0022-5347/04/1722-0565/0
THE JOURNAL OF UROLOGY®

Vol. 172, 565–567, August 2004
Printed in U.S.A.
DOI: 10.1097/01.ju.0000130752.97414.c8

A PROSPECTIVE RANDOMIZED COMPARISON OF TYPE OF NEPHROSTOMY DRAINAGE FOLLOWING PERCUTANEOUS NEPHROSTOLITHOTOMY: LARGE BORE VERSUS SMALL BORE VERSUS TUBELESS

MAHESH R. DESAI, RAJESH A. KUKREJA, MIHIR M. DESAI,* SUMEET S. MHASKAR, KISHORE A. WANI, SNEHAL H. PATEL AND SHARAD D. BAPAT

From the Department of Urology, Muljibhai Patel Urological Hospital, Nadiad, India

ABSTRACT

Purpose: We compared postoperative outcomes among tubeless, conventional large bore nephrostomy drainage and small bore nephrostomy drainage following percutaneous nephrostolithotomy (PCNL) in a prospective randomized fashion.

Materials and Methods: Between January and June 2001, 30 patients undergoing PCNL were randomized to receive conventional large bore (20Fr) nephrostomy drainage (group 1, 10 patients), small bore (9Fr) nephrostomy drainage (group 2, 10 patients) or no nephrostomy drainage (group 3, 10 patients). Inclusion criteria included a single subcostal tract, uncomplicated procedure, normal preoperative renal function and complete stone clearance. Factors compared among the 3 groups were postoperative analgesia requirement, urinary extravasation, duration of hematuria, duration of urinary leak, decrease in hematocrit and hospital stay.

Results: The postoperative analgesic requirement was significantly higher in group 1 (217 mg) compared to groups 2 (140 mg, $p < 0.05$) and 3 (87.5 mg, $p < 0.0001$). Patients in group 3 had a significantly shorter duration (4.8 hours) of urinary leak through the percutaneous renal tract compared to patients in groups 1 (21.4 hours, $p < 0.05$) and 2 (13.2 hours, $p < 0.05$). Hospital stay was significantly shorter in group 3 (3.4 days) compared to groups 1 (4.4 days, $p < 0.05$) and 2 (4.3 days, $p < 0.05$). All 3 groups were similar in terms of operative time, duration of hematuria and decrease in hematocrit. Postoperative ultrasound did not reveal significant urinary extravasation in any case.

Conclusions: Tubeless PCNL is associated with the least postoperative pain, urinary leakage and hospital stay. Small bore nephrostomy drainage may be a reasonable option in patients in whom the incidence of stent dysuria is likely to be higher.

KEY WORDS: nephrostomy, percutaneous; drainage, treatment outcome

Percutaneous nephrostolithotomy (PCNL) is an integral component in the treatment of larger renal calculi, either as monotherapy or in combination with shock wave lithotripsy. Traditionally 20 to 24Fr tube nephrostomy drainage has been advocated after PCNL with the aim of providing reliable urinary drainage, hemostatic tamponade of the percutaneous renal tract and maintaining access for future percutaneous manipulations. Despite these apparent advantages, nephrostomy tubes have been implicated in causing postoperative discomfort and morbidity. Therefore, the practice of routine placement of nephrostomy tube after an uncomplicated PCNL with complete calculus clearance has been questioned. Recently there have been several reports in the literature advocating "tubeless" PCNL.[1–3] Additionally, the size of the nephrostomy tube may also correlate with a degree of postoperative discomfort.[4] In this study we compared in a prospective randomized fashion standard large bore nephrostomy drainage, small bore nephrostomy drainage and no nephrostomy (tubeless) drainage after PCNL. To our knowledge such a study has not yet been reported in the literature.

Accepted for publication February 13, 2004.
* Correspondence and requests for reprints: Section of Laparoscopic and Minimally Invasive Surgery, E32, Cleveland Clinic Foundation, 9500 Euclid Ave., Cleveland, Ohio 44124 (telephone: 216-445-1530; FAX: 216-444-4830; e-mail: desaim1@ccf.org).

MATERIALS AND METHODS

Between January and June 2001, 30 patients with renal calculi undergoing PCNL were randomized to receive standard (20Fr) nephrostomy drainage (group 1, 10 patients), small bore (9Fr) nephrostomy drainage (group 2, 10 patients) or no nephrostomy drainage (group 3, 10 patients). Randomization was performed by the circulating nurse drawing lots at the end of the procedure. Study inclusion criteria included uncomplicated procedure, single subcostal percutaneous tract, normal preoperative renal function (serum creatinine less than 1.5 mg/dl), absence of previous surgery on the ipsilateral urinary tract, and complete calculus clearance as assessed by intraoperative nephroscopy and fluoroscopy. All 30 patients were comparable in terms of calculus size (264 versus 243 versus 250 mm^2), age (43 versus 45 versus 41 years old), American Society of Anesthesiologists class (1.2 versus 1.2 versus 1.5), previous stone treatments (1 versus 1 versus 2 patients) and degree of hydronephrosis (table 1).

A standard technique of percutaneous nephrostolithotomy was used. All procedures were performed with the patient under general anesthesia in the prone position. After retrograde ureteral catheterization, initial percutaneous renal access was obtained under ultrasound guidance. The tract was dilated under fluoroscopic control using telescoping Alken metal dilators (Karl Storz, Tuttlington, Germany) and a 26 to 30Fr Amplatz sheath (Microvasive, Natick, Massachusetts) was positioned into the renal collecting system. Calculus

TABLE 1. *Patient and calculus data*

	Group 1 Large Bore Nephrostomy	Group 2 Small Bore Nephrostomy	Group 3 Tubeless	p Value Group 1/2	p Value Group 2/3	p Value Group 1/3
No. pts	10	10	10			
Mean pt age	43.4	44.8	41.1	0.37	0.28	0.33
No. American Society of Anesthesiologists class:				0.14	0.58	0.14
I	8	8	6			
II	2	2	3			
III	0	0	1			
No. rt side:lt side	2:8	6:4	4:6	Not applicable	Not applicable	Not applicable
No. male:female	8:2	8:2	6:4	Not applicable	Not applicable	Not applicable
Mean mm^2 stone area	263.7	243	249.1	0.26	0.43	0.35
No. previous stone treatments	1	1	2	Not applicable	Not applicable	Not applicable
No. hydronephrosis:				0.9	0.58	0.9
None	1	2	2			
Mild	5	6	7			
Moderate	4	2	1			
Severe	0	0	0			

disintegration was performed using pneumatic lithotripsy (Swiss LithoClast, EMS, Nyon, Switzerland). After complete calculus clearance was confirmed, a standard 20Fr nephrostomy tube was placed in 10 patients in group 1 a 9Fr pigtail catheter (Cook Urological Inc., Spencer, Indiana) was placed in the 10 patients in group 2 and no nephrostomy tube was placed in the 10 patients in group 3. All patients in group 3 had antegrade placement of a 6Fr Double-J stent (Medical Engineering Corp., New York, New York) at the end of the procedure. The nephrostomy tube in patients in groups 1 and 2 were removed after 48 hours. The Double-J stent in patients in group 3 was removed after 4 weeks.

All patients underwent postoperative renal ultrasonography before discharge home to assess perinephric urinary collection. A complete blood count was performed before surgery and 48 hours after surgery to determine the decrease in hematocrit. The dressings at the percutaneous access site were changed every 4 hours and duration of urinary leak was determined after the wound was completely dry for 4 hours. The 3 groups were compared with respect to analgesia requirement, duration of urine leak through the percutaneous tract, hospital stay, decrease in hematocrit and presence of urinary extravasation. Statistical analyses were performed using the paired t test for categorical and continuous variables. All results are reported as mean ± standard deviation and $p < 0.05$ was considered statistically significant.

RESULTS

Results are summarized in table 2. Mean operative time (45 versus 46 versus 45 minutes), duration of hematuria (1.5 versus 1.4 versus 1.7 days) and decrease in hematocrit (3.9% versus 3.0% versus 4.2%) was similar in all 3 groups. Group 1 had a significantly higher analgesia requirement (218 mg diclofenac sodium) compared to groups 2 (140 mg diclofenac sodium, $p < 0.05$) and 3 (88 mg diclofenac sodium, $p < 0.001$). Group 3 was associated with a shorter hospital stay (3.4 days) compared to groups 1 (4.4 days, $p < 0.05$) and 2 (4.3 days, $p < 0.05$). Also group 3 had the shortest duration (4.8 hours) of percutaneous tract site urine leak compared to groups 1 (21.4 hours, $p < 0.05$) and 2 (13.2 hours, $p < 0.05$). Additionally, the urine leak was significantly lower in group 2 compared to group 3 ($p < 0.05$). None of the patients showed evidence of perinephric urinary collection on postoperative renal ultrasonography. There were no readmissions to the hospital and no patient required any ancillary procedures.

DISCUSSION

PCNL is an integral component of contemporary surgical management of large volume renal calculi. PCNL has significantly decreased the morbidity associated with open stone surgery. Traditionally wide bore nephrostomy tube drainage after PCNL has been advocated for several reasons. It provides reliable urinary drainage, it provides hemostatic tamponade to the fresh percutaneous renal tract and it provides continuing access to the renal collecting system should a secondary percutaneous procedure be required. Despite these obvious and important advantages large nephrostomy tubes, especially in the vicinity of a rib, are thought to contribute to postoperative pain and morbidity. As a result certain investigators have recently proposed tubeless PCNL in an attempt to avoid nephrostomy tube drainage after uncomplicated, straightforward percutaneous procedures.[1–3] In this approach the nephrostomy tube is replaced by internal Double-J ureteral stent drainage. Limb and Bellman reported on tubeless percutaneous procedures in 116 kidneys in 112 patients (PCNL in 86, endopyelotomy in 26).[3] Hospital stay was 1.25 and 1.56 days, and complications occurred in 6% and 4% in the stone extraction and endopyelotomy groups, respectively. The authors concluded that the tubeless approach was reasonably safe in select patients with uncomplicated percutaneous procedure and a low calculus burden.

Alternative strategies to avoid morbidity related to nephrostomy tubes include use of a smaller caliber nephrostomy tube or placement of a small caliber nephrostomy tube through the lower pole calix regardless of the tract used for calculus manipulation.[5] This study was designed to assess, in a prospective randomized fashion, the influence of various forms of nephrostomy tube drainage after PCNL on postoperative morbidity.

TABLE 2. *Outcome data*

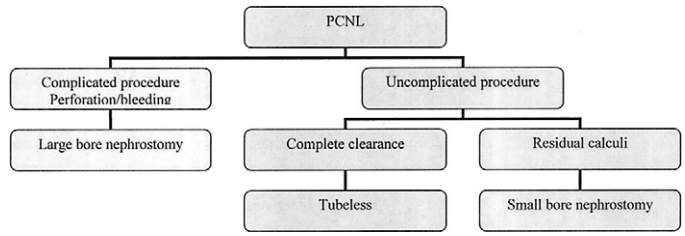
	Group 1 Large Bore Nephrostomy	Group 2 Small Bore Nephrostomy	Group 3 Tubeless	p Value Group 1/2	p Value Group 2/3	p Value Group 1/3
Mean mins operating room time ± SD	44.5 ± 13.2	45.5 ± 11.7	45 ± 13.7	0.43	0.46	0.47
Mean mg analgesia ± SD	217.5 ± 59	140 ± 92.9	87.5 ± 55.8	<0.05	0.08	0.38
Mean days hospital stay ± SD	4.4 ± 0.8	4.3 ± 0.7	3.4 ± 0.5	0.39	<0.05	<0.05
Mean days of hematuria ± SD	1.5 ± 0.5	1.4 ± 0.5	1.7 ± 0.5	0.33	0.10	0.20
Mean hrs urine leak ± SD	21.4 ± 5.7	13.2 ± 4.6	4.8 ± 1.7	0.05	<0.05	<0.05
Mean % decrease in hematocrit ± SD	3.9 ± 0.7	3.0 ± 1.0	4.2 ± 0.7	0.23	0.16	0.20

In the present study standard 20Fr nephrostomy tube drainage was associated with a significantly greater analgesia requirement compared to small bore nephrostomy drainage and no nephrostomy drainage. The analgesia requirement was the least in the tubeless group. This finding confirms that the presence of a nephrostomy tube is a source of postoperative pain and discomfort, and the tubeless approach is associated with the least amount of postoperative pain. A factor that must be accounted for in the equation of postoperative pain is the fact that tubeless PCNL involves routine placement of a Double-J ureteral stent with potential for stent dysuria and the need for an additional procedure for stent removal. Although none of the 10 patients in the tubeless group experienced stent related discomfort severe enough to warrant early stent removal, it may be a concern in an individual patient. Additionally, the cost of the ureteral stent is also a limitation of the tubeless approach.

The tubeless approach was also associated with the shortest duration of postoperative percutaneous tract site urine leak and hospital stay. Although it usually resolves spontaneously, urine leak from the percutaneous tract site can often be bothersome to the patient. The duration and caliber of the percutaneous nephrostomy tube usually determine the duration of leak. Since the ureteral stent provides reasonable urinary drainage in the initial postoperative period, the tubeless approach is usually associated with minimal urine leak from the percutaneous access site. A concern with the tubeless approach is the potential for extravasation and perinephric urinary collection. None of the patients in the present study showed any perinephric collection on postoperative renal ultrasonography, further attesting to the reliability of ureteral stent drainage alone after uncomplicated percutaneous procedures.

The tubeless approach was also associated with a lower hospital stay compared to the groups with nephrostomy tube drainage. At our institute the nephrostomy tube is usually removed 48 hours after the procedure and the patient is kept in the hospital for at least 12 hours thereafter. Routine postoperative nephrostomy drainage for 48 hours may have artifactually increased the hospital stay in this study. The tubeless approach typically shortens the hospital stay by a couple of days. It is noteworthy that none of the 10 patients with the tubeless approach required readmission or secondary ancillary procedures.

Thus the type of nephrostomy drainage after percutaneous surgery should be tailored to the individual patient (see figure). Patients with a large complex calculus, prolonged procedure, multiple renal tracts, bleeding, perforation or preexisting urinary infection should receive conventional large (20 to 24Fr) nephrostomy tube drainage. Reliable urinary drainage in this subset of patients is of the utmost importance and should not be compromised. In the patient with a low volume calculus burden and an uncomplicated short procedure, the tubeless approach may help decrease postoperative morbidity. In the patient who may be at high risk for stent related symptoms or who may require percutaneous access for subsequent calculus manipulation, a small bore (8 to 12Fr) nephrostomy tube may be a reasonable option.



Algorithm for nephrostomy drainage after PCNL

CONCLUSIONS

Tubeless PCNL is associated with the least postoperative pain, urinary leakage and hospital stay, and is a good option after an uncomplicated percutaneous renal procedure. Small bore (9 to 12Fr) nephrostomy drainage may be a reasonable option in patients in whom the incidence of stent dysuria is likely to be higher or in whom secondary percutaneous procedures may be required. Conventional large bore (greater than 20Fr) nephrostomy drainage may be reserved for procedures with significant bleeding, infected calculi or major perforations, wherein the need for reliable drainage is of paramount importance.

REFERENCES

1. Bellman, G. C., Davidoff, R., Candela, J., Gerspach, J., Kurtz, S. and Stout, L.: Tubeless percutaneous renal surgery. J Urol, **157:** 1578, 1997
2. Goh, M. and Wolf, J. S., Jr.: Almost totally tubeless percutaneous nephrolithotomy: further evaluation of the technique. J Endourol, **13:** 177, 1999
3. Limb, J. and Bellman, G. C.: Tubeless percutaneous renal surgery: review of first 112 patients. Urology, **59:** 527, 2002
4. Maheshwari, P. N., Andankar, M. G. and Bansal, M.: Nephrostomy tube after percutaneous nephrolithotomy: large-bore or pigtail catheter? J Endourol, **14:** 735, 2000
5. Lifshitz, D. A., Orris, B. G. and Lingeman, J. E.: Towards the ideal renal access: tubeless supracostal punctures. J Endourol, **14:** 735, 2000