Comparison of single-step renal dilatation and serial renal dilatation in percutaneous nephrolithotomy: A retrospective case–control study

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Abstract
Background: Access to the pelvi-calyceal system and subsequent dilatation of the tract are among the initial important steps in percutaneous nephrolithotomy (PCNL). In this study, we share our experience with single-step renal dilatation when compared to multiple serial renal dilatation in PCNL.

Materials and Methods: This is a retrospective study wherein 35 patients who underwent PCNL by single-step renal dilatation by appropriate size Amplatz Dilator were compared with 35 patients who underwent multi-step serial renal dilatation using serial metallic Alken dilators. These patients were analyzed on the basis of demographic profile, total intra-operative time, fluoroscopic time, intra-operative and postoperative complications, stone clearance, requirement of blood transfusion, duration of hospital stay, and follow-up.

Results: There were no significant differences in the demographic profile among the patients in these two groups. The mean total operative duration and fluoroscopic duration were less in single step renal dilatation group, and these have been found to be statistically significant (P < 0.05). There were no statistically significant differences in the rates of other complications – incomplete stone clearance, bleeding and hematoma formation, requirement of blood transfusion, duration of hospital stay, and follow-up.

Conclusion: Operative duration and rate of radiation exposure are significantly less in PCNL by single-step renal dilatation; however, there is no statistically significant difference in the rates of other complications.

Keywords: Percutaneous nephrolithotomy, renal tract dilatation, serial, single step

INTRODUCTION

After its first description in 1976 by Fernström and Johansson, percutaneous nephrolithotomy (PCNL) has now become the standard of care for the management of renal stone disease.[1,2] It is a minimally invasive technique associated with higher success rate and lower complications for the efficient management of renal calculi >2 cm in diameter, staghorn calculi, and larger lower calyceal calculi.[3,4]

Gaining access to the pelvi-calyceal system by renal puncture and subsequent dilatation of the tract is a crucial...
and challenging step in this procedure and is conventionally
done by one of the following three techniques – serial
Alken metal telescope dilators, semi-rigid Amplatz
sequential fascial dilators, and single-step balloon dilator.[1,3]
The reusable metal telescopic dilators are economical, and
there is less blood loss because of the tamponade effect
on renal parenchyma by metal dilators. Sequential fascial
dilators are disposable, and there is possibility of more
blood loss as the tamponade effect is lost during sequential
exchange of these fascial dilators. Both these serial and
sequential multi-step dilators are time-consuming and lead
to increased radiation exposure by increased fluoroscopic
time.[8] Single-step balloon dilator was developed to provide
a single-step dilatation and avoid the complication of
bleeding, but it is not reusable and hence costly.[9]

In this study, we compared single-step renal dilatation by
directly using the appropriate size Amplatz dilator and
multi-step renal dilatation by Alken dilator during PCNL.

MATERIALS AND METHODS

Thirty-five patients who underwent PCNL by single-step
renal dilatation using the appropriate size Amplatz dilator
at our institute between January 2017 and December
2018 were retrospectively compared with 35 patients who
underwent PCNL multi-step renal dilatation by Alken
dilators during the same period. The study was approved
by the Institutional Ethical Committee, and appropriate
written and informed consent was taken by all the patients
included in this study. The inclusion criteria were age more
than 14 years, stone size more than 2 cm and/or multiple
renal calculi. Patients with coagulation disorders and
pregnant patients were excluded from this study.

There were 35 patients in each group; these groups were
not matched. All patients were admitted, and complete
blood count, renal function test, serum electrolytes, and
cogulation profile were done for all of them.

Surgical technique
Under general anesthesia, first, cystoscopy and retrograde
placement of ureteric catheter was done in supine
lithotomy position, and then, the patient was turned to
the prone position. After delineation of the pelvi-calyceal
system by retrograde injection of contrast, the desired
calyx was punctured by two part 18 G PCNL needle
and guide wire was placed. In patients of single-step
dilatation group, the appropriate-sized Amplatz dilator
was slowly advanced by applying constant pressure under
fluoroscopy guidance followed by the access sheath. In
patients of multi-step dilatation group, serial Alken metallic
dilators were used for renal dilatation till the appropriate
size. Then, appropriate size nephroscope was used, and
stone disintegration was done by ballistic energy from the
lithotripter. After the procedure, an appropriate-sized DJ
stent and a nephrostomy tube were placed.

Statistical analysis
The parameters compared were demographic profile, total
intra-operative time, fluoroscopic time, intra-operative
and postoperative complications, stone clearance,
requirement of blood transfusion, duration of hospital
stay, and follow-up. The total operative duration was
calculated from the time of cystoscopy to completion of
the procedure, i.e., to the time when nephrostomy tube
was secured to the skin. The fluoroscopic time was also
calculated. Stone clearance was assessed by plain X-Ray
KUB on the first postoperative day. Peri-operative and
postoperative complications were assessed using the
Modified Clavien–Dindo grading system. The tests used
were Student’s ‘t’ test and Chi-square test. P < 0.05 was
considered statistically significant.

RESULTS

Demographic details
The demographic characteristics are summarized in
Table 1. There were no statistically significant differences
in demographic profiles among the two groups.

Intra-operative and postoperative details
Intraoperative and postoperative details are summarized
in Tables 2 and 3. The mean total operative duration
and fluoroscopic duration were less in single-step
renal dilatation group, and these have been found to
be statistically significant (P < 0.05). Two patients in
single-step group and three patients in multi-step group
had incomplete stone clearance; however, this was
not found to be statistically significant. There was no
significant blood loss or peri-renal hematoma in any
patients in either group. Blood transfusion was required
in two patients – one in each group. A total of four
patients had Grade 1 complications (Modified–Clavien
Classification) – two in each group. There were no other
complications and no deaths.

| Table 1: Demographic characteristics of the patients |
|----------------------------------|----------------|----------------|
|                                  | Single-step    | Multi-step serial |
| Total number of patients         | 35             | 35             |
| Age (years)                      |                |                |
| Mean                             | 38.5           | 40             |
| Range                            | 16-62          | 18-60          |
| Males                            | 23             | 17             |
| Females                          | 12             | 18             |
The mean hospital stay was 2–5 days in single step dilatation group and 3–5 days in multiple step dilatation group. All patients have no complaints on follow-up.

DISCUSSION

PCNL is the gold standard management for renal stones and has undergone and still undergoing several modifications. Gaining access into the pelvi-calycal system and dilatation of the tract are the important initial steps in PCNL and various techniques are in use – multistep dilatation by serial metallic Alken dilators and by serial fascial Amplatz dilators.[1,5] Bleeding is a major feared complication of PCNL during multi-step serial dilatation as the tamponading effect of the dilator on renal parenchyma is lost during exchange of dilators. Another source of concern for both the patients and the operative team is the radiation exposure. Hence, there are ongoing efforts to shorten the total operative time, thereby decreasing the radiation exposure and also to minimize blood loss.

Single-step renal dilatation techniques have been introduced to tackle the above two complications. Single-step balloon dilatation was safe and effective; however, being disposable, it is costly and not in routine use now.[1] In 2001, Frattini et al., in their study on 78 patients undergoing PCNL, concluded that single-step renal dilatation is safe and is associated with significantly less radiation exposure and cost.[1,6] In 2003, Goel et al. compared single-shot renal tract dilatation by Webb target dilator with multistep sequential dilators and found that Webb target dilator is safe and takes significantly less time; however, it has limitations when there is no associated hydronephrosis and its available size (26 Fr).[1] Amjadi et al. and Suelozgen et al. have also reported significantly less operative and radiation exposure time with single-step dilatation and comparable stone clearance rates.[1,9] In a recent study, Girisha et al. concluded that single-step renal dilatation is safe, effective, and is associated with significantly lesser operative and radiation exposure time. Similar conclusions were reported by Nour et al. in their study; the rates of bleeding and other complications being the same with single-step renal dilatation and serial dilatation.[1]

In the present study, we found that total operative time and radiation exposure were significantly less in the single-step renal dilatation group; stone clearance rates and bleeding and other complications being comparable in both groups. However, this study has its limitations. The two groups were not matched, and present study sample size calculation was not done. Moreover, this is a single-center study and has been done over a short period of time. Larger, multicenter studies would be required to draw efficient conclusions.

CONCLUSION

Single-step renal dilatation is safe, effective, economical, and has less operative time and radiation exposure. There are no specific complications related to this procedure, and bleeding and stone clearance rates are also comparable to conventional serial dilatation methods.

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Conflicts of interest
There are no conflicts of interest.

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