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A prospective comparative study of percutaneous nephrolithotomy in patients with and without a history of open stone surgery

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Abstract

Background & Objectives: Percutaneous nephrolithotomy in individuals with prior open stone operations might be difficult. The purpose of our research was to compare the efficacy and complications of the procedure in individuals who had previous open renal stone surgeries with patients without previous open renal surgeries.

Methods: This is a prospective comparative study carried out on 115 patients between May 2020 to April 2021, the patients were classified into two groups. Group 1 (n=50) had previously undergone open renal stone surgery. Group 2 (n=65) had no prior open operations. Both groups' demographic data, stone parameters, operative and fluoroscopy time, stone-free rate, hospital stays, and perioperative and postoperative complications were compared.

Results: The demographic data and stone parameters were comparable between the two groups, the total operative time and fluoroscopic time were significantly higher for group 1 versus group 2 (74.18 min vs 62.89 min), (22.12 min vs 11.69 min) respectively. Postoperative hospital stays nephrostomy tube removal time, and mean hemoglobin drops were also similar, 6 patients in group 1 received a blood transfusion in comparison to 2 patients in group 2, but statistically was not significant. There were no statistically significant differences between groups 1 and 2 in terms of perioperative and postoperative complications.

Conclusion: Individuals with a history of open renal stone operations who have subsequent percutaneous nephrolithotomy may require more fluoroscopic and operating time, although the success rate and overall morbidities were the same in both groups.

Key words: Open kidney stone operations, Percutaneous nephrolithotomy, Urolithiasis.

Introduction

The overall lifetime prevalence of urolithiasis is approximated to be 1% - 15% and will vary with age, race, gender, and geographic location.[1] The growth in prevalence of nephrolithiasis is a worldwide phenomenon, and its prevalence and incidence have been growing with time all over the world.[2,3] When a kidney stone forms, there is nearly a 50% chance of forming a second stone in five to seven years.[4] The decline in open surgeries for urinary stones took place in the 1980s, the establishment of percutaneous nephrolithotomy, and the advancements in ureteroscopic apparatus and techniques brought on the basic reduction in the percentage of open stone surgical operations performed.[5] In 1976; Fernstrom and Johansson conducted the first percutaneous nephrolithotomy (PNL) using a nephrostomy tract created for stone removal, later on, PNL virtually

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supplanted open procedures in the majority of institutions for removing complicated renal calculi.[6]Open kidney surgery and its impact have not been outdated. Because of the large relapse rate of the stone disease, several patients treated today have previously had open renal stone surgery. Additionally, open renal stone operations continue to play an important role in particular clinical situations when minimally invasive procedures may not be appropriate, as well as in many remote parts of underdeveloped nations where PCNL is not widely available.[7,8] With the high recurrence rate for kidney stones, these individuals may also require PNL operation afterward. Patients who have had previous open kidney surgery may have retroperitoneal scar tissues surrounding the kidney, pelvicalyceal system architectural abnormalities, and in some circumstances, bowel displacement could occur. Generally, while doing an operation in a prior surgical anatomical location, the surgeon might expect a technical difficulty that could result in a longer surgical time, greater perioperative and postoperative morbidities, and, maybe, a poor outcome.[7]There are contradictory reports on the outcome of percutaneous nephrolithotomy after open stone surgery. Some reports found that prior open renal stone operations could raise the risk of percutaneous nephrolithotomy failure, whereas others have found the opposite.[9,10]The goal of our study was to prospectively look at the impact of past open renal stone operations on future PCNL efficacy and morbidities. Because the majority of previous research has been conducted retrospectively, we intended to perform a prospective study.

Materials and methods

Following approval of the study protocol by the Kurdistan Higher Council of Medical Specialties (KHCMS) and gaining the acceptance of the ethical committee, this prospective comparative study started from (May 2020 - April 2021) in three Hospitals in Erbil City (Rizgary Teaching Hospital, Zheen International Hospitals, and Zanko Hospitals) and was conducted on 115 patients with the age range of 18-72 years old, all patients with stones 15 mm and larger (including Staghorn stones and multiple stones) were included in the study, PCNL was done for all patients with or without a history of previous open renal stone operations. Patients with renal anomalies, pregnancy, a history of uncontrolled coagulopathy, and severe musculoskeletal deformities were excluded from the study. A questionnaire was prepared for the variables of the participants included in the study after taking their consent and their names were kept secure Patients were categorized into two groups: Group 1: patients with recurrent stones who had prior open renal stone surgeries (Nephrolithotomy/Pyelolithotomy) and Group 2 consists of primary patients without prior open surgery for renal stone disease. All patients were preoperatively diagnosed by ultrasonography, KUB, abdominal computerized tomography scan (CT scan), or intravenous urography (IVU). The two groups were compared in terms of patient age, gender, BMI, stone burden, operative time (including total and fluoroscopy time), length of hospital stays, number of tracts, nephrostomy tube removal time, blood transfusion, pre and postoperative hemoglobin (Hb), stone clearance, and complication rates. Single-stage prone position PNL was done on all patients by different surgeons in the urology department as a standard procedure. Antibiotic prophylaxis was given to all patients at induction of anesthesia. The contrast was injected retrogradely through the ureteral catheter to visualize the pelvicalyceal system. Under C-arm fluoroscopy (Siemens) monitoring, percutaneous renal access was

established through a suitable posterior calyx with an initial puncture needle 18G, a guidewire was immediately placed into the renal pelvis or coiled in the calyx through a puncturing needle, 1 cm incision was done just tangential to the needle passing deep to the subcutaneous tissue before the withdrawal of the needle, tract dilatation was done under fluoroscopic control with the placement of a 28F-30F Amplatz Sheath, 26 Fr Nephroscope was inserted directly into the kidney through the Amplatz sheath, stones were fragmented by pneumatic lithotripsy then removed by stone forceps, the fine fragments were removed by flushing with normal saline. At the end of the operation, the collecting system was inspected by direct nephroscopy and fluoroscopy for any retained stone pieces and any procedure-related complications. The ureteric catheters were removed and an antegrade JJ stent was inserted for all of them which are removed 4 weeks later and the nephrostomy catheter was fixed for all patients. Patients were followed up postoperatively for vital signs, hematuria, and urine output. A complete blood count (CBC) was done for all patients on the first postoperative day and Hemoglobin checks were performed at more frequent intervals for specific cases. The urethral catheter and nephrostomy tube were removed on the first postoperative day, but in cases of bleeding and pelvicalyceal perforation, the nephrostomy tube was kept for a longer time. Patients were followed up at 1 week, and after 1 month for assessing the postoperative complications, KUB and renal ultrasound were done for assessing residual stone fragments. The data has been recorded using a specifically created questionnaire, gathered and entered in the computer via Microsoft Excel, and then analyzed using SPSS version 25 and the findings were compared across patients with various variables. A p-value of 0.05 was considered to be statistically significant. The findings are provided in tables as mean, standard deviation, and percentages and are analyzed using Chi-square tests and the t-test.

Results

As shown in Table (1), There were no statistically significant differences between groups I and II regarding the mean age, stone size, and number of tracts. Pearson Chi-square test was used p – values were more than 0.05. There was a significant statistical difference between group I and II participants in their BMI, group I patients had a higher (28.42±3.89) BMI than group II cases (26.40±4.33), t-test was done to compare the mean BMI of both groups and p–value was 0.011. Also, there was no significant statistical association between study groups (I and II) in regard to gender, site of PNCL, stone location, and the number of stones. Most of the patients in both groups were male; PNCL was on the left, stones at calyx, and mostly single.

Table (1): Demographic data and stone characteristics of groups I and II participants**.**

Variables	Categories	Group I (n=50)	Group II (n=65)	p-value
Age (years)	Mean ± S. D	47.06±9.82	45.78±13.12	0.567
Sex	Male	28 (56%)	37 (56.9%)	0.921
	Female	22 (44%)	28 (43.1%)	
BMI (kg/m^2)	Mean ± S. D	28.42±3.89	26.40±4.33	0.011
Stone size (mm)	Mean ± S. D	29.90±8.99	30.11±8.86	0.902
Site of PNCL	Right	20 (40%)	30 (46.2%)	0.509
	left	30 (60%)	35 (53.8%)	
Stone location	Pelvis	12 (24%)	19 (29.2%)	0.614
	Pyelocaliceal	18 (36%)	18 (27.7%)	

	Calyceal	20 (40%)	28 (43.1%)	
Number of tracts	Mean ± S. D	1.10±0.30	1.06±0.24	0.451
Number of stones	Single	30 (60%)	40 (61.5%)	0.867
	Multiple	20 (40%)	25 (38.5%)	

The findings of Table (2) reveal that there was a non-significant statistical relationship between study groups (I and II) in both pre-and post-operative complications. A chi-square test was done and p–values were more than 0.05. The majority of participants in both groups had very good stone clearance. Post-operative fever was very uncommon and only six patients in each group had it, likewise, post-operative leak, pseudoaneurysm, renal pelvic injury, and hemopneumothorax were rare among group I and II cases. None of the participants in both study group developed an injury to adjoining organs. In the same manner, there was a significant statistical difference between group I and II participants in regard to the total operative time and fluoroscopy time. On average; group I cases had much longer total operative time and nearly double fluoroscopy time compared to group II cases, the t-test was highly significant and p–values were 0.001. There was no significant difference in the number of tracts, postoperative hospital stays, nephrostomy tube removal, or pre, and postoperative Hb levels. The average Hb drop for group I was 0.87g/dl, whereas the decrease in group II was slightly less (0.72gmdl). Although (12%) of the patients in group I needed a blood transfusion and only 1.3% of group II cases were in need of a blood transfusion, this difference was not statistically significant and the p-value was 0.076.

Table (2): Per and post-operative variables of both study groups.

Variables	Group I (n=50)	Group II (n=65)	p-value
blood transfusion	6 (75%)	2 (25%)	0.076
stone clearance	46 (92%)	59 (90.8%)	0.816
post-operative fever	6 (12%)	6 (9.2%)	0.630
post-operative leak	2 (4%)	3 (4.6%)	0.873
pseudo aneurysm	1 (2%)	1 (1.5%)	0.851
hemopneumothorax	1 (2%)	1 (1.5%)	0.851
renal pelvic injury	1 (2%)	0 (0%)	0.435
injury to adjoining organs	0 (0%)	0 (0%)	N.A
total operative time (minutes)	74.18±15.65	62.89±13.09	0.001
fluoroscopy time (minutes)	22.12±9.47	11.69±5.35	0.001
post-operative hospital stay (days)	1.60±1.29	1.40±1.02	0.357
nephrostomy tube removal	1.20±0.49	1.17±0.41	0.718
pre-operative Hb (g/dl)	14.07±1.40	13.92±1.38	0.580
post-operative Hb (g/dl)	13.20±1.43	13.20±1.32	0.994

Discussion

Percutaneous nephrolithotomy (PCNL) history dated back to 1976, but it was not until the 1990s that it became a favored method for the management of renal stones.[11-13] In Kurdistan of Iraq, the PCNL was just available in the last 13 years whereas before, we treated most renal stones by open techniques and still in peripheral regions, and because of economic status, some cases were managed by open surgery, due to the high recurrence incidence of renal stones (approximately 50% in five to seven years).[4] patients frequently require more re-interventions. There are several reports that the incidence of PCNL failure is

higher in individuals with previous open surgery.[12,14] Among those who have contributed to this work are Shah et al. In addition, Margel et al. discovered that anatomical alterations after open renal stone surgeries, such as infundibular stenosis, peri-renal scarring, intestinal displacement, and incisional hernia, might diminish the success rate of PCNL and increase its morbidities.[15,16] Several studies including ours, have demonstrated that PCNL may be done effectively without increasing the risk of complications in patients who have had prior open interventions[16-19]. The mean total operative duration and fluoroscopy time in our study were considerably higher in the group that had previous open kidney stone surgeries, similar results are reported by Margel, Tugcu, and Reddy who have also shown that operative duration was significantly higher in patients with prior open stone surgeries.[16,17,19] Factors that can prolong the patient's PCNL time after open operations include more attempts to puncture the pelvicalyceal system in order to access them due to distorted anatomy of the calyces, also tract dilatation will be difficult in the scarred collecting system, retro-peritoneal, and perirenal tissues. Also, stone extraction by grasping forceps and rigid nephroscope may be difficult in scarred and fixed kidneys in the retroperitoneum.[13,19]Our research, like other earlier research, found no difference in stone-free rate (SFR), time of nephrostomy removal, or period of hospital stays between those patients who have had prior open surgeries and those who do not.[9,17,19,20] Basiri and colleagues evaluated the outcome of primary PCNL (177 patients) with PCNL in prior open interventions (65 patients). They discovered that the success rates of the two groups were similar. In their series, the data of the patients in the two groups were not matched correctly, particularly the stone burden, which was substantially lower in patients with prior open stone operations. In this article, the two data sets are carefully compared; therefore, this series gives more objective results.[10]In our study, the rate of bleeding that necessitated blood transfusion was higher in individuals with previous open surgery, during operation mostly required only 1 unit and responded well to conservative measures but it was statistically insignificant, like our study, there were several studies that showed no difference in blood transfusion rates between these two groups.[9,19,21] Only one patient in each group developed a pseudoaneurysm and required angioembolization, which was statistically not significant. The incision of the kidney parenchyma may lead to the formation of new blood vessels in the kidney tissue, which can make the kidney parenchyma more fragile, which may be the reason for the increased rate of bleeding. Additionally, pelvicalyceal deformity and infundibular stenosis can promote bleeding during nephroscope manipulations.[2] Both groups had similar rates of postoperative febrile UTI (12% vs 9.2%), post-operative urine leak (4 % vs 4.6%), Hemopneumothorax (2% vs 1.5%), Renal pelvic injury (2% vs 0.0%), damage to adjoining organs (0.0% vs 0.0%), all of which were not statistically significant. Like our reports, many studies showed that PCNL can be done in individuals with a history of previous open stone operations without increasing the likelihood of complications.[13,16,17,19] The results of our study probably have been affected by some variables like the operations were performed by different surgeons, in different centers, which may affect the results of the PCNL, and we did not differentiate between the types of previous open renal stone surgeries whether they were pyelolithotomy or nephrolithotomy, which may again affect the results.

Conclusion

Our study shows that percutaneous nephrolithotomy may take a longer time in patients with a history of prior open renal stone surgeries which may be due to the scar tissues and anatomical alterations in the kidney, however, the effectiveness and success rate of percutaneous nephrolithotomy as well as the complications were comparable to those of patients without previous open renal surgeries.

Conflicts of interest

There were no conflicts of interest.

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