 (0.704-14.77)

OR: Odds Ratio, CI: confidence interval, a: referance cathegory

performed in 1 (0.8%) of them, and the operation was terminated early in one patient due to bleeding. No cases of death during the operation.

In the study of Segura, one of the first series on the complications of percutaneous nephrolithotripsy, published in 1985 and examining a total of 1000 PCNL cases, the rate of major complications was reported as 3.2% (13). In this study, perioperative bleeding, which occurred in 0.6% patients and required the termination of the operation, was the most common complication. In addition, embolization was performed in 0.6% patients due to the development of arteriovenous fistula, and nephrectomy was performed in one patient due to post-operative excessive bleeding, but no death was reported. On the other hand, Stoller et al.

Tablo 6. *Investigation of the effects of demographic and laboratory parameters on the development of major complications*

Characersitics (N=97)	No (n=91) Median (Min-Max) or n (%)	Yes (n=6) Median (Min-Max) or n (%)	P value	OR (95% CI)
Age, years	**44 (20-79)**	**64 (26-72)**	**0.044**	**1.075 (1.002-1.154)**
Gender				
Male	65 (71.4)	5 (83.3)	-	1.000[a]
Female	26 (28.6)	1 (16.7)	0.536	0.500 (0.056-4.489)
Operation number				
Primary	78 (85.7)	2 (33.3)	-	1.000[a]
Secondary	**9 (9.9)**	**3 (50.0)**	**0.009**	**13.00 (1.910-88.46)**
Tertiary	4 (4.4)	1 (16.7)	0.086	9.750 (0.723-131.6)
Previous ESWL	13 (14.3)	-	NA	NA
Stone size, mm^2	745.2 (324.8-1980.6)	1052.9 (760.4-1650.2)	0.133	1.001 (1.000-1.003)
Punc number				
1st entry	85 (93.4)	4 (66.7)	-	1.000[a]
2nd entry	**6 (6.6)**	**2 (33.3)**	**0.042**	**7.083 (1.072-46.82)**
Entry site				
Subcostal entry	76 (83.5)	4 (66.7)	-	1.000[a]
Intercostal entry	9 (9.9)	1 (16.7)	0.524	2.211 (0.212-21.01)
Subcostal + intercostal entry	6 (6.6)	1 (16.7)	0.335	3.167 (0.304-32.99)
Pnm. Number	750 (70-3630)	1200 (650-1850)	0.078	1.001 (1,000-1,002)
Mai Mic	**18 (6-30)**	**26 (18-28)**	**0.015**	**1.311 (1,054-1,632)**
Operation time, minutes	136 (45-280)	145 (80-220)	0.529	1.005 (0,989-1,021)
Scopy time, minutes	6.2 (0.4-17.9)	6.5 (4.2-17.9)	0.051	1.190 (0,999-1,416)
Hematocrit fall	1.7 (0.2-3.4)	5.1 (3.0-6.0)	0.078	6.633 (0,632-64,41)
Degree of hydronephrosis				
None	6 (6.6)	2 (33.3)	-	1.000[a]
Mild	10 (11.0)	1 (16.7)	0.365	0.300 (0.022-4.060)
Moderate	57 (62.6)	2 (33.3)	0.039	0.105 (0.012-0.888)
Severe	18 (19.8)	1 (16.7)	0.172	0.167 (0.013-2.182)
Stone Free Rate	**1 (1.1)**	**2 (33.3)**	**0.004**	**45.0 (3.34-606.47)**
Nephrostomy withdrawal time, days	**3 (2-3)**	**3 (2-5)**	**0.034**	**10.26 (1.19-88.269)**
Duration of hospital stay, days	4 (3-4)	9 (7-16)	0.996	3.285 (1.000-6.177)
Pre-op Hg	13.8 (10.8-17.8)	12.7 (11.2-13.9)	0.077	0.558 (0.292-1.065)
Post-op Hg	12.2 (9.9-17.3)	7.9 (6.6-8.3)	0.991	0.644 (0.355-0.944)
Pre-op WBC	8.0 (5.2-11.2)	8.1 (7.5-9.3)	0.685	1.144 (0.597-2.192)
Post-op WBC	13.5 (10.4-16.8)	19.1 (17.8-28.9)	0.987	2.101 (1.450-4.877)
Pre-op BUN	14.0 (6.0-27.0)	13.0 (11.0-18.0)	0.602	0.947 (0.773-1.161)
Post-op BUN	15.0 (7.0-40.0)	69.0 (35.0-82.0)	0.087	1.333 (0.959-1.853)
Pre-op Creatinine	0.8 (0.1-9.0)	0.9 (0.8-1.1)	0.866	0.924 (0.370-2.308)
Post-op Creatinine	0.9 (0.4-1.7)	2.2 (1.6-3.4)	0.100	5.138 (2.080-32.28)

OR: Odds Ratio, CI: confidence interval, a: referance cathegory

reported a 23% transfusion rate in their study (14). In the study of Arthur D. Smith and Won J. Lee, published in 1987, in which the complications developing in a total of 582 patients who underwent PCNL operation were examined in detail, the rate of development of major complications was reported as 6.8% and the rate of development of minor complications as 50% (15).

Stoller et al. reported a 23% transfusion rate (14). In our study, it was found that the bleeding developed in 2 (n=1.6) cases. No patient required partial or total nephrectomy. In our series of 126 cases, the need for renal angiography and embolization is 0.92%. This value is similar to the large series in the literature (16,17,18,19).

In a study of 430 cases conducted by Tefekli et al. (2008), patients with metabolic syndrome and its components such as hypertension, diabetes, hyperlipidemia, and obesity were evaluated. Complication rates were found to be higher in patients with metabolic syndrome, hypertensive and diabetic patients (20). Kukreja et al. showed that diabetes is an independent factor that increases bleeding rates (21). Duvdevani et al. found similar success and complication rates in patients with diabetes in a study they conducted in 2009. (22). In the presented study, it was concluded that these factors did not affect the development of complications statistically.

In the study, it was shown that the history of previous renal surgery in the patient undergoing PCNL affected the development of complications. In the literature, there are contradictory publications regarding the results of PCNL applied to patients with a history of open surgery or ESWL. Netto et al. have published studies in which the presence of a history of open surgery in patients undergoing PCNL is a risk factor that increases bleeding (23). Conversely, when Stoller et al. reviewed their cases retrospectively, they showed that the history of previous ESWL or open surgery did not affect bleeding in PCNL operations (14). Kukreja et al. reported that PCNL application to patients with previous PCNL or open surgery would result in less bleeding (21). Although these contradictory publications are surprising, the difference in renal parenchyma thickness can be considered as the reason for the different results. Indeed, Smith et al. show that less blood loss occurs with PCNL in pyelonephrotic kidneys with thin, scarred parenchyma (24).

In the study, it was found that the stone free rate significantly affected the rate of complications ($p<0.0001$). Turna et al. showed that this rate increased to 28% in simple stones and over 40% in complex stones. In addition, similar results are reported in the literature (25).

Stoller and Martin showed that the creation of multiple working channels increases bleeding rates (14, 26). In study series, it was concluded that the creation of multiple working channels did not affect the development of complications. As a result, complications after PCNL operation were found to be high in patients with a history of previous renal surgery, mai mik, hematocrit fall, stone free rate, post-operative Hg, WBC, BUN and creatinine. These were inline with published studies (27,28,29). Preoperative prone abdominal tomography eliminated the risk of adjacent organ injury.

Conclusion

In percutaneous nephrolithotomy surgery, complications can be prevented by taking some precautions before the operation (such as prone abdominal tomography) and during the operation (such as monitoring the duration of the operation or the amount of blood mai mic volume and pressure). Regarding the results of this study one can conclude that examining the complications of the PCNL operation will not only provide the surgeon with an idea and a chance to predict the possible results, but also will provide the chance to influence the result by taking some precautions in the preoperative and perioperative period. The possibility of developing complications after PCNL operation was found to be high in patients with a history of previous renal surgery, mai mik, hematocrit fall, stone free rate, post-operative Hg, WBC, BUN and creatinine.

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