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Safety and efficacy of tubeless percutaneous nephrostolithotomy

Abstract The experience at this institution with tubeless percutaneous nephrostolithotomy was reviewed to determine its safety and efficacy. Between April 1997 and June 1998, 33 "tubeless" percutaneous nephrostolithotomies were performed. All procedures were performed by a single surgeon (R.W.W). All patients had an internal ureteral stent placed at the time of surgery, and a Foley catheter remained in place overnight. All patients had their nephrostomy tube removed in the OR at the end of their surgery. The length of hospitalization, operative time, patients' comorbid conditions, pre- and postoperative hematocrits, transfusion requirements, reasons for a stay of longer than 24 h, complications, stone burdens treated, residual stone disease, any additional procedures required, and postoperative analgesia requirements were reviewed.

All 33 percutaneous procedures were performed without significant complication. No transfusion was required. The average length of hospital stay was 1.5 days, with two-thirds of patients staying less than 24 h. A 94% stone-free rate was achieved, and patients had minimal analgesia requirements.

This experience with the "tubeless" percutaneous nephrostolithotomy indicates that it is a safe and effective means of stone management. It will likely have an expanding role in the treatment of stone disease and other urologic problems of the upper urinary tract.

Percutaneous renal surgery has become a more frequent procedure among practicing urologists. It has proved to be a viable treatment for a variety of urologic problems, including large renal stones, ureteropelvic junction (UPJ) obstructions, caliceal diverticula, and transitional-cell carcinomas in patients with compromised renal function or solitary kidneys. Percutaneous nephrostolithotomy (PCNL) is also being employed more frequently, even for smaller lower pole stones. Lingeman et al. [5] showed a better stone-free rate for PCNL as opposed to extracorporeal shock-wave lithotripsy (ESWL) for lower pole stones. Residual stones after ESWL procedures that were initially thought to be clinically insignificant have now been shown to impact directly on the incidence of stone recurrence [7]. Thus, PCNL, with its higher stone-free rate, has garnered wider appeal as a procedure of choice in many instances.

PCNL has routinely involved postoperative placement of a nephrostomy tube and a 2- to 3-day hospital stay [2]. The nephrostomy tube serves the purpose of aiding hemostasis, promoting healing, and providing access for further endoscopic procedures or for chemolysis [1]. Often, however, blood loss has been minimal and no further procedure is planned. Some authors are now challenging the need for routine placement of nephrostomy tubes after percutaneous renal surgery [1, 2]. They propose that percutaneous surgery can be performed safely and effectively using a ureteral stent for internal drainage rather than external drainage with a nephrostomy tube [1, 2]. This modification in technique allows for earlier discharge from the hospital and decreased discomfort for the patient, making it more comparable with ESWL in these respects. In this report, our experience with "tubeless" percutaneous nephrostolithotomy is reviewed.

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Patients and methods

Patients

Between April 1, 1997, and June 17, 1998, tubeless PCNL was performed on 33 patients. We retrospectively reviewed these cases to evaluate our experience with this tubeless technique. These patients were referred to the university staff and had their procedures performed at one of three institutions: the University of Tennessee William F. Bowld Hospital, Baptist Memorial Hospital, or the Memphis Veterans Affairs Medical Center (VAMC). The Memphis VAMC serves as a major stone referral center for the Midwestern and Midsouthern VA systems. All procedures were performed by a single surgeon (R.W.W) with a resident assistant. Informed consent was obtained from all patients. All patients were considered candidates for tubeless PCNL.

Indications for PCNL at this institution included a large stone burden (≥2 cm), a UPJ stone with associated UPJ obstruction, large lower pole stones, stones in a caliceal diverticulum, and ESWL failures.

Exclusion criteria for the study included procedures lasting more than 3 h, significant perforation of the collecting system, procedures requiring more than two accesses, a residual stone burden requiring additional percutaneous intervention, and procedures associated with significant postoperative hemorrhage.

Surgical technique

The surgical technique employed is very similar to that used by Bellman and his group. In all, 28 patients had their percutaneous access placed by interventional radiology on the morning of their procedure before they were brought to the OR, and 5 patients had their access placed by the urologist in the OR. All tracts were dilated up to 30 Fr with the balloon dilator in standard fashion to allow passage of the 34-Fr working sheath. Overall, 28 patients had PCNL alone and 5 patients underwent additional procedures at the same setting, including cystoscopy in 5 cases, retrograde ureteroscopy in 1 case, and dilation of an infundibular stricture in 1 case. After the removal of stones, all patients had antegrade placement of a 6-Fr × 26-cm stent for internal drainage. Adequate placement was confirmed by nephroscopy and fluoroscopy. The working sheath was then removed and an avascular nephrostomy tract was noted. Removal of the wire was followed by closure of the nephrostomy site utilizing a vertical mattress technique with 0-chromic sutures. A pressure dressing was applied. A Foley catheter was left overnight for maximal drainage.

Discharged patients were instructed to return to the emergency room for any difficulties; otherwise, they were followed up 1 week later for stent removal and clinical evaluation. All records were reviewed for the length of hospitalization, operative time, patients' comorbid conditions, pre- and postoperative hematocrits, transfusion requirements, reasons for a stay of longer than 24 h, complications, stone burdens treated, residual stone disease, any additional procedures required, and postoperative analgesia requirements.

Results

A total of 33 patients were treated by the tubeless PCNL technique. In all, 4 patients had full staghorn calculi, 9 had partial staghorns, 14 had large renal pelvis or UPJ stones, and 6 had lower pole or ESWL-failure stones. Excluding the staghorn calculi, which required post procedure lithotripsy, the stone free rate was 94%. There was no significant complication, and no additional procedure was required as a result of some event occurring during PCNL. No patient required a transfusion.

The average age of the patients treated was 55.7 years (range 25–78 years, median 55 years). The length of hospitalization, starting at the time of the procedure, was reviewed. Overall, 22 patients stayed less than 24 h. The mean length of hospitalization was 1.5 days ($n = 33$), and the range was 1–5 days (median 1 day). The number of comorbid conditions per patient was also reviewed. Comorbid conditions were defined as a history of coronary artery disease, arrhythmia, congestive heart failure, diabetes, hypertension, stroke, chronic obstructive pulmonary disease (COPD), or morbid obesity. The average number of comorbid conditions per patient was 1.06. The average number of comorbid conditions in the patients who stayed less than 24 h was 0.91 per patient. The average number in the patients who stayed longer than 24 h was 1.36 per patient. In all, 11 patients stayed longer than 24 h; Table 1 delineates the reasons reported for the longer hospital stay. Most longer hospitalizations were secondary to brief postoperative temperature elevation. One patient had residual stone fragments and stayed at the VA for an ESWL treatment and was having no problem. One patient stayed for a pacemaker adjustment.

Table 1 Patients hospitalized for longer than 24 h (*POD* Postoperative day)

Patient	Number of comorbid cond.	Length of hospitalization	Reason for stay
M.D.	0	2 days	Febrile on POD 0
B.H.	3	5 days	Febrile on POD 0 and 1
A.G.	1	2 days	Febrile on POD 0
W.B.	0	2 days	Discomfort
D.C.	0	2 days	Febrile on POD 0
G.E.	1	2 days	Pacemaker adjustment
W.M.	2	5 days	Stayed for ESWL/no problem
W.F.	2	3 days	Febrile on POD 0 and 1
J.R.	2	2 days	Hematuria
J.H.	2	2 days	No problem
M.P.	2	2 days	Morbid obesity

Overall, 28 accesses were placed by interventional radiology, and 5 patients had accesses placed by the urologist in the OR. The average operative time was 57 min ($n = 30$), and the range was 15–105 min (median 55 min). Estimated blood loss was clinically insignificant. The mean change in hematocrit from the preoperative level to the postoperative value was a decrease of 3.2 points ($n = 19$), the range being 0–9.2 (median 2.1) points. No transfusion was required in this population.

Analgesic requirements were also reviewed. Pain medication requirements were tabulated as i.v. or i.m. milligrams of morphine equivalents. Oral pain medication was recorded as the number of tablets required. The average dose of i.v. or i.m. medication was 4.4 mg of morphine per patient ($n = 29$). The average number of oral pain medications was 3.7 tablets per patient ($n = 29$).

The stone-free rate was 94% after one procedure. This excludes the staghorn calculi which required post procedure ESWL. All staghorn calculi achieved successful outcome after lithotripsy (fragments < 4 mm). Two patients had small residual stone fragments, one of whom required ESWL. This patient stayed during that hospitalization period for ESWL of some remaining "gravel." There was no episode of urosepsis, no clinically significant urinoma, no postoperative bleeding requiring transfusion, and no readmission for complications.

Discussion

The morbidity of percutaneous stone procedures has decreased dramatically with improvements in technique [1]. The balloon dilators that are now routinely used have been associated with less postoperative hemorrhage [3].

Davidoff et al. [3] reported a 25% transfusion rate for Amplatz dilation of the percutaneous tract versus 10% for the balloon dilator. Limitation of the length of procedures to less than 2–3 h has also decreased the incidence of postoperative sepsis, hypothermia, and hyponatremia [1]. The challenge currently facing urologists is whether the technique can be modified to a true outpatient procedure without a loss of efficacy and safety [2].

This move toward making percutaneous renal surgery an outpatient procedure is not a new concept. In 1986, Preminger et al. [6] discharged five patients after percutaneous procedures with their nephrostomy tubes in place. A significant cost advantage was demonstrated, but patients were very reluctant to leave the hospital with a painful tube "sticking out" of their backs [6]. In 1986, Winfield et al. [8] reported two cases of early removal of the nephrostomy tube that resulted in significant morbidity and prolonged hospitalization. Neither of these patients, however, had any internal drainage placed in the form of a stent [8]. Bellman et al. [1] have reported on a series of 50 patients who had early removal of the nephrostomy tube after percutaneous surgery. The first 30 patients had the nephrostomy tube removed within 2–3 h of the surgery. The remaining 20 patients had their nephrostomy tubes removed in the OR. All patients had ureteral stents placed during their procedure, and a Foley catheter was left in place for 24 h [1]. These authors reported no significant complication, no urinoma, no episode of urosepsis, and no difference in transfusion rate, and their patients' length of hospitalization was decreased to 0.6 days versus a control group treated in the standard fashion, who were hospitalized for an average of 4.6 days [1].

In the current report, the experience with tubeless percutaneous stone procedures at this institution was reviewed. From April 1, 1997, to June 17, 1998, PCNL was performed on 33 patients. A 94% stone-free rate was achieved. The average hospital stay was 1.5 days, which is significantly less than that reported for the standard hospital admission for PCNL. Two-thirds of patients stayed less than 24 h. Overall, blood loss was minimal, with the average hematocrit decrease being 3.2 points per patient and the maximal decrease being 9.2 points. No patient required transfusion. Minimal analgesia was required postoperatively. No episode of urosepsis occurred. The most frequent reason for a longer hospital stay was a brief temperature elevation postoperatively; all fevers resolved quickly. This experience indicates that tubeless PCNL with internal drainage can be performed safely and effectively in association with a significant decrease in hospital stay and, thus, a decrease in hospital and patient costs.

The improved cost, decreased hospital stay, and improved morbidity to the patient are expanding the indications for PCNL. In a study by Jewett et al. [4] the cost and effectiveness of ESWL and PCNL were compared. PCNL had a better success rate than ESWL, with a stone-free rate of 96% versus 70% being recorded, respectively [4]. PCNL also had a lower need for additional therapy for stone treatment [4]. ESWL, however, was less expensive than PCNL, including the cost for additional treatments within this, i.e., U.S. $4,087 for PCNL versus U.S. $2,746 for ESWL [4]. With the modification of the "tubeless" PCNL, the hospital stay and patient morbidity are decreased. Bellman et al. [1] looked at the hospital cost difference between their 50 tubeless percutaneous patients as compared with a control group of 50 patients undergoing standard percutaneous renal surgery with a nephrostomy tube left in place. They found a significant cost difference, i.e., U.S. $1,638 for a tubeless percutaneous patient versus $3,750 for a patient treated in the standard fashion [1]. This significant savings makes the cost of PCNL more comparable with that of a single ESWL treatment. The demonstrated high success rate and low morbidity of a tubeless percutaneous procedure may, from a cost viewpoint, make multiple ESWL procedures a less attractive alternative. This further expands the indication for PCNL, especially for lower pole and ESWL-failure stones.

In conclusion, our experience to date with tubeless PCNL was reviewed. In a total of 33 cases, no significant complication occurred and no transfusion was required. Patients seemed to tolerate the procedure well, and two-thirds of the patients were discharged home in less than 24 h. This experience parallels that seen by Bellman et al. [1]. These results are encouraging, and the use of the tubeless PCNL has expanded at our institution. These preliminary results indicate that the tubeless PCNL is safe and effective and will likely have an expanding role in stone management.

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Note added in proof Of note, we have now increased our total cases to greater than 50 with similarly encouraging results