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Outcomes of Percutaneous Nephrolithotomy in an Experienced Center: 1000 Cases Experience

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ABSTRACT

Objective: The aim of this study was to evaluate the success and complication rates of percutaneous nephrolithotomy (PNL) surgeries performed in our clinic.

Material and Methods: Between March 2011 and January 2018, patients who underwent percutaneous nephrolithotomy in Adana City Training and Research Hospital and their records were retrospectively analyzed. Routine non-contrast computed abdominal tomography, hemogram, biochemistry, urine culture, kidney ureter bladder radiography (KUB) and postoperative first month urinary culture, urinary tract X-ray and urinary ultrasound were performed. The patients were evaluated in terms of sex, age, stone localization and size, operation time, number of stones, success rates, intraoperative and postoperative complications, nephrostomy and hospital stay.

Results: In our study, 586 males and 414 females with a mean age of 45.2 ± 10.4 (1-84) were enrolled to 1183 renal units, and 1000 patients were treated with PCNL. Mean operative time was 74.2 ± 29.5 min (30-170). 462 patients had isolated pelvis and calyceal stones, 347 had partial staghorn, 44 had complete staghorn, and 147 were multiple. The success rate of the patients (stone free + clinically insignificant residual stone) was 85.3%. In the postoperative period, 114 patients (11.4%) required transfusion, 14 patients (1.4%) had arteriovenous fistula and 132 patients (13.2%) had a Double J catheter. Four (0.4%) patients had colon perforation.

Conclusion: As seen in our comprehensive series of percutaneous nephrolithotomy, success rates are high in experienced centers and complication rates are acceptable, and the operation is safe and effective.

Keywords: Kidney stones, percutaneous nephrolithotomy, endourology, experience

ÖZ

Deneyimli Bir Merkezde Perkütan Nefrolitotomi Sonuçları: 1000 Vakalık Deneyim

Giriş: Bu çalışmanın amacı kliniğimizde yapılmakta olan perkütan nefrolitotomi (PNL) ameliyatlarının başarı ve komplikasyon oranlarını değerlendirmektir.

Gereç ve Yöntemler: Mart 2011-Ocak 2018 tarihleri arasında Adana Şehir Eğitim ve Araştırma Hastanesi kliniğinde PNL uygulanan hastaların kayıtları retrospektif olarak incelendi. Preoperatif dönemde hastalardan rutin olarak kontrastsız üst-alt batın tomografisi, hemogram, geniş biyokimya, idrar kültürü, direkt üriner sistem grafisi (DÜSG) ile cerrahi girişime hazırlandı. Postoperatif ise birinci ayda DÜSG, birinci ayda idrar kültürü, DÜSG ve üriner ultrasonografi ile değerlendirildi. Hastalar; yaş, cinsiyet, taş lokalizasyonu ve boyutu, operasyon süresi, renal üniteye yapılan girişim sayısı, başarı oranları, intra-operatif ve post-operatif komplikasyonlar, nefrostomi kateteri ve hastanede kalış süreleri açısından değerlendirildi.

Bulgular: Çalışmamızda yaş ortalaması 45.2 ± 10.4 olan 586 erkek, 414 kadın toplamda 1000 hastaya 1183 üniteye giriş yapılarak PNL uygulandı. Ortalama operasyon süresi 74.2 ± 29.5 dakikaydı. Hastaların 462 tanesi izole pelvis ve kaliks taşı, 347 tanesi kısmi staghorn, 44 tanesi tam staghorn, 147 tanesi multiple yerleşimliydi. Hastaların başarı oranı (klinik önemsiz rezidüel taş) %85.3'tü. Postoperatif dönemde 114 (%11.4) hastada transfüzyon gereksinimi, 14 (%1.4) hastada arterovenöz fistül, 132 (%13.2) hastada üriner ekstravazasyona bağlı Double J stent takılması, dört (%0.4) hastada kolon perforasyonu komplikasyon olarak görüldü.

Sonuç: Perkütan nefrolitotomi; yaptığımız geniş kapsamlı serimizde görüldüğü gibi deneyimli merkezlerde başarı oranları yüksek, komplikasyon oranları kabul edilebilir, güvenli ve etkin bir operasyondur.

Anahtar Kelimeler: Böbrek taşı, perkütan nefrolitotomi, endoüroloji, deneyim

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INTRODUCTION

Urinary stone disease is seen at a rate of 1-20% worldwide with renal function losses and serious complications (1). Treatment of urinary stone disease varies from conservative to medical or surgical methods depending upon the patient and type of the stone. Open stone surgery has been replaced by minimally invasive methods in the treatment of urinary stone disease together with the advancements in technology. Percutaneous nephrolithotomy (PNL) is a minimally invasive method defined by Fernström and Johansson for the first time in 1976 and is now accepted as the first choice of approach in the surgical treatment of kidney stones (2).

Size of the stone is the most important factor affecting the choice and success of treatment in patients with kidney stones. Additionally, success rate is also affected by the localization and composition of the stone, renal anatomy and factors related with the patient him/herself (3). The only absolute contraindication of PNL is the presence of coagulation defect (4,5).

In our study, it was aimed to present the outcomes of our first 1000 PNL cases which we started implementing for the first time in 2011 and discuss in light of the literature data.

MATERIALS and METHODS

Outcomes of 1289 patients who had undergone PNL between March 2011 and January 2018 were retrospectively reviewed following ethics board approval. Two hundred and eighty-nine patients whose preoperative or postoperative data were incomplete were excluded from the study. Preoperatively, the patients were evaluated with anamnesis, physical examination, urine culture, hemogram, blood biochemical parameters, coagulation parameters, chest radiography, electrocardiogram, and unenhanced abdominal computed tomography. Patients in whom growth was detected in urine culture were operated on after appropriate antibiotherapy had been given and the urine culture had been sterilized, and patients who used anticoagulants and had preoperative bleeding diathesis were operated on after bleeding diathesis had ameliorated. Intravenous 1 g ceftriaxone was administered to the patients one hour prior to surgery for prophylactic purposes. Stone load was calculated as the value obtained by the multiplication of the stone's long axis with the length that cut it vertically. In patients with opaque stones, direct urinary tract graphy (DUTG) was performed in the postoperative first month to evaluate complete clearance of the stone. Residual fragments smaller than 4 mm and not causing any symptoms were accepted as clinically insignificant residue fragments (CIRF) and fragments larger than 4 mm were accepted as residual fragments (RF). Patients with non-opaque stones were followed with antegrade pyelography through the pre-existing re-entry catheter. Complication classification of the patients was evaluated regarding the Clavien-Dindo classification. All surgeries were performed by five surgeons experienced at percutaneous nephrolithotomy. SPSS (Statistical Package for the Social Sciences) 22 was used for data analyses (IBM, Armonk, NY). Mean values and standard deviations were calculated.

Surgical Technique

Under general anesthesia and in lithotomy position, 16 F ureteral catheter was placed in the bladder by inserting a 6F open-ended ureteral catheter accompanied with fluoroscopy and 21 F cystoscope (Richard Wolf Gmbh Knittlingen, Germany). The patient was put into prone position, and the chest area was supported with pillows. Following the administration of radio-opaque material from the ureter catheter, caliceal system of the related kidney was localized with C-arm fluoroscopy. The targeted calyx was entered with an 18 G percutaneous entry needle. Guide wire was placed to the collecting duct system through the needle and dilatation of 14 F to 30 F, as the surgeon's preference, was applied with the amplatz renal dilator set (Willy-Rüsch Kernen im Remstal, Germany). Afterwards, following visual image with 24 F nephroscopy (Richard Wolf Gmbh Knittlingen, Germany) by placing the renal sheath, the stones were broken into pieces with pneumatic and holmium YAG laser lithotripsy and were removed with foreign object forceps. Re-entry nephrostomy catheter was inserted in all patients at the end of the procedure. The catheter was removed on postoperative day 1 according to the patients' urine color.

RESULTS

PNL was performed on a total of 1000 patients (586 males and 414 females) with a median age of 45.2 ± 10.4 years (1-84 years). Mean operative time was determined as 74.2 ± 29.5 minutes. A total of 1183 renal units were entered and of these entries, 847 were single kidney entries, 127 were 7.15 ± 5.22 cm^2. Removal of the nephrostomy tube was mean 2.54 ± 1.21 days. Of the patients' stones, 624 were broken with the pneumatic method and 376 with the lithotripsy method. Seven hundred and ninety-one (79.1%) of a total of 1000 patients that underwent PNL had complete clearance of the stone, 62 (6.2%) had CIRF and 147 (14.7%) had RF. Table 1 summarizes the anatomic localization of the stones and success rates. Various complications were encountered in a total of 272 (27.2%) patients intra- and post-operatively. Mean hematocrit loss was calculated as 5.72 ± 2.31. Complications and their frequencies are summarized in Table 2.

Table 1. Anatomic localization of the stones and success rates

Anatomic localization of the stones	N (%)	Complete clearance	CIRF	RF
Isolated pelvis or calyx stone	462 (46.2%)	437 (94.5%)	10 (2.2%)	15 (3.3%)
Partial Staghorn stone	347 (34.7%)	258 (74.4%)	30 (8.6%)	59 (17%)
Complete Staghorn	44 (4.4%)	17 (38.6%)	8 (18.2%)	19 (43.2%)
Multiple localizations	147 (14.7%)	79 (53.7%)	14 (9.5%)	54 (36.8%)
Total	1000 (100%)	791 (79.1%)	62 (6.2%)	147 (14.7%)

N: Number, CIRF: Clinically insignificant residual fragment, RF: Residual fragment.

Table 2. Complications and their frequencies according to clavien-dindo classification

Complication	Number (N)	Percentage (%)	Clavien classification
Bleeding requiring transfusion	114	11.4	2
Double J stent necessity	132	13.2	3A
Urinary infection	8	0.8	2
Colon perforation:	4	0.4	
1. Conservative	3		2
2. Requiring colostomy	1		3A
AV fistula requiring angioembolization	14	1.4	3A
Total	272	27.2	-

DISCUSSION

Nowadays, the treatment of kidney stones has significantly changed thanks to minimally invasive techniques, and the need for open surgery has gradually decreased. PNL has become the practicable option in the treatment of kidney stones due to its treatment success, low cost, short length of hospital stay, and nearly no scar tissue presence (3). There are success rates reported over 90% in the literature. While success in open surgery equals to complete clearance of the stones, the parameters to be considered in the evaluation of success in PNL operations are debatable. Operation success has become a matter of debate in multiple and Staghorn stones and in the presence of RF stones. The question "Do small-sized stones that do not cause obstruction, pain, infection, and bleeding in the urinary tract decrease the success rate of the operation?" has been debated and the notion of CIRF has been put forth. In this notion, stone size is limited to 4 mm, and it has been decided upon that stones smaller than 4 mm do not have an impact on the success of the operation (6). The success of PNL surgery ranges between 72-98% in published large-scale studies. The first large-scale study to report a 98% success rate was the study by Hasun et al. conducted on 1000 cases in 1985 (7). In the first PNL studies conducted in our country, complete clearance of the stones has been reported as 60%, 77% and 87% respectively by Müslümanoğlu et al., Ünsal et al., and Ötençtemur et al. (8-10). While complete clearance of the stones was obtained in 79.1% of the 1000 patients undergoing PNL in our study, CIRF was detected in 6.2%, and 85.3% success rate was achieved in total.

Staghorn stone term is independent of stone size and defines the stone's configuration (11). First treatment option in these stones is PNL (11-12). In different series, complete clearance of the stones following PNL in complete Staghorn stones has been reported at a varying rate between 49% and 78% (13-14). In our study, 56.8% success rate was obtained in total in 44 complete Staghorn stones, with 38.6% complete stone clearance and 18.2% CIRF.

Just as in any surgical intervention, complications may arise in PNL. Different studies have reported complications at different rates. In a systematic review evaluating 12.000 patients, complications have been reported as fever (10.8%), bleeding that required transfusion (7%), thoracic complications (1.5%), sepsis (0.5%), organ injuries (0.4%), embolization (0.4%), urinoma (0.2%) and death (0.05%) (15). Additionally, bleeding requiring transfusion ranges between 4-24% in various studies (16). Compatible with the literature, bleeding requiring transfusion was observed at a rate of 11.4% in our study. One of the most common complications of PNL is prolonged extravasation. In cases of prolonged extravasation, additional intervention like double J stent insertion may be necessary. In a study by Michel et al., the most common

complication has been reported as urine extravasation with 7.2% and prolonged wetting (17). Again, in the same study, it has been reported that prolonged extravasation is directly related with the number of entries to the renal unit. The most commonly seen complication in our study was determined as prolonged urine extravasation with a rate of 13.2%. Bleeding requiring intervention may be seen at a rate of 1% in PNL operations (18). Kessaris et al. have reported the rate of bleeding requiring embolization as 0.8% (19). In our study, postoperative bleeding related to arteriovenous (AV) fistula was seen at a rate of 1.4%. Angioembolization was applied to these bleedings with the company of interventional radiology. Patients developing AV fistula have been observed to be those that required multiple entries to the renal system (20). Compatible with the literature, multiple renal entries were present in 13 of the 14 patients developing AV fistula in our study. One of the rare but serious complications of PNL is colon injury. It varies between 0.2-4% in the literature (21). Colon perforation was seen in 4 patients (0.4%) in our study. Three of these patients were followed closely, and the perforation was observed to heal with a drainage inserted into the retroperitoneum. Upon the development of acute abdomen in one patient and following consultation with general surgery, colostomy was opened. Limitations of our study include its retrospective design and the fact that surgical procedures were performed by different surgeons.

CONCLUSION

As seen in our series and in the literature, PNL is an endourologic procedure with high success rate and acceptable complications. Primary parameters affecting success rate are the number of stones, stone size, and its anatomic localization in the kidney.

Ethics Committee Approval: The approval for this study was obtained from Adana City Training and Research Hospital Clinical Research Ethics Committee (Date: 22.04.2020, Decision No: 809).

Author Contributions: Concept/Design: GG, HA, ET; Analysis/Interpretation: UÜ, EV, SBP, AA; Data Acquisition: GG, UÜ, EV, SBK; Writting: GG, HA, ET; Critical Revision: AA, SBK, EV; Final Approval: All of authors.

Conflict of Interest: There is no conflict of interest.

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