

Percutaneous nephrolithotomy versus open surgery for the treatment of unilateral staghorn stone, Erbil province

Received: 07/09/2022

Accepted: 03/11/2022

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Abstract

Background and objective: Staghorn stones are large branching stones that completely or partially occupy the renal pelvis and renal calyces. The developments in the urological field have decreased the role of open surgery (OS) and currently percutaneous nephrolithotomy (PCNL) is considered as the gold standard procedure for the management of staghorn stone. This study aimed to determine the outcomes of open surgery and percutaneous nephrolithotomy for the treatment of unilateral staghorn stone.

Methods: This retrospective analysis included 76 patients with unilateral staghorn stone who had been treated with either percutaneous nephrolithotomy (57) or open surgery (19). A comparison was made between the mentioned groups (PCNL vs. OS).

Results: The differences between the two groups were not significant in term of preoperative characteristics. In addition, there was no significant difference between the two groups for intraoperative, postoperative complications and the rate of stone clearance ($P = 0.447$, $P = 0.180$, $P = 0.259$ respectively). The means of postoperative hospital stay (days) and recovery time (weeks) were significantly lower in the PCNL than OS ($P < 0.001$). However, the mean operative time was significantly less in the OS group ($P = 0.018$).

Conclusion: The PCNL is a very efficient treatment option for staghorn stones. However, the open surgery still has a role in the treatment of kidney stones (especially staghorn stone).

Keywords: Operation time; Open surgery; Staghorn stones; Percutaneous; Nephrolithotomy.

Introduction

The European Association of Urology (EAU) has established classifications for urinary stones depending on criteria such as size, location, X-ray characteristics, etiology, composition, and likelihood of recurring stone formation.^{1,2} Staghorn stones, which affect a significant portion of the renal collecting system, identified as the most significant type of urinary stones.³ All around the world, staghorn calculi are reported everywhere.⁴ However, staghorn kidney stones are more

Staghorn stones, according to Campbell's urology and associated literature, are large branching stones that completely or

partially occupy the renal pelvis and renal calyces depending on the level of occupancy of the collecting system.^{5,6} However, "staghorn" as a term describes stone configuration and it doesn't provide details about stone volume and composition.⁵ Untreated staghorn stones (struvite stones) can cause urinary tract infections, recurrent urosepsis, renal impairment, and even mortality, they require immediate evaluation and treatment.^{7,8} Staghorn stones are thus regarded as a serious disease entity that needs to be aggressively and successfully treated.^{9,10} Extracorporeal shock wave lithotripsy (ESWL), retrograde intrarenal

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surgery (RIRS), percutaneous nephrolithotomy (PCNL), laparoscopy, and open surgery are among the available treatments for staghorn stones.^{11,12}

The Open surgery (OS) was once considered as a "gold standard" procedure for the treatment of staghorn stone.¹³ However, developments in the urological field have decreased its use. Currently, PCNL is indicated as the gold standard procedure for staghorn calculi according to the most recent American Urological Association (AUA) guidelines due to lowest complication rates and high stone-free rates.^{14,15}

The objectives of this study were to determine the outcomes of open surgery and percutaneous nephrolithotomy among patients with unilateral staghorn stone.

Methods

This study was conducted in Erbil governorate - Kurdistan region of Iraq, from May 2019 to May 2022. This retrospective analysis included 76 patients with unilateral staghorn stone who had been treated with either percutaneous nephrolithotomy 'PCNL' (57 patients) or open surgery 'OS' (19 patients). Patients who were treated with PCNL considered as (Group 1) and patient who were treated with open surgery were considered as (Group 2). In all patients, sociodemographic data such as (age and gender), detailed patient history, physical examination, clinical examination, laboratory investigations and radiological evaluation, intravenous urography (IVU), 3-dimensional computerized tomography (3D-CT) reports and history of antibiotic treatments prior to operation were collected from medical records. The data for both groups compared regarding operative time, days of hospital stay, intraoperative and postoperative complications, the rate of stone clearance at discharge home and hospital stay. The duration of the procedure, from start to finish was used to calculate the operative time. The recovery period defined as the duration back to the

normal day activity.

Generally, enrolled patients with unilateral staghorn stone who had at least 1 year of recorded follow-up after treatment, patients with normal BMI and normal creatinine levels and patients with age range of (35-55) years included in this study. Patients with genetic disorders and patients with urinary or skeletal abnormalities were excluded from this study.

Statistical analysis

All the statistical analyses were performed in SPSS version 25 (IBM Corp., Armonk, NY, USA). Chi-square and unpaired t test were used and *P*-values of <0.05 were considered to indicate statistical significance.

Results

This study reviewed and analyzed the medical records of 76 patients who had been treated for unilateral staghorn stones, in which 57 patients were treated with percutaneous nephrolithotomy (PCNL) and 19 patients were treated with open surgery (OS). As shown in Table 1, no significant differences were detected between the two groups regarding the proportions of the following variables: gender (*P* = 0.665), age (*P* = 0.254), UTI (*P* = 0.672), hydronephrosis (*p* = 0.940), side of stone (*P* = 0.504), type of stone (*P* = 0.182), and nature of stone (*P* = 0.899) (Table 1).

Detailed complications, intraoperative and postoperative, in both groups are reported and compared in Table 2. In the PCNL, the majority (89.5%) of patients had no intraoperative complications compared with 84.2% in the OS group (*P* = 0.477). Bleeding was reported in five patients during PCNL procedure (8.8%) while two patients (10.5%) of group two had bleeding. The majority (84.2%) of patients of the PCNL group had no postoperative complications, compared with 73.3% of the OS group (*P* = 0.180).

Table 1 Baseline characteristics and preoperative profiles in both groups

Variables		PCNL (n 57) No.(%)	OS (n 19) No.(%)	P-value
Gender	Male	18 (31.6%)	5 (26.3%)	0.665*
	Female	39 (68.4%)	14(73.7%)	
Age (years)	< 45	41 (71.9)	11 (57.9)	0.254*
	≥ 45	16 (28.1)	8 (42.1)	
	Mean (SD) (range year)	42.54 (5.42) (35-55)	43.78 (6.20) (34-53)	
UTI (culture)	Positive	18(31.6%)	7(36.8%)	0.672 *
	Negative	39 (68.4%)	12(63.2%)	
Hydronephrosis	Mild	26 (45.6%)	8 (42.1%)	0.940 *
	Moderate	21 (36.8%)	7 (36.8%)	
	Severe	10 (17.5%)	4 (21.1%)	
Side	Right	31(54.4%)	12(63.2%)	0.504 *
	Left	26(45.6%)	7 (36.8%)	
Type of stone	Partial	34(59.6%)	8(42.1%)	0.182 *
	Complete	23(40.4%)	11 (57.9%)	
Nature of stone	De-novo	42 (71.9%)	15 (78.9%)	0.899**
	Recurrent	15 (28.1%)	4 (21.1%)	
Total		57 (100.0%)	19 (100.0)	

PCNL = Percutaneous Nephrolithotomy, OS = Open surgery.

*By Chi-square test, **By Fisher's exact test. †By Unpaired t-test

The rate of postoperative stone clearance showed no significant differences between PCNL and OS groups. Notably, the number of patients diagnosed with residual calculi (>5mm) was two in the PCNL group (3.5%) and two (10.5%) in OS group ($P = 0.259$) (Table 2).
 The mean operative time of the PCNL group (119.4 minutes) was significantly ($P = 0.018$) higher than the mean of the OS

group (99.57 minutes), while the mean post operative days of hospital stay in the PCNL group (2.61 days) was significantly ($P < 0.001$) lower than that of the OS group (5.63 days). The recovery time, in weeks, was significantly ($P < 0.001$) shorter in the PCNL group (1.01 week) than the OS group (3.15 weeks) as presented in Table 3.

Table 2 Complication, stone clearance and results after PCNL and OS for the treatment of staghorn stones

Variable		PCNL (n 57) and %	OS (n 19) and %	P-value
Intraoperative complication	None	51 (89.5%)	16 (84.2%)	0.477*
	Bleeding	5 (8.8%)	2 (10.5%)	
	Pleural injury	0 (0%)	1 (5.3%)	
	Renal pelvic injury	1 (1.8%)	0 (0%)	
Postoperative complication	None	48 (84.2%)	14 (73.3%)	0.180*
	leakage of urine	3 (5.3%)	1 (5.3%)	
	Wound Infection	0 (0%)	2 (10.5%)	
	Septic shock	1 (1.8%)	0(0%)	
	Blood transfusion	5 (8.8%)	2 (10.5%)	
Post-operative rate of stone clearance	Stone free	55(96.5%)	17 (89.5%)	0.259*
	Residual calculi >5mm sent for ESWL	2 (3.5%)	2 (10.5%) sent for ESWL	
Total		57 (100.0%)	19 (100.0)	

PCNL = Percutaneous Nephrolithotomy, OS = Open surgery, ESWL = Extracorporeal Shock Wave Lithotripsy, *By Fisher's exact test.

Table 3 Mean of operation time, days of hospital stay and recovery time in both groups (PCNL versus OS)

Variables		PCNL (n 57)	OS (n 19)	P-value
Operative time	Mean (SD)	119.40(32.92)	99.57(24.70)	0.018
	(range in minutes)	(85 – 185)	(65 – 160)	
Postoperative days of hospital stay	Mean (SD)	± 1.14	5.63 (1.57)	< 0.001
	(range in days)	(2 -5)	(3 -8)	
Recovery time	Mean (SD)	1.01 ± 0.43	3.15 (0.68)	< 0.001
	(range in weeks)	(0.8 -2)	(2 -3)	

PCNL = Percutaneous Nephrolithotomy, OS = Open surgery

Discussion

Open surgery (OS) was long regarded as the "gold standard" method for treating staghorn stones.¹³ Currently, the need for open surgery has drastically decreased since the evolution of endoscopic instruments, the rapid development of percutaneous nephrolithotomy and other less invasive techniques.¹⁶ Thus, the key factor modifying the guidelines for open surgery is thought to be the substantial advancements in endourological technology.^{17,18}

Today, the most serious staghorn calculi are managed without open stone surgery using shock wave lithotripsy and percutaneous nephrolithotomy due to its low morbidity rate and decreased risk of bleeding and less hospital stay.¹⁹ PCNL has been recommended by the majority of researchers as the first-line and gold standard treatment for complex multiple renal stones and staghorn stones.^{13,20} Other studies, however, recommend open surgery, specifically anatomic nephrolithotomy and infected hydronephrosis.^{16,21,22}

In our study, there was no statistically significant difference between the groups in term of demographic (age and gender) and other preoperative variables. This matching is an important key factor to show the real differences between the two studied groups.

Despite the non-significant differences in term of intraoperative complications between the two groups, the rate of intraoperative complications was lower in the PCNL group (10.6%) than OS group (15.8%). This finding coincide with findings of a previous study which reported lower rate of injury and bleeding in PCNL (peri-operative bleeding 6.3%, late bleeding 0.9%, renal collecting ducts injury 5.2%, and major vessels injury 0.4%) than open surgery.²³ This is not in-line with findings of other study which reported higher intraoperative complications in PCNL group (20%)²⁴. However, two other studies concluded significantly less intraoperative

complications in PCNL group.^{25,26}

No significant differences were detected between the two groups regarding the post-operative complications. This result, agree with findings of Zhong et al²⁴ and Memom et al.²⁷ The discrepancies found in different studies regarding the incidence of intraoperative complications could be attributed to the experience of the surgeon using the percutaneous route, intrarenal manipulations, and used techniques for stone fragmentation and extraction, which are regarded to be the key human-related risk factors for developing problems after PCNL.²⁸ Given the aforementioned, our study found less intra and post-operative complications in the studied groups, the sample size and geographic location may be the main reasons.

High rates of postoperative stone clearance were observed in the studied groups (96.5% in PCNL group and 89.5% in OS group) with no significant differences between two groups. This result is in-line with Zhong et al,²⁴ Memon et al²⁷ and Al Nahas et al.²⁹

Regarding the postoperative hospital stay and recovery time, this study founded significant differences between two groups. The mean postoperative hospital stay was 2.61 days in PCNL group and 5.63 days in OS group, while the mean of recovery time was 1.01 weeks in PCNL group and 3.15 weeks in OS group. A meta-analysis study also founded a shorter hospitalization times in PCNL group.¹³ According to the results of this study, the duration of operation (operative time) was significantly less in the OS group than the PCNL group. Previous study reported significantly lower mean of operative time in PCNL than OS.¹³

Conclusion

Staghorn stones can be treated with PCNL and OS as well, although most of surgeons now use PCNL over open surgery since it is less invasive method. There were no significant differences between studied groups in term of intraoperative,

postoperative complications and stone free rates. Furthermore, postoperative hospital stays, and recovery time were significantly lower in PCNL group. As a result, the PCNL recommended option is a very efficient treatment option for staghorn stones.

Funding

Not applicable.

Competing interests

The authors declare that they have no competing interests.

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