Percutaneous Nephrolithotomy in a Previously Operated Kidney

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ABSTRACT

Objective: To ascertain the safety and efficacy of percutaneous nephrolithomy in patients with previous open renal surgery.

Study Design: Descriptive study.

Place and Duration of Study: The Kidney Centre Postgraduate Training Institute, Karachi from January to December 2018.

Methodology: Patients with previous open renal surgery underwent percutaneous nephrolithomy during study period (Group A). Equal number of percutaneous nephrolithomy patients without previous open surgery taken as *controls* (Group B). Safety was defined in terms of 'blood loss' as change in hemoglobin (HB) level and 'blood transfusion,' while efficacy was defined in terms of 'stone clearance' and were compared between both the groups.

Results: There were a total of 87 patients. Both groups had comparative gender ratio [$p = 0.858$]. Mean age [$p = 0.132$] and BMI [$p = 0.879$] of patients in both groups was not significantly different from each other. Both groups showed no statistically significant difference in terms of values of stone size [$p = 0.186$], stone laterality [$p = 0.437$] stone location [$p = 0.949$], preoperative Hb [$p = 0.095$], postoperative Hb [$p = 0.423$] and change in Hb (indicating blood loss, $p = 0.398$). Puncture levels were significantly different among both groups (supracostal puncture in 18 and 36 patients; infracostal puncture in 63 and 51 patients in groups A and B, respectively, $p = 0.006$), while operative time [$p = 0.787$], calyx punctured [$p = 0.051$], double puncture [$p = 0.787$], nephrostomy tube [$p = 0.288$] were statistically not different among groups. Similar number of patients demonstrated residual stones [$p = 0.773$], along with residual stone sizes [Group A (0.5; 0.5) and Group B (0.65; 0.38)] [$p = 0.445$]. Intra- and postoperative complications like blood transfusion [$p = 0.700$] and fever [$p = 1.000$] along with hospital stay [$p = 0.614$] were comparable among groups.

Conclusion: Percutaneous nephrolithomy is safe and effective in previously operated kidneys despite the possibility of calyceal anatomy distortion and scarring.

Key Words: *Percutaneous nephrolithotomy, Open surgery, Kidney calculi.*

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INTRODUCTION

Urolithiasis is a highly prevalent disease worldwide with rates ranging from 7 to 13% in North America, 5-9% in Europe, and 1-5% in Asia.[1] In the current times, percutaneous nephrolithotomy (PCNL) is the gold standard treatment for renal calculi of 2 cms or more.[2] This revolutionary procedure was pioneered by Fernstrom and Johansson in 1976.[3] It was further refined and innovated to its role as a gold standard procedure.[4,5] PCNL is also indicated in renal stones smaller than 2 cms in cases where the stone is refractory to non-surgical treatment of extracorporeal shockwave lithotripsy or for diverticular stones.

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PCNL has been deemed surgically difficult in previously operated cases due to scarring and distorted tissue anatomy.[6,7] Some authors have concluded that PCNL in previously operated kidney has similar safety and efficacy, but there are difficulties in establishing renal access; and it may require multiple attempts.[8] Failures in procedure also comprised of large residual stones requiring re-procedure in some studies.[9] Some recent literature also shows that PCNL is safe and effective even as a secondary procedure after previous open surgery and a primary PCNL; thus ignoring the fear of infundibular stenosis, perinephric fibrosis, bowel displacement, and incisional hernia.[10] Another rare complication is the presence of vascular malformations / complications during or after PCNL in previously operated kidneys. These vascular events were diagnosed on renal vascular angiography and ultimately required angioembolisation in a few cases.[11]

The safety of PCNL in previously operated patients has even been demonstrated in pediatric population.[12] Then again, few authors have emphasised their concerns over procedural struggle due to presence of retro-renal colon in pediatric

patients, necessitating indication of non-ionic contrast CT scans preoperatively.[13]

The rationale of this study was to provide further input on the safety of PCNL in previously operated patients in order to strengthen the evidence, because the data on previously operated patients undergoing PCNL is scarce nationally; and vastly debatable and contrasting as per international literature. Very few prospective studies have been published internationally with such a variable.

The objective of the study was to ascertain the safety and efficacy of percutaneous nephrolithomy in patients with previous open renal surgery.

METHODOLOGY

This descriptive study was conducted at The Kidney Centre Postgraduate Training Institute, Karachi, Pakistan. Patients included were those who underwent PCNL from January 2018 till December 2018. Prior to the study, Institutional Ethical Review Board approval was taken (Reference # 76-URO-052019).

Eighty seven (87) patients with previous history of open renal surgery (pyelolithotomy) underwent PCNL during study period and were placed into Group A. An equal number of PCNL patients who never had previous open renal surgery were taken as *controls* and comprised the Group B. Controls had similar demographic and investigative parameters as the cases and these values were also recorded for both groups. Both groups underwent PCNL by the same surgeon.

The PCNL procedure performed in both groups was the same. After receiving general anesthesia, cystoscopy was done in dorsal lithotomy position, followed by ureteric catheterization and Foley's catheter placement. Position was changed to prone and renal system was accessed under fluoroscopic guidance. After successful puncture with lumber puncture 18G needle, guide wire was inserted into the renal system, followed by serial dilatation of the tract with help of Alken's serial metallic dilators. A 30 French Amplatz sheath was placed into the renal system and stones fragmented through the nephroscope using pneumatic lithotripter. Foreign body grasper was used for stone fragments retrieval. Nephrostomy tube was kept at the end of some procedures as per requirement of drainage, to be removed on second postoperative day. First postoperative day hemoglobin levels were compared with preoperative data and recorded on proforma. Similarly, operative parameters like puncture details, number of tracts, operative time, intra- and postoperative complications along with duration of stay were also recorded for both groups. Safety was defined in terms of 'blood loss' as change in hemoglobin (HB) levels after the procedure, and 'blood transfusion' while efficacy was defined in terms of 'stone clearance' and were compared between both groups.

All recorded data underwent normality check through Shapiro-Wilk test. Data that was normally distributed was described in terms of mean and standard deviation for continuous variables (age, BMI, pre-operative and postoperative Hb); and parametric testing by independent t-test was performed. Data that failed normality check (age, stone size, change in Hb, operative time, residual stone size and hospital stay) was described in terms of median and interquartile ratio; and was tested using Mann-Whitney U test.

Table I: Baseline demographics and clinical characteristics.

	Group-A (previously operated) cases	Group-B (Non-operated) controls	p-value (*p*)
Gender			
Male (n number)	66	67	$p = 0.858$
Female (n number)	21	20	
Age (years)			
Median	45	50	$p = 0.132$
Interquartile range	27	27	
BMI (kg/m^2)			
Mean	24.61	24.49	$p = 0.879$
Standard deviation	+5.35	+5.02	
Stone Size (cms)			
Median	2.0	2.0	$p = 0.186$
Interquartile range	1.0	0.8	
Stone Side			
Right	57	55	$p = 0.437$
Left	30	32	
Stone Location			
Upper calyx	16	12	$p = 0.268$
Middle calyx	28	24	$p = 0.310$
Lower calyx	40	36	$p = 0.323$
Pelvis	26	39	$p = 0.030$

Table II: Investigative and operative parameters.

	Group-A (previously operated) cases	Group-B (non-operated) controls	p-value (p)
Preoperative hemoglobin (gm/dl)			
Mean	13.31	12.56	$p = 0.095$
Standard deviation	+1.61	+1.84	
Post-operative hemoglobin (gm/dl)			
Mean	11.77	11.28	$p = 0.423$
Standard deviation	+1.70	+1.80	
Change in hemoglobin (gm/dl)			
Median	1.10	1.10	$p = 0.398$
Interquartile range	1.60	1.10	
Operative time (minutes)			
Median	120	120	$p = 0.787$
Interquartile range	50	50	
Calyx punctured			
Upper calyx	25	38	$p = 0.051$
Middle calyx	08	11	
Lower calyx	54	38	
Puncture level			
Supracostal	18	36	$p = 0.006$
Infracostal	63	51	
Double puncture			
Number of patients	08	07	$p = 0.787$
Nephrostomy tube placed			
Number of patients	45	38	$p = 0.288$
Complications			
Residual stone	07	06	$p = 0.773$
Residual size (median; IQR)	0.50 ; 0.50	0.65 ; 0.38	$p = 0.445$
Blood transfusion	04	03	$p = 0.700$
Fever	01	01	$p = 1.000$
Urosepses	00	00	---
Pleural effusion	00	00	---
Conversion to open	00	00	---
Re-PCNL	00	00	---
Hospital stay			
Number of days	3.00 ; 1.00	3.00 ; 1.00	$p = 0.614$

Categorical variables (gender, stone location and laterality, calyx punctured, level of puncture, nephrostomy tube and complications) were described in terms of 'n number'& were compared between the 2 groups applying chi square Test. SPSS (Statistical Packages of Social Sciences) version 20 was used to analyze data. P-value of less than 0.05 was taken as statistically significant.

RESULTS

An approximately equal number of male and female patients underwent PCNL in both groups A and B [$p = 0.858$], as shown in Table I. Median and interquartile ratio of patients in group-A and B was not significantly different from each other [$p = 0.132$] as shown in Table I. Similarly, mean BMI patients in groups A and B was also not significantly different from each other [$p = 0.879$] as shown in Table I.

When it comes to stone parameters, both groups showed statistically significant values in terms of stone size [$p = 0.186$], stone laterality [$p = 0.437$] and stone location as shown in Table I.

In term of laboratory parameters, values in both groups were not significant different among each other in terms of preop Hb [$p = 0.095$], post-op HB [$p = 0.423$] and change in Hb (blood loss) [$p = 0.398$] as shown in Table II.

Among the operative parameters, puncture level values were significantly different among both groups (supracostal puncture in 18 and 36 patients; infracostal puncture in 63 and 51 patients in group A and B respectively) [$p = 0.006$], while rest of variables like operative time [$p = 0.787$], calyx punctured [$p = 0.051$], double puncture [$p = 0.787$], nephrostomy tube [$p = 0.288$] were statistically significant among both groups A and B, as shown in Table II. A nearly equal number of patients demonstrated Residual stones in both groups [$p = 0.773$], along with statistically significant residual stone size among Groups A and B [$p = 0.445$] as shown in Table II.

Among both groups, differences in intra- and postoperative complications like blood transfusion [$p = 0.700$] and fever [$p = 1.000$] were also significantly significance among each other, while there were no cases of known complications like urosepsis, pleural effusion, conversion to open procedure or repeat noted in any of the groups, as shown in Table II. Median and interquartile ratio of hospital stay was also not statistically signicant among both groups [$p = 0.614$], as shown in TableII.

DISCUSSION

In this study, intra- and postoperative complications like blood transfusion and fever were significantly different between the groups, while there were no cases of known complications like urosepsis and pleural effusion.

Kidney stones present a sizable worldwide health problem. Pakistan is situated in the Afro-Asian stone belt (stretching from Egypt, Middle East, Iran, Pakistan, India, and Thailand up to Indonesia and the Philippines) and has consistently reported a high incidence of urolithiasis.[14] Approximately 12% of the population suffers from urolithiasis once in their life-time and recurrence rate approaches 50% in coming years.[15] Urolithiasis constitutes a major etiology of morbidity in adult and pediatric population in Pakistan.[16]

Though PCNL has reduced morbidity associated with open procedures, which were previously performed for large renal calculi, there still exists theoretical fear of surgical difficulty in previously operated cases due to scarring and distorted tissue anatomy.[6,7] This fear has led to surgeons doing repeated open procedures in the past but due to newer advents of surgical instruments and radiological innovations; this notion is now a thing of the past.

During the past decade or so, several authors have shared their success stories of doing PCNL in previously operated patients, but few have also highlighted the operative obstacles faced. This dilemma has caused panic among surgeons to arrange surplus blood products during their cases of PCNL with such variable. Some surgeons have deemed PCNL in such patients to be less efficacious due to large residual stones, while others have advocated comparatively higher rates of access / procedure failure.

Sofikerim reported a retrospective case-control study on 89 patients who had underwent PCNL after having a previous open renal surgery.[17] Like this study, this study also demonstrated comparable age, stone burden and laterality among both case and control groups. Both groups showed no difference in terms of operative time, postoperative analgesic doses, pain scores, intraoperative and postoperative complications, number of accesses or stone-free rate. We, on the other hand, did not calculate pain scores and analgesic doses, but the rest was comparable.

Another review in 2006 by Shah consisted of 25 patients as cases and an equal number of controls.[18] All cases studied were tubeless PCNL in the study, unlike the present study where both tubeless and with tube were examined. Shah HN also reported PCNL with such variable to be safe and effective in terms of stone clearance and complications.

In 2007, Kurtulus[19] performed a retrospective case-control study in Turkey, comprising of 328 patients among which 142 underwent PCNL secondary to some open renal procedure in the past, while remaining were controls for comparison. Baseline demographic details were similar in both groups and significant differences were not observed in terms of number of tract (8.5% *vs.* 10.2%), operative time (2.3 *vs.* 2.2 hours), transfusion rate (540 *vs.* 495 mL), hospitalisation time (4.4 *vs.* 4.2 days), complication rate (1.4% *vs.* 3%) and residual stones (5% *vs.* 3%). With the difference of sample size, rest of parameters and results are comparable with this study. Access difficulty was faced by Kurtulus and was tackled by using high pressure balloon dilators for tract formation.[19] Another more recent Turkish study by Yesil noticed a rare complication of vascular malformation during or after PCNL in previously operated kidneys.[11] These vascular events were diagnosed on renal

vascular angiography and ultimately required angioembolisation in few cases as well. The present authors did not check such complications.

Tugcu *et al.* also described similar results in their retrospective study performed in 2007, but they took note of lengthy operative times in previously operated group due to scarring of tissue.[20] In this study, the authors did not notice any significant difference in terms of operative time.

An Iranian study from 2007 by Amjadi implied slight variation in PCNL technique in previously operated patients.[21] Among the 31 patients, half were assigned to the group in which Alken's serial dilators were used, while in the other group a 'one-shot' 27-Fr dilator was used for tract dilatation. Results implied no differences in safety and efficacy but there was significant reduction in radiation exposure in the 'one-shot' group. The present authors did not use 'one-shot' dilator study and only used the conventional Alkene's serial metallic dilators.

Two studies done on pediatric population with similar variables also mimicked the results of other authors. Aldaqadossi in 2014, and Onal in 2011 demonstrated the safety and efficacy to be comparable in PCNL patients with and without previous open surgery.[12,13] There was concern regarding presence of retrorenal colon in previously operated cases which advocated use of preoperative CT scans. Pediatric PCNL cases not compared in this study.

Although PCNL is a minimally invasive procedure, but in the presence of soft tissue scarring and tissue distortion due to previous surgery, renal access as well as tract dilatation can be challenging. The findings of this study proved that modern day techniques of PCNL are safe and effective even in scarred soft tissue. There is no objective reason to hold back the decision of performing PCNL in previously operated patients.

Prominent limitation of the study is lack of prospective trial. Larger sample size in a prospective setting would yield better representation of population in future trials. Although use of nephrostomy tube was statistically similar in both studies, but this small bias can also be removed in future studies by doing all cases tubeless. We did not use balloon dilators or 'one shot' dilators for the tract and hence the implications of such modalities are not well understood in our study. Vascular complications were not investigated by us which may impact on the outcome of such patients who have undergone previous surgery. Pediatric population may be included in our future studies to further investigate specific complications like retrorenal colon.

CONCLUSION

PCNL is a safe and effective procedure for sizable renal stones; even in previously operated kidneys, where there is significant fear of tissue scarring and distortion of normal calyceal anatomy. Modern instruments and innovated techniques have resulted in better surgical outcomes.

ETHICAL APPROVAL:

Ethical approval was provided by Ethical Committee of The Kidney Centre, Dorab Patel Post Graduate Training & Research Centre with (Reference # 76-URO-052019), dated May 2019.

PATIENTS' CONSENT:

A detailed informed consents were taken from all patients, explaining about the risks and benefits of the surgical procedure and also about the research proceedings along with confidentiality methods.

CONFLICT OF INTEREST:

The authors declared no conflict of interest.

AUTHORS' CONTRIBUTION:

SM, FY, AS: Surgical practices.
SM: Conception of study.
AS: Design, analysis or interpretation of data and manuscript writing.
FY, AS, SH, WH, SK: Data collection and processing.
AS, FY, SM: Literature search.

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