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Percutaneous Nephrolithotomy: Current Methods and the Henry Ford Hospital Experience

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The combined radiologic/urologic approach to percutaneous renal stone extraction has been practiced at Henry Ford Hospital since November of 1982. This article describes the current methodology and reviews our experience in performing 121 percutaneous nephrolithotomies (PCNL). We conclude that PCNL is a safe, reliable, and cost-effective alternative to open nephrolithotomy in most patients.

Percutaneous nephrolithotomy provides access to the upper urinary tract as the urethra provides access to the bladder. First demonstrated by Goodwin in 1955, percutaneous nephrostomy has become a safe and effective method of urinary diversion. Our experience with more than 300 percutaneous nephrostomies has helped us to extend this technique to percutaneous nephrolithotomy and renal stone extraction from the upper collecting system. Since its early description by Fernstrom and Johansson (1), percutaneous nephrolithotomy (PCNL) has become a popular alternative to surgical removal of renal calculi.

Current Methods

The patient receives meperidine (0.4 mg, intramuscular injection) before the procedure is started, and endoscopic retrograde ureteral stent placement is performed in the urologic clinic. One percent lidocaine with epinephrine is given, supplemented by intravenous administration of sedative as needed for the remainder of the procedure, which is performed in a radiology suite (Fig 1) equipped with a high-resolution, C-arm fluoroscopic device. Vital signs, including EKG and depth of sedation are monitored by a nurse anesthetist.

A specially designed sterile draping and fluid-collecting system is used to prevent contamination of the sterile field and protect the fluoroscopic equipment (Fig 2). A preliminary (scout) radiograph is obtained before the intrarenal collecting system is opacified. Contrast agent is injected via the previously placed retrograde ureteric stent. These steps confirm the position of the stone before selection of the nephrostomy site. Opacification of the upper collecting system can also be achieved using percutaneous thin-needle antegrade pyelography if placement of the ureteric stent was unsuccessful.

Under local anesthesia and fluoroscopic guidance, an 18-gauge trocar needle is introduced into the intrarenal collecting system via a preselected infundibulum. Approach through a posterior calyx or infundibulum is preferred to minimize the angle of entry in the renal pelvis. After confirming the position of the needle tip within the collecting system, a J guidewire (0.035 inch in length) is advanced into the periphery of the collecting system. Serial dilatation of the nephrostomy tract is performed over this guidewire with 7-, 9-, and 12-F Teflon dilators. Using a headhunter or cobra catheter, a floppy-tipped guidewire (0.035 inch in length) is directed down the ureter. The tip of the catheter is left in the distal ureter or, preferably, coiled in the bladder.

Early in our experience, an 8-F Teflon catheter (without the hub) was advanced over this anchor wire. Serial dilatation of the tract was performed over the catheter-guide wire using Amplatz Teflon dilators, and a 30-F sheath was left in place. Using high-pressure tract-dilatation balloon catheters, it is possible to dilate the nephrostomy tract from 9- to 30-F in one step (2), which reduces patient discomfort, bleeding, and radiation exposure, as well as the time required to perform the procedure (Fig 3). By preloading the 30-F Teflon sheath (without a dilator) over a new PE Plus dilatation catheter (10 cm in length, 10 mm in diameter) (USCI, C.R. Bard, Inc), the sheath can be advanced directly over the inflated balloon (Fig 4), which further reduces the time required to perform the procedure. With these modifications, tract dilatation and placement of the 30-F sheath can be achieved in 20 minutes in most patients.

Once the 30-F sheath is in place, 40 mg of Lasix is administered intravenously to help clear clots from the collecting system more rapidly.

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The urologist then introduces the nephroscope into the collecting system through the 30-F sheath. Fluoroscopy is complementary to endoscopy, especially when the calculus is covered with fresh clots (Fig 5). Calculi up to 1.3 cm in size can be removed without fragmentation. An ultrasonic lithotriptor is used to fragment larger calculi and staghorn calculi before they are extracted. Two or more procedures are required for complete removal of most staghorn calculi.

Following extraction of the calculus, the sheath is left in place for about ten minutes with no manipulation, which has considerably decreased bleeding from the tract. During this time, radiographs are obtained before and after injecting contrast agent through the retrograde stent or the drainage catheter itself. Irrigation of the renal pelvis through the drainage catheter is performed until the returning fluid is clear of clots. Catheters are anchored to the skin with 2-0 silk sutures. The retrograde ureteric stent and the Foley catheter from the bladder are removed after the procedure. The average time to complete the procedure is two and one-half hours.

A nephrostogram, including a scout radiograph, is obtained after 48 hours to determine if the collecting system is clear of clots and there is good drainage of contrast agent into the bladder without extravasation. When these conditions are met, the nephrostomy tube and the ureteric stent are removed, and the patient is discharged the next day. It is advisable in place until no extravasation of contrast agent can be seen.
Percutaneous Nephrolithotomy

It is advisable to keep the drainage catheter and the ureteric stent in place until no clots exist in the upper collecting system, no extravasation of contrast material is evident, and contrast agent can pass freely down the ureter.

**Results**

We reviewed the records of 121 patients (75 men and 46 women who ranged in age from 26 to 83 years [mean 47]) who had undergone PCNL between November, 1982 and December, 1984. The procedure was successful in 106 of these patients (88%). The average length of hospital stay was 6.7 days.

In 15 patients, PCNL was unsuccessful due to failure to place the nephrostomy tube (n = 4); failure to visualize the calculus endoscopically (stones with little or no calcium could not be seen under fluoroscopy) (n = 3); accidental pulling and displacement of the guidewire and the sheath, which resulted in termination of the procedure (n = 5); and excessive bleeding, which resulted in termination of the procedure (n = 3).

The most common significant complications were bleeding and sepsis. Hemorrhage requiring transfusion was reported in 5% of patients. One patient required an emergency open pyelolithotomy to control hemorrhage. Another patient underwent successful transcatheter embolization of false aneurysm for bleeding. Temperature elevation that prolonged the hospital stay was reported in 3% of patients. Multiple pulmonary emboli were detected in one patient during recovery. Perforation of the renal collecting system was noted in two patients on the follow-up nephrostogram. Also of note, an ileus pattern in a significant number of patients was observed on the supine nephrostogram.

**Discussion**

Our overall success rate of 88% compares favorably with the reported results of other large series (3-6). Likewise, the

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*Fig 2*

Patient positioned under fluoroscopy tube (head to left), ready for nephrostomy-tract preparation. Note plastic draping and drainage device (arrows).
Sequential films demonstrate establishment of nephrostomy and subsequent dilatation of nephrostomy tract using balloon dilatation catheter (steps g and h).

Sheath (30-F Teflon) is advanced directly over balloon dilatation catheter.
length of hospital stay and the types and frequency of complications are comparable to those reported. Increased experience and improved technique raised the success rate in the last 60 patients in our study to 90%. With further refinements and careful patient selection, we feel that a 95% success rate is achievable. A significant cost saving is achieved when the number of days of hospitalization is reduced. Another significant factor is the fast recovery after the procedure and the return to normal activity: this ranges from three to ten days depending on the patient’s occupation.

This procedure is reliably successful, safe, and cost-effective. In the current medical economic setting, it is clear that PCNL is an attractive alternative to open pyelolithotomy.

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References