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ORIGINAL RESEARCH

The Effects of One-Shot Tract Dilatation vs. Metal Telescopic Dilatation in Percutaneous Nephrolithotomy on Various Outcomes

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ABSTRACT

Background: In Percutaneous Nephrolithotomy, the track may be dilated using numerous incremental flexible Amplatz type, Alken metal telescopic dilators, or balloons (PCNL) (PCNL). The balloon dilator is the most expensive method. In both cases, the gradual dilation methods take longer and are more prone to failure. The goal of this study was to evaluate the effectiveness of metal telescopic dilatation vs a single dilatation procedure in percutaneous nephrolithotomy.

Material and methods: All adult patients undergoing PCNL surgery for renal or upper ureteric stone disease were included in the analysis. One hundred patients were used in this study, and they were randomly divided into two Categories. Category 1 patients were treated with MTD, whereas Category 2 patients underwent OSD. After the nephroscope was dilated enough, its sheath was inserted. In this case, pneumatic lithotripsy was used once the stone was located. As soon as the fragments were extracted, a standard DJ stent was placed across the ureter into the bladder. The patient was turned supine and sent to the ward when they were stabilised.

Results: Hydronephrosis, symptom duration, and history of flank surgery were all similar across the two Categorys (Table 2). Category B had somewhat bigger stones than Category A (2.80±0.77 vs. 2.50±0.71), but this difference did not reach statistical significance (0.21). Laterality and dispersion of stones were uniform throughout cultures. It was shown that the lower calyx was more often chosen for puncture in both sets of subjects. Category A required significantly more time under fluoroscopy for dilatation of the tract than Category B (54.11±3.58sec vs. 37.89±2.74 sec, p=.002) Category A also had a much longer time to access than Category B (407.58±55.87 sec vs 301.71±39.71 sec, P=0.001). Haemoglobin dropped considerably more in Category 2 at 24 hours post-op . Both Categories had similar mean hospital stays and blood transfusion rates (p=0. 41 and p=0.55). There were five patients in Category 2 with Grade 3 issues, compared to three in Category 1.

Conclusion: When it comes to dilatation of the tract during PCNL, both OSD and MTD are effective and safe options. When it comes to tract dilatation, OSD saves time and reduces radiation exposure compared to MTD. Same length of hospital stay, decrease in haemoglobin, percentage of patients without stones, and occurrence of complications were seen with both methods.

Keywords: Amplatz dilator, PCNL, Serial metal telescopic dilation

INTRODUCTION

Renal stone disease may be effectively treated by percutaneous nephrolithotomy. The procedure is often carried out by introducing a percutaneous needle into the renal collecting

system under fluoroscopic guidance. This is followed by dilation of the nephrostomy tract. In order to widen the passageway, doctors may employ a variety of techniques, such as balloon dilators, metal telescopic dilators, or amplatz sequential fascial dilators. [1] Balloon dilation is the most up-to-date and safest method, with a low likelihood of bleeding complications; nonetheless, its high price makes it impractical for frequent usage in all patients, especially in developing countries. The use of a balloon dilator device is very difficult and has a higher risk of failing in patients with renal scarring. [2] Dilation using the amplatz set, which wastes 10 disposable dilators after each operation, has an intermediate cost equivalent to pneumatic dilation. The alken system dilation is the least expensive surgery. However, both of these multiple incremental dilation techniques require more time and involve more fluoroscopy exposure than balloon dilation. The risk of working guidewire displacement, buckling, and the creation of a false path is also associated with incremental dilator systems like the alken and amplatz. This might lead to internal bleeding, perforation of the collecting system, or possibly the inability to complete the procedure. In some studies, as many as one-third of patients who had these operations for tract dilatation needed blood transfusions. [3, 4] Access has been improved and radiation exposure periods have decreased in a number of ways. [5, 6] One-shot or single-shot acute dilation involves using an Amplatz dilator to dilate the nephrostomy tract only once. These dilation systems are one-step access devices that cut down on operation time, patient radiation exposure, and access failure. One shot dilation has been shown to be as safe and effective as metal telescopic dilation, even in patients with a history of ipsilateral open renal surgery. [7] However, its implementation has been slow because to a dearth of sufficient research using sufficiently large samples. The goal of this study was to evaluate the effectiveness of metal telescopic dilatation vs a single dilatation procedure in percutaneous nephrolithotomy.

MATERIALS AND PROCEDURES

This study was done adult patients undergoing PCNL surgery for renal or upper ureteric stone disease were included in the analysis. Informed consent was given by all patients. There was no need to get ethical clearance for this study since it was only a statistical analysis of existing data. There was no outside influence involved. All amendments to the Helsinki Declaration were implemented. Patients with a history of nephrostomy placement, ectopic kidneys, or horseshoe kidneys were not eligible to participate. We kept meticulous records of the patient's medical history, physical exam, and routine blood and urine testing. The diagnosis was made using ultrasound, X-ray KUB, and intravenous pyelography. Hydronephrosis was documented together with the stone's size, location, length of hospital stay, and date of diagnosis. Patients undergoing anaesthesia were slated for operations. There was either a general or spinal anaesthetic given. We treated it with antibiotics. In lithotomy position, a ureteric catheter was placed into the renal pelvis. The patient was placed in the prone position and a calyx of interest was punctured with an 18G needle while under fluoroscopic guidance. The ureter or renal pelvis was the entry point for the guidewire. The needle used to make the puncture was removed. Patients were divided into two Categories, one for each dilatation technique used. One hundred patients were used in this study, and they were randomly divided into two Categorys. Category 1 patients were treated with MTD, whereas Category 2 patients underwent OSD. After the nephroscope was dilated enough, its sheath was inserted. In this case, pneumatic lithotripsy was used once the stone was located. As soon as the fragments were extracted, a standard DJ stent was placed across the ureter into the bladder. The patient was turned supine and sent to the ward when they were stabilised.

The key objectives were the rate of haemorrhage, under-dilation, false tract, and pelvic injury, as well as the length of time it took to obtain access and perform the surgery.

Secondary outcomes included postoperative haemoglobin (Hb) drop, blood transfusion need, stone-free rate, perioperative complications, and the need for further surgery.
Descriptive information was calculated using the following statistical measures: frequency, mean, range, standard deviation, and percentage. The Chi-square test and the T-test were used to analyse the data. With a significance level of 0.05 or below, we calculated a 95% confidence interval and a 95% degree of certainty. SPSS version 25.0 was used for the analysis.

RESULTS

The average ages of the patients in the two Categories are shown in Table 1 to be 39.59±3.87 and 39.87±4.69 years. Patients in Category 2 had a mean BMI of 29.44±2.94 compared to 30.11±2.57 in Category 1. Both Category A and B had 50 occurrences each.
Hydronephrosis, symptom duration, and history of flank surgery were all similar across the two Categorys (Table 2). Category B had somewhat bigger stones than Category A (2.80±0.77 vs. 2.50±0.71), but this difference did not reach statistical significance (0.21). Laterality and dispersion of stones were uniform throughout cultures.

CONTRASTING INTRAOPERATIVE EVENTS

It was shown that the lower calyx was more often chosen for puncture in both sets of subjects. Category A required significantly more time under fluoroscopy for dilatation of the tract than Category B (54.11±3.58sec vs. 37.89±2.74 sec, p=.002) [Table 3]. Category A also had a much longer time to access than Category B (407.58±55.87 sec vs 301.71±39.71 sec, P=0.001). Nothing changed in terms of the actual running time. There was no statistically significant difference between Categories in terms of the occurrence of bleeding, under-dilatation, false tract, or PCS injury. Six more dilations were required for Category 1, but just two for Category 2.

INCIDENCES AFTER SURGERY: A COMPARISON

Haemoglobin dropped considerably more in Category 2 at 24 hours post-op (Table 4). Both Categories had similar mean hospital stays and blood transfusion rates (p=0. 41 and p=0.55). There were five patients in Category 2 with Grade 3 issues, compared to three in Category 1. PCNL needs to be conducted twice in both Categories. In Category 2, 2 patients with stein strasse were treated with ureteroscopic lithotripsy.

Table 1 demographic profile of Category1 and Category 2 patients

Gender	Category 1	%	Category 2	%
Male	30	60	28	56
Female	20	40	22	44
Age in years				
Below 20	6	12	5	10
20-30	11	22	12	24
30-40	30	60	27	54
above 40	3	6	6	12
Mean age	39.59±3.87		39.87±4.69	
BMI	30.11±2.57		29.44±2.94	

Table 2 clinical profile of the of Category1 and Category 2 patients

	Category 1	%	Category 2	%	p value
Presence of hydronephrosis	25	50	20	40	0.41
Past flank surgery	0	0	3	6	0.42

Symptom duration	8.11±0.87		7.11±0.45		0.49
Stone size (cm)	2.5±0.71		2.8±0.77		0.21
Stone Location					0.33
Calyx	10	20	11	22	
Pelvis	14	28	18	36	
Ureter	8	16	9	18	
Pelvis & Calyx	7	14	5	10	
Ureter & Pelvis	6	12	4	8	
Calyx & Ureter	5	10	3	6	

Table 3: Comparison of intraoperative events in Category1 and Category 2

	Category 1	**%**	**Category 2**	**%**	**p value**
Calyx punctured					
Upper	8	16	9	18	0.55
Middle	12	24	13	26	
Lower	30	60	28	56	
Tract dilatation fluoroscopy time (sec)	54.11±3.58		37.89±2.74		0.002
Access establishment time (sec)	407.58±55.87		301.71±39.71		0.001
Operation time (min)	57.89±4.59		60.87±5.87		0.45
Tract length (cm)	8.1±1.11		8.8±1.42		0.69
Bleeding obscuring vision	12		10		0.41
Under dilatation	12		10		0.18
False tract creation	10		8		0.26
Repeat dilatation	28		22		0.23
Pelvicalyceal system injury	2		1		0.41

Table 4: Comparison of postperative events in Category1 and Category 2

Parameter	**Category 1**	**%**	**Category 2**	**%**	
Hemoglobin drop (gm/dl)	0.9 ± 0.2		1.4 ± 1.1		0.45
Hospital stay (days)	4.9 ± 1.7		6.1 ± 3.1		0.41
Blood transfusion rate	3	6	4	8	0.55
Stone free rate	45	90	40	80	0.44
Additional procedure required					
Redo PCNL	5	10	5	10	
Ureteroscopic lithotripsy	0		2	4	

DISCUSSION

Minimally invasive PCNL has supplanted open surgical methods as the standard of care for removing big renal stones (>2 cm). The construction and dilation of the nephrostomy path is the most important part of percutaneous nephron-sparing nephrectomy (PCNL). This is done using either metal telescopic Alken dilators, incremental Amplatz dilators, or balloon dilators. All of these methods help create a nephrostomy tract large enough to accommodate a standard Amplatz sheath (28-34 F). [2] Balloon dilators are widely regarded as the safest approach for one-step tract dilation, but their expensive price limits their usage in many centres with limited resources. [2] Additionally, the failure rate is greater in individuals who already have renal scarring. [2] PCNL has been a staple in the treatment of big renal stones ever since it was discovered by Fernstorm in 1976. [8] After an initial puncture is made, the next challenging step is to create a tract for nephroscopic intervention. Amplatz K outlined the use of serial fascial dilators, and Dr. Alkem made them famous. [9] OSD was first presented by

Frattini et al. in a study of 78 instances in 2001. In a list of [10], the existence or absence of hydronephrosis, the patient's body mass index, the number of prior surgeries they've had, whether or not their kidneys are hypermobile, and the skill of the operating surgeon are all potential factors that might affect the result of dilatation. [11] After looking into this, we found that the OSD Category's time to set up network connectivity was over 2 minutes less than the MTD Category's. Studies in the literature corroborate this fact. [12,13] One possible explanation is that the OSD cohort has fewer dilators to pass. Recently, there has been a lot of talk regarding how using fluoroscopy might cause unnecessary radiation exposure for PCNL patients. [14] Many methods have been suggested to lessen the risk, including ultrasonography, radiation protection gear, still fluoroscopy images, and the use of on-screen display (OSD) and bolus dose (BD) to decrease the amount of time spent in the procedure. [7] We also found that the tract dilatation fluoroscopy time for the OSD Category was much lower than that of the MTD Category. There is some concern that the increased axial force required for OSD might be harmful to the renal parenchyma, however this has only been mentioned in a small number of articles so far. [15] Research, however, has allayed these concerns and shown OSD to be safe. [16,17] We found a similar incidence of bleeding, under dilatation, false tract, and PCS damage in both study Categorys. The postoperative drop in haemoglobin was somewhat more pronounced in the OSD Category, according to our findings. It might be associated with the larger stone size seen in OSD patients. But some studies have shown that OSD patients had a smaller haemoglobin decline than other patients, while others have found no difference at all. [17,18] Both Categorys saw a similar frequency of blood transfusions. Between Categorys 1 and 2, there was an 80% and 90% success rate in passing stones (p=0.44). Hospitalization and complication rates after surgery were similarly similar. Many studies have shown no significant difference in stone-free rates, transfusion rates, or complication incidence across the various tract dilatation procedures. [16-18] The primary advantages of OSD over MTD are less time spent in the installation process and less time spent exposed to radiation. The small sample size, single-site data, lack of randomization, and the absence of other dilatation methods are all drawbacks of the research.

The retroperitoneal scarring surrounding the kidney that results after open nephrolithotomy might make it difficult to position the access needle in the correct location and restrict the extent to which the tract can be dilated, necessitating the use of metal and balloon dilators.[19] Those who have had open intervention in the past have been reported to have a higher PCNL failure risk.[19] Two patients who had had prior open stone surgery stated that a single dilation attempt had failed. [5] In a separate experiment, three patients, including two who had had prior open kidney surgery, found that a single dilation attempt was unsuccessful. [7] They saw these features as a serious detriment to the one-shot method. With no specialised equipment, an access needle with amplatz dilators for tract dilation may easily penetrate a kidney that has undergone open surgery.

CONCLUSION

When it comes to dilatation of the tract during PCNL, both OSD and MTD are effective and safe options. When it comes to tract dilatation, OSD saves time and reduces radiation exposure compared to MTD. Same length of hospital stay, decrease in haemoglobin, percentage of patients without stones, and occurrence of complications were seen with both methods.

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