Single Shot Tract Dilatation During Percutaneous Nephrolithotomy: Our Experience

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Abstract

Objective: To compare safety and efficacy of one-shot dilation and Alken sequential dilatation in PCNL

Method: This prospective study conducted on 60 renal stones patients underwent supine PCNL at Department of urology, Lahore General Hospital, Lahore from June 2020 to July 2021.Tract dilatation was performed using Alken dilatation (Group A, 30 patients) or One-shot dilatation (Group B, 30 patients).

Results: The mean age of patients in Group A and Group B were comparable (P=0.78). Stone clearance between group A and B was not different (86.7% v 83.3% respectively, p=1). Group B had a lower mean fluoroscopy time than group A. (124.13±22.40 Sec Vs 102.16±32.26 Sec, P=.003). Mean tract dilatation was shorter in group B than group A (5.06 ±0.80 min Vs 5.94 ±0.87 min, p<.001). Mean hemoglobin drop was similar in both groups (1.62±.56 g/dl Vs 1.38 ±.36 g/dl, P=.055). The complications among the groups were not significantly different.

Conclusion: One-Shot dilatation is a safe and effective technique for creation of nephrostomy tract in PCNL. That can reduce tract dilatation time and X-rays exposure time.

Keywords: PCNL, Tract dilatation, One-shot dilatation.

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Introduction

Nephrolithiasis is common urological problem, with worldwide prevalence ranging from 2 to 20%.[1] The life time risk of developing renal stones is 12% for men and 5% for women.[1] Incidence of renal stones is high in Pakistan as it located in the geographic region called the "stone belt" extends from Egypt and Sudan into the Middle East, India, Pakistan, Myanmar, Thailand and Indonesia.[2] Percutaneous nephrolithotomy (PCNL) portrayed within the 1980s revolutionized the treatment of kidney stones and still remains a vital treatment tool.[3]

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This minimally invasive surgery has emerged to become the preferred approach for treatment of large size renal stones and has superseded the open surgery for nephrolithiasis. This approach has replaced open renal surgery for stones. In selected cases RIRS (retrograde intrarenal surgery) might be a viable alternative to PCNL.[4,5] PCNL involves entering the renal collecting system with an access needle and guide wire, followed by tract dilation.[3] After appropriate tract dilation, a suitable size Amplatz sheath is introduced over dilators which make it easier to insert endoscope, working instruments, and nelaton catheter for stone wash out during procedure and placement of nephrostomy tube after completion of procedure.[6]

Recent studies agree that renal puncture and tract dilatation is a critical and fundamental step in PCNL and may be fulfilled by utilizing Amplatz dilators (semi rigid polyurethane facial dilators), Alken dilators (metal telescopic coaxial dilators), balloon dilator, or one-shot dilator.[7]

Alken dilators are more economical because of their

re-usability, and maintaining tamponade impact during dilatation of the tract.[8] Amplatz dilators are not reusable and may cause more blood loss due to consecutive dilator exchange which causes displacement of tamponade effect on paranchymal tract. The use of Alken and consecutive Amplatz dilators takes more time and are time-consuming, with a higher frequency of guide wire kinking during tract development.[8]

Minimizing X-rays exposure and blood loss are of prime importance during PCNL, and therefore balloon dilation is nowadays being considered as one of the methods for tract dilatation as it helps in reducing the X-rays exposure time during tract dilatation. Similarly, because of the steady pressure applied at the time of tract dilatation to the parenchyma of kidney, the rate of blood loss is decreased due to the tamponade effect. The drawbacks of this method are its cost as it is disposable.[9] In 2001, Frattini et al. conducted a study in Italy; they state that; one-shot dilation is easy to performed in majority of the patients. This method is as safe and effective as the balloon dilatation which is the gold standard but this method of dilatation can be performed in short time and with low cost than balloon dilatation.[10] In routine, Alken dilators are used for tract dilatation in PCNL but they are time consuming. The objective of this research was to compare outcomes of one-shot renal dilation and Alken dilatation in terms of tract dilation fluoroscopy time, hemoglobin decrease, hematoma formation, visceral injuries, urinoma formation, stone clearance and conversion to open surgery.

Material and Methods

This prospective study was conducted on 60 renal stones patients underwent PCNL at urology department, Lahore General Hospital, Lahore from June 2020 to July 2021. A thorough history was obtained, and a physical examination was carried out. Routine tests for anesthetic fitness were done and some specific investigations was performed i.e. urine culture & sensitivity, USG KUB, plain X-rays KUB, IVU and CT KUB was done if needed. Selected patients were randomly assigned into two equal groups, group A and B (30 patients in each group) by using computer generated table. In Group "A", Alken dilators were used, while in Group "B", one-shot procedure was employed. All procedures underwent under general endotracheal anesthesia in Galdakao- modified supine Valdivia position. Each procedure was carried out by the same surgical team. An open-ended **6**Fr ureteric catheter was placed into the collecting system retrogradly by using cystoscope. After injecting of the contrast dye through ureteric catheter under fluoroscopic guidance puncture of an appropriate calyx to the renal collecting system done with an 18 gauge Chiba needle. In some difficult cases access to the renal collecting system was achieved with combined ultrasound and fluoroscopic guidance.

Following the puncture of the renal collecting system, a 0.035-inch guide wire was passed through needle to collecting system. Then an 8 Fr olive tip was advanced over guide wire. In group A dilatation was carried out with six to seven consecutive dilators under fluoroscopy guidance. Eventually the tract dilated between 27Fr and 30Fr. In group "B" tract dilatation was performed under fluoroscopy guidance by directly advancing of a single 28Fr Amplatz dilator over 8Fr Olive tip dilator. During procedure tract dilatation fluoroscopy time was recorded from the time of guide wire insertion until placement of the sheath. Hemoglobin of the patients was checked pre operatively, Post-operative (immediately), and after 24 hours of surgery. Patients were evaluated for stone clearance during operation by fluoroscope and at first operative day by KUB X-rays or ultrasound. Patients were evaluated for any collection (hematoma, urinoma) at first operative day. For diagnosis of pleural injuries intra operative fluoroscopy was done, if the patient became symptomatic post-operatively, chest x-ray was performed. Patients were evaluated clinically for abdominal visceral injuries post operatively. Any suspected abdominal visceral injury was evaluated with contrast enhanced CT abdomen.

Data were entered and analyzed by using SPSS 24.0 version. Quantitative variables such as age, hemoglobin decrease and tract dilation fluoroscopy time were described as Mean ± S.D. for each group. Qualitative variables like gender, presence of hematoma, urinoma formation, visceral injuries, stone clearance and conversion rate were described as percentage.

Mean of hemoglobin decrease in each group were compared with Independent t test. Mean of tract dilation fluoroscopy time among both groups were compared with Independent t test. Presence of hematoma, urinoma formation, visceral injuries, stone clearance and conversion to open surgery in each group were compared with Chi-square test. For both the independent t test and the Chi-square test, a P-value of less than 0.05 was considered significant.

Results

The mean age of patients in group A was 41.16 ± 11.48 while the mean age in group B was 41.96±11.18 years (P=0.78). There were 35 males (58.3%) and 25 females (41.7%) among the patients. In group A male to female ratio was 19/11, In group B it was 16/14 (P=0.43) Table 1.

In Group A the mean of nephrostomy tract dilatation time was 5.94 ± 0.87 min while in Group B mean tract dilatation time was 5.06 ± 0.80 min (P<.001). In Group A the mean fluoroscopy time was 124.13 ± 22.40 Sec and range was (70-200) Sec. In Group B mean was 102.16± 32.26 Sec and range was (50-190) Sec (P=.003). Drop of hemoglobin was compared in both groups, In Group A the mean drop of hemoglobin was 1.62 ± .56 g/dl and 1.38 ± .36 g/dl in Group B (P=.055).

Stone free rate in Group A was 86.7% and in Group B was 83.3%, P value was 1.000 which is statistically not significant. Hematoma formation, urinoma formation and visceral injuries were not reported in all study population. These complications were not occurred in both groups. Conversion to open surgery was reported in (3) cases (5%) in all study population, 2 cases (6.7%) in group A and 1 case (3.3%) was in Group B (p= 0.554). Table 2

Table 1: *Comparison of demographic Characteristics of patients in groups.*

	Group A (Alken Serial dilatation, n=30)	Group B (One-shot dilatation, n=30)	P Value
Mean age (year ± SD)	41.16 ± 11.48	41.96 ± 11.18	0.78
Male Gender	19(63.3%)	16(53.3%)	0.43
Female Gender	11(36.6%)	14(46.6%)	0.43

Table 2: *Comparison of demographic Characteristics of patients in groups.*

	Group A (Alken Serial dilatation, n=30)	Group B (One-shot dilatation, n=30)	P Value
Mean Nephrostomy tract dilatation time (min ± SD)	5.94 ± 0.87	5.06 ± 0.80	<0.001
Mean Tract dilatation fluoroscopy time **(Sec ± SD)**	124.13±22.40	102.16±32.26	0.003
Mean Drop of hemoglobin **(g/dl ± SD)**	1.62± 56	1.38 ± .36	0.055
Stone free rate	26(86.7%)	25(83.3%)	1.000
Conversion to open surgery	2(6.7%)	1(3.3%)	0.554

Discussion

Dilatation of the tract is very important step in PCNL as it may cause hemorrhage, so selection of an appropriate dilatation system is necessary.[10] Traditionally Amplatz dilator and Alken dilator systems are used for tract dilatation in PCNL.But their main problem is the incremental nature which results in extended tract dilatation time, increased radiation exposure and also increases the risk of tract displacement.[10] Using Balloon dilator for PCNL tract creation helps to prevent renal displacement and kinking of guide wire during dilatation of tract. But due to high cost, it cannot be used regularly and it also found to have 17% of failure rate which may goes up to 25% in patients with previous renal surgery.[11] During the last few years, working has been done to perform tract dilatation with technique such as single-step dilation of the tract to be simple in use, having low cost, suitable for all patients with decreasing of complications like hemorrhage and radiation exposure. Frattini and colleagues used the novel one-shot technique with 26Fr-30F Amplatz dilator for nephrostomy tract creation. They used this method in 26 patients, the parameters, like exposure of radiation, blood loss, and used costs were analyzed and compared with other to groups; Alken metal telescopic dilator group, and balloon dilator group. They stated that one-shot dilation is easy to use, more secure, less time-consuming, and cheaper technique. However, they found that their research lacked a sufficient number of patients and the technique was not tried in patients who had previous kidney surgery.[10]

Penbegul et al used novel PCNL set (Ecoset) in 42 patients; which comprises of a single 30-F dilator, 30-F sheath, and 8-F polyurethane dilator. They concluded that; Ecoset is safe and feasible technique to be used in almost every adult patient for the tract dilation in PCNL [(12)]. Recent studies have shown that OSD is safe and effective for access to the renal collecting system. In meta analyses on comparison of tract dilatation methods in PCNL by Peng et al and Chiancone et al reported that OSD can reduce access time, fluoroscopy time and drop in hemoglobin. But there was no difference in stone clearance, transfusion rate and complications rate.[13,14] The results of these studies are same as in our study regarding fluoroscopy time, access time stone free rate and complication rate but no significant

diffidence in hemoglobin drop between groups in our study. In a recent retrospective study by Sharma et al on 70 patients undergoing PCNL, they compared single step dilatation and serial dilatation and reported that of using single step dilator can decrease radiation exposure and operation time.[15]

Girisha et al. concluded that; One-step dilatation is a safe, cost effective and easily accomplished technique with additional benefits of little tract dilatation time, less X-rays exposure and less chance of blood transfusion.[16] Suelozgen et al concluded that single step dilatation is safe and effective alternative for nephrostomy tract dilatation in adults.[17] Srivastava and colleagues compared sequential facial dilation and one-shot dilation in 100 patients of pediatric age group. They said that OSD is feasible and safe method in children reducing X-rays exposure and operative time.[18] Ganesh and associates concluded that; In patients who had previous open surgery for kidney stone of the same side, the single-shot dilation procedure is just as successful, safe, and well tolerated as the Alken dilation method.[19]

In a study conducted by Mohyelden et al on 150 patients, concluded that OSD is efficient as MTD during PCNL while patients in Barts flank-free modified supine position, with less dilatation time, X-ray exposure, blood loss, and hospital stay than MTD.[20]

Arslan and colleagues used One-shot multi access PCNL; they concluded that it can be safely performed for complex kidney stones due to its high clearance rates, despite some potential complications.[21]

In our study, no difference was found between the groups concerning the bleeding and changes in hemoglobin level. But difference in tract creation time and X-rays exposure time were significant.

Conclusion

Our findings demonstrate that one-shot dilatation is a safe and efficacious method of tract dilation that lowers both tract dilatation and X-ray exposure time. No differences were observed in decreasing of hemoglobin levels post-operatively, the successful dilation rate, and stone-free rate between the two techniques of tract dilatation.

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Authors Contribution

HKW: Conceptualization of Project
AA: Data Collection
TAW: Literature Search
MRG: Statistical Analysis
AA, SHS: Drafting, Revision
MN, GJAN: Writing of Manuscript