

The efficacy of conventional PCNL and two modifications to standard procedure

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Abstract

Objective: To compare the efficacy of conventional Percutaneous Nephrolithotomy (PCNL) with two of its modified procedures.

Methods: A randomized controlled trial, was performed on 60 patients undergoing PCNL. Cases of renal stone regardless of stone size and configuration, having pre-operative negative urine culture, no coagulopathy, and no visible residual stone in intra-operative fluoroscopy, were included. They were randomly divided into 3 groups of 20 cases each with nephrostomy tube (NT) and temporary ureteral catheter(TU) in group A, only TU in group B and only indwelling ureteral catheter(IU) in group C. Mean age of cases were 43.2 (25-70), 40.1(25-73), and 44(25-70) years in groups A , B and C, respectively (P=0.6). Procedures were performed under general anaesthesia, using standard techniques for access and lithotomy. Forty-eight hours, 2 weeks and 3 months after PCNL, plain X-ray abdomen, ultrasonography and IVP were performed for each case.

Results: Only one case in group A had urinary leakage after removal of nephrostomy tube. No cases in the other two groups encountered this problem. There was no haemorrhagic episode. Ultrasonic evaluation showed mild residue in 3, 1 and 1 cases of groups A, B and C, respectively (P=0.2). No collective fluid was found in these groups. IVP showed dilatation without obstruction in 3 subjects of group A and none in group B or C (P=0.03).

Conclusion: Tubeless PCNL seems to be accompanied by better outcome. So, further evaluation on more patients seems necessary (JPMA 56:302;2006).

Introduction

After introducing percutaneous nephrolithotomy (PCNL), the treatment of kidney calculi has been improved. PCNL is usually accompanied by less morbidity compared to open stone surgery.¹

The disadvantages of PCNL as compared with ureteroscopy or ESWL include, increased blood loss, greater pain, and longer hospital stay.² To decrease these side effects some modifications of the standard procedure have been developed. The tubeless technique, using a double-J stent for internal drainage without nephrostomy tube, used for external drainage at termination of the procedure, was associated with the least morbidity and was most cost-effective, compared to the standard procedure or the other modification so-called "mini-PCNL".³ A case of simultaneous bilateral tubeless PCNL has been reported to be performed successfully.⁴ Tubeless PCNL will possibly have an expanding role in the treatment of stone disease and other urologic problems of the upper urinary tract.⁵ PCNL with conventional postoperative nephrostomy tube drainage of the kidney is a routine approach in patients with renal calculi.⁶ Placement of nephrostomy tube is the last step after completion of PCNL. Omission of this step in properly selected patients (tubeless PCNL) using either externalized ureteral catheter or internal ureteral stent may be safe and economical. In a case series in 1999, primary PCNL was performed in 26 renal units in 21 patients (5 bilateral PCNL, 4 of which were simultaneous) by one surgeon at the University of Michigan and the Ann Arbor Veterans Affairs Medical Center. A postoperative nephrostomy tube was placed if the stone burden was >3 cm, more than one access site used, the renal anatomy was obstructive, significant bleeding or perforation was noted, or a second look was required.⁷ In the other case series two years later, a total of 37 patients underwent tubeless PCNL with an externalized 6F ureteral catheter for 48 hours.⁸ To our knowledge, no randomized control trial has been conducted in this regard, previously.

In this randomized control trial, we compared efficacy of PCNL using conventional method and two modifications to standard procedure using only temporary ureteral or indwelling ureteral catheter

Patients and Methods

Between July 1999 and December 2002, 60 cases (34 males, 26 females) underwent PCNL. All patients had active occupation. Each case had a documented negative urine culture preoperatively.

Prophylactic intravenous antibiotics were administered before surgery. Subjects were operated in dorsal lithotomy position under general anaesthesia. PCNL was

performed for all cases using standard technique for cystoscopy, retrograde visualization, access to the kidney and lithotripsy with pneumatic lithotripter.

They were prospectively randomized to three groups of 20 patients: group A including cases of conventional PCNL, group B using only temporary ureteral catheter, and group C using only indwelling ureteral catheter.

Mean age of cases were 43.2 (25-70), 40.1 (25-73) and 44 (25-70) years, respectively ($P=0.6$). Male to female ratio in these groups was 11/9, 11/9 and 12/8, respectively ($P=0.9$).

Preoperatively, patients were assessed regarding personal history, family history and physical examination. Paraclinical variables included serum haemoglobin, haematocrit, K^+ , Na^+ , urea, creatinine, urine analysis and urine culture. Forty-eight hours, 2 weeks and three months after PCNL, KUB radiography, ultrasonography and IVP were performed for all cases.

Ethical approval was had from the ethics committee and written consent was taken from all patients.

Statistical analysis was done by using ANOVA, Unpaired T-test (for comparison between two groups), Chi-square and Fisher's exact test.

Results

Stone chemical composition in 3 groups of our study was: 14 (70%) calcium oxalate stones, 4 (20%) mixed calcium oxalate and calcium phosphate, 2 (20%) mixed uric acid and calcium oxalate in group A; 18 (90%) calcium oxalate stones, 1 (5%) uric acid, and 1 (5%) mixed oxalate and uric acid in group B; 15 (75%) calcium oxalate stones, 2 (10%) mixed calcium oxalate and calcium phosphate, and 3 (15%) mixed uric acid and calcium oxalate in group C.

The longest diameter of stones in the three groups were on an average 28.6 ± 6.8 mm in group A, 26.1 ± 6.4 mm in group B, and 25.8 ± 8.2 mm in group C ($p=0.4$). Fifteen cases (75%) in group A, 9 (45%) in group B, and 6 (30%) in group C needed analgesic therapy after operation ($p=0.01$).

Five cases in group A (25%), 4 in group B (20%) and 2 in group C (10%) had remanant stones in KUB, 48 hours following PCNL ($p=0.5$). Mean body temperatures before and after operation were, $37.1 \pm 0.30^\circ C$ and $37.5 \pm 0.70^\circ C$ in group A, $37 \pm 0.30^\circ C$ and $37.5 \pm 0.30^\circ C$ in group B and $37.1 \pm 0.20^\circ C$ and $37.4 \pm 0.70^\circ C$ in group C.

Only one case in group A had urinary leakage after removing nephrostomy tube. No cases in two other groups had this problem after removing Amplatz sheath. No haemorrhagic episode was observed in this study. Ultrasonic evaluation showed mild residue in 3, 1 and 1 cases of groups A, B, and C, respectively ($P=0.2$).

Table 1. Pre-operative variables in different groups.

	Group A	Group B	Group C	P value
Previous medical Treatment	5	0	3	0.07
Previous PCNL	0	0	1	0.6
Previous ESWL	0	0	1	0.6
Haematuria Before operation	6	9	8	0.6
Pyuria	14	13	15	0.8
Pre- operative Positive U/C*	1	1	4	0.2
Oxalate crystal	1	2	8	0.008
Male to female ratio	11/9	11/9	12/8	0.9
Age	43.2 (25-70)	40.1 (25-73)	44 (25-70)	0.6
GI Problem	2	2	1	0.8
Flank pain	13	9	13	0.3
Renal colic	9	7	7	0.75
Upper UTI+ s/s ++	1	0	1	0.6
Lower UTI s/s	3	7	1	0.04
Renal failure s/s	0	0	0	1
Incidental Diagnosis	3	3	3	1

*U/C: cases with urine culture who treated before operation.

+UTI: urinary tract infection

++S/S: signs and symptoms

Table 2. Post-operative variables in three different groups.

	Group A	Group B	Group C	P value
Dilatation without obstruction in IVP	3	0	0	0.03 (F)
Collection in ultrasonography	0	0	1	1
Residue in ultrasonography	3	1	1	0.2 (F)

F: Fisher's exact test after combining group B and C for comparison with group A.

Table 3. Mean of laboratory variable, following operation.

Variable	Group A	Group B	Group C	P-value
Urea (mg/dl)	25.7	31.5	29.8	0.18
HCT (%)	34.1	37.2	35.4	0.18
Cr (mg/dl)	1.03	1.17	1.24	0.11
Na (meq/c)	129.33	136.65	129.48	0.53
Hg (g/dl)	20.03	13.11	12.54	0.31
K (meq/c)	10.3	3.8	18.9	0.53

Hct: Haematocrit
Cr: Creatinine
Na: Sodium
Hg: Haemoglobin
K: Potassium

No collection was found in these groups. IVP studies showed dilatation without obstruction in 3 patients of group A and no cases of group B or C (P=0.03). Only one case in group A needed transfusion after the procedure.

Table 1 shows pre-operative variables in detail. The

last outcome of the patients is demonstrated in Table 2. Three months after PCNL, IVP showed no obstruction in the above groups. Regarding patient satisfaction, there was no statistically significant difference among three groups. Mean score of satisfaction in group A was 9.05, 9.3 in group B and 9.75 in group C (p=0.8). Table 3 demonstrates our post-operative laboratory variables.

Discussion

PCNL has proved to be a less morbid procedure compared to open stone surgery. Synder et al⁹ compared the success rate, procedure duration, complications, and recovery time for percutaneous and anatomic nephrolithotomy in patients with stag horn stones. They demonstrated a decreased cost, earlier return to activity, decreased requirement for either blood transfusion or narcotic drug, and shorter operative time in favor of patients undergoing PCNL. After this study multiple investigators have showed that modification to standard technique may be accompanied by decreasing the length of hospital stay or promoting patient outcome.

As our experiences have developed in performing PCNL, researchers sought to refine the procedure to lower hospitalization stay and enhance patient satisfaction. Now, the placement of a nephrostomy tube following PCNL is considered to be a standard technique.⁷ In order to decrease patient's pain and post-operative complication rate, some

researchers have suggested performing PCNL without nephrostomy tube.

On 100 cases of tubeless PCNL, Wickham and colleagues⁶ reported of neither leakage of nephrostomy tract, nor complain of severe pain. The main advantage of this study was a low mean hospitalization (2.8 days). They also described a small modification of technique, which decreased mean length of stay in hospital.⁶ Some disappointing results have also been published. Winfield and colleagues¹⁰, reported stressed occurrence of severe urinary extravasation with an increase in either case discomfort or length of hospital stay. They did not support the tubeless PCNL because of excessive bleeding. They concluded that because of pre-existing outflow obstruction and probability of bleeding, this modification may be accompanied by an increase in cost. This report suffered from lack of sufficient sample size.

Further reports of Bellman and his colleagues¹¹ demonstrated positive outcomes. They studied 50 cases of Tubeless PCNL and compared their complications with control group. The period of "return to activity" was obviously less than control group (17.9 days vs 26.6 days). The main disadvantage of this study was using a historical control group including cases that had undergone routine placement of a nephrostomy tube. This study simply suffers from selection bias.

Most colleagues prefer to place a nephrostomy tube after PCNL. It has been demonstrated that the nephrostomy tube makes the haemostatic process easy, prevents urinary extravasation, and provides an access if a second-look procedure is necessary.^{10,11} Our study showed that using only temporary ureteral catheter or indwelling ureteral catheter might be accompanied by more acceptable patient outcomes. This is particularly true when we measure the urine residue in early post-operative period. When it comes to measure the obstruction and /or dilatation three months later, the same results may be obtained.

McDougall and colleagues¹² demonstrated

associated morbidity with indwelling ureteral catheters. Since we noticed no worse outcome in cases of group C compared with two other groups, some of untoward effects in previous reports may have been associated with other factors.

In conclusion, tubeless PCNL seems to be an effective procedure to decrease unfavorable outcome. We strongly suggest conducting more studies on this procedure and its advantages and disadvantages. There could be a debate regarding our choice of either above techniques described in groups B or C. We think both mentioned procedures should be investigated in further studies, although both techniques seem to have equivalent outcomes.

References

1. Evangelos NL, David H, Caner Z, Kapoor R, Alexiane M, Yohannes P, et al. Tail Stent versus re-entry tube: A randomized comparison after percutaneous stone extraction. *Adult Urology* 2002;59:15-9.
2. Jackman SV, Docimo SG, Cadeddu JT, Bishoff JT, Kavoussi LR, Jarrett TW. The "mini-prec" technique: a less invasive alternative to percutaneous nephrolithotomy. *World J Urol* 1998;16:371-4.
3. Feng MI, Tamaddon K, Mikhail A, Kaptein JS, Bellman GC: Prospective randomized study of various techniques of percutaneous nephrolithotomy. *Urology* 2001;58:345-50.
4. Weld KJ, Wake RW: Simultaneous bilateral tubeless percutaneous nephrolithotomy. *Urology* 2000; 56:1057.
5. Delnay KM, Wake RW: Safety and efficacy of tubeless percutaneous nephrolithotomy. *World J Urol* 1998;16:375-7.
6. Wickham JE, Miller RA, Kellet MJ, Payne SR: Percutaneous nephrolithotomy: One stage or two. *Br J Urol* 1984;56:582-5.
7. Goh M, Wolf JS: Almost totally tubeless percutaneous nephrolithotomy: further evaluation of the technique. *J Endourol* 1999;13:177-80.
8. Lojanapiwat B, Soonthornphan S, Wudhikarn S: Tubeless percutaneous nephrolithotomy in selected patients. *J Endourol* 2001;15:711-3.
9. Snyder JA, Smith AD, Staghorn calculi: percutaneous extraction versus anastrophic nephrolithotomy. *J Urol* 1986;136:351-4.
10. Winfield HN, Weyman P, Clayman RV: Percutaneous nephrolithotomy: complication of premature nephrostomy tube removal. *J Urol* 1986; 136:77-9.
11. Bellman GC, Davidoff R, Candela J, Gerspach J, Kurtz S, Stout L. Tubeless percutaneous renal surgery. *J Urol* 1997;157:1578-82.
12. McDougall EM, Denstedt JD, Clayman RV: Comparison of patient acceptance of polyurethane vs. silicone indwelling ureteral stent. *J Endourol* 1990;4:79-91.