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PERCUTANEOUS NEPHROSTOMY: A WELL ESTABLISHED AND EFFICACIOUS PROCEDURE

FARHOOD SEREMI M.D.

From the Department of Radiology, Imam Khomeini Hospital, Tehran University of Medical Sciences, Tehran, Islamic Republic of Iran.

ABSTRACT

56 percutaneous nephrostomies were evaluated in 50 patients, with a malignant underlying factor in 32 and benign conditions in 24. The clinical indication was decompression for supravesical obstruction with or without azotemia in the majority of cases. Less common indications were management of ureteral fistula, ureteral stricture dilatation, and pelvic stone extraction. Serious complications were encountered in 5.4% with one fatal hemorrhage. Successful results were achieved in about 98% of cases with one placement failure. The procedure offers an excellent and efficacious alternative to surgical nephrostomy.

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INTRODUCTION

Percutaneous nephrostomy (PCN) was first reported in 1955; however there was a 10-year interval before the next published paper in 1965.[1-2] Since 1975, the procedure has rapidly been developed and in many hospitals and clinics has replaced surgical nephrostomy. It is the purpose of this report to decribe our experience with 56 percutaneous nephrostomy placements, as well as its indication, failures, and complications.

MATERIALS AND METHODS

56 percutaneous nephrostomies were performed in 50 patients (46 adults and four children) at the Vali-Asr, Imam Khomeini Hospital affiliated to Tehran University of Medical Sciences between April, 1986 and January, 1988. Their ages ranged from 1.5-68 years. Four patients underwent a bilateral procedure and two others were punctured twice. The nephrostomies were usually performed for relief of supravesical obstruction in patients with azotemia and/or infection. Less common indications were uncomplicated supravesical obstructions, ureteral fistula and stricture, and pelvic stone extraction (Table I). The patients were evaluated preoperatively with routine coagulation studies to exclude bleeding disorders. An excretory urogram was obtained to determine the site of puncture. In patients with impaired renal function, a blind puncture was used for antegrade pyelography, based on knowledge of the patient's renal anatomy from prior studies. In a few patients, the puncture site and it's distance from the center of the pelvocalyceal system was localized with CT scan or real-time ultrasound.

Following skin preparation and local anesthesia, the kidney was punctured under fluoroscopic guidance from a posterolateral aspect with the patient prone oblique. After using a 16 or 18-gauge thin-walled needle for puncture, a 0.38 gauge guide-wire was introduced into the collecting system and all were replaced with a 7 French pigtail or straigh raphic or nephrostomy catheter in a manner similar to that described by others.

Replacing the percutaneous 7 French catheter with a larger polyethylene catheter was performed approximately two weeks later by tract dilatation with fascial dilators over a sturdy guide wire.

In those patients who required percutaneous stenting, a J-shaped guide wire or Lunderquist torque wire was passed through the strictured ureter and replaced with a 6 French stent catheter and secured to the skin of the flank by a monlar disc.

Nephrostomy in children was carried out in a similar

fashion to that described above, but a 5 or 6 French catheter was preferentially inserted into the collecting system.

RESULTS

The results are summarized in Tables I,II, and III. Of 56 percutaneous nephrostomies in 50 patients, 32 procedures were performed for relief of an underlying factor in malignant disease and 24 for benign conditions. Percutaneous nephrostomy was performed in dilated calyces and renal pelvices in all of the patients except four: one for stone extraction, one for management of traumatic uretero-cutaneous fistula, and two others for relief of malignant obstructive anuria due to rectal and prostatic carcinoma.

Three major complications were encountered. One fatal hemorrhage occurred (case report). Hectic fever with mild sepsis occurred in another patient about 48 hours after a difficult nephrostomy placement. A small perirenal collection was noted on ultrasound. The patient underwent successful recovery following appropriate medical therapy.

Minor complications occurred in 10.7% of the patients. Percutaneous nephrostomy was successful in 98%. There was one catheter placement failure. The patient was a 3-year-old child with a mildly dilated, purulent collecting system containing multiple calculi. Nephrostomy placement was successful only on one side.

CASE REPORT

A 25-year-old female had undergone partial bowel resection with end-to-end anastomosis for sigmoid carcinoma one year before admission. The patient admitted with uremia due to a nonfunctioning pyelonephritic right kidney and malignant obstruction of the left ureter at the level of the pelvic successfully performed on the left side (Figure 4). Because of gross hematuria during the next 48 hours, a second nephrostomy placement was performed on the same side and the first was removed. This was followed by exacerbation of hemorrhage and acute left flank pain. CT scan and ultrasound revealed perirenal and subcapsular hematomas, and hypertension developed within 24 hours due to marked compression of the kidney (Page's kidney). The patient underwent an emergency laparotomy, and a massive subcapsular hematoma was evacuated, while the nephrostomy tube was maintained. Hepatic metastases, peritoneal seeding, and recurrence of tumor with invasion to left ureter was noted during surgery. The patient died 24 hours after laparotomy in a clinical state of uremia and acute renal failure. Platelet count was normal, but platelet fuction studies were not performed.

TABLE I. Clinical Indication For PCN

Indication	Benign	Malignant	Total
Complicated supravesical obstruction:			
Uremia with or without infection	4	24	28
Pyohydronephrosis	5	1	6
Uncomplicated supravesical obstruction	9	5	14
Management of ureteral fistula	3	1	4
Ureteral stricture relief	2	1	3
Stone extraction	1	-	1
Total	24	32	56

TABLE II. Underlying Conditions

Etiology	No. of Patients	No. of PCNs
Carcinoma:		
Cervix	9	11
Prostate	4	6
Colon	4	4
Bladder	6	7
Ureter	1	1
Lymphoma	2	2
Calculi	9	9
Tuberculosis	1	1
UPJ obstruction	2	2
UVJ obstruction	2	2
Iatrogenic obstruction	3	3
Uretero-ileal stricture	2	3
Diabetes with pyonephrosis	1	1
Fistula:		
Uretero-retroperitoneal	2	2
Uretero-cutaneous	2	2
Total	50	56

TABLE III. Complications of PCN

Complication	No.	%
Major:		
Fatal hemorrhage: Hypertension	1	1.8
Pyohydronephrosis	1	1.8
Hectic fever with mild sepsis	1	1.8
Subtotal	3	5.4
Minor:		
Fluid extravasation	3	5.4
Catheter dislodgment	2	3.5
Transient UPJ obstruction	1	1.8
Subtotal	6	10.7
Total	9	16.1

DISCUSSION

The popularity of percutaneous nephrostomy has grown vastly in the last decade, and its indications have significantly broadened. Currently, the most common use of this technique is to establish an access for percutaneous nephrolithotomy and nephrolithotripsy, and 80% of nephrostomies are being done for stone removal.[3]

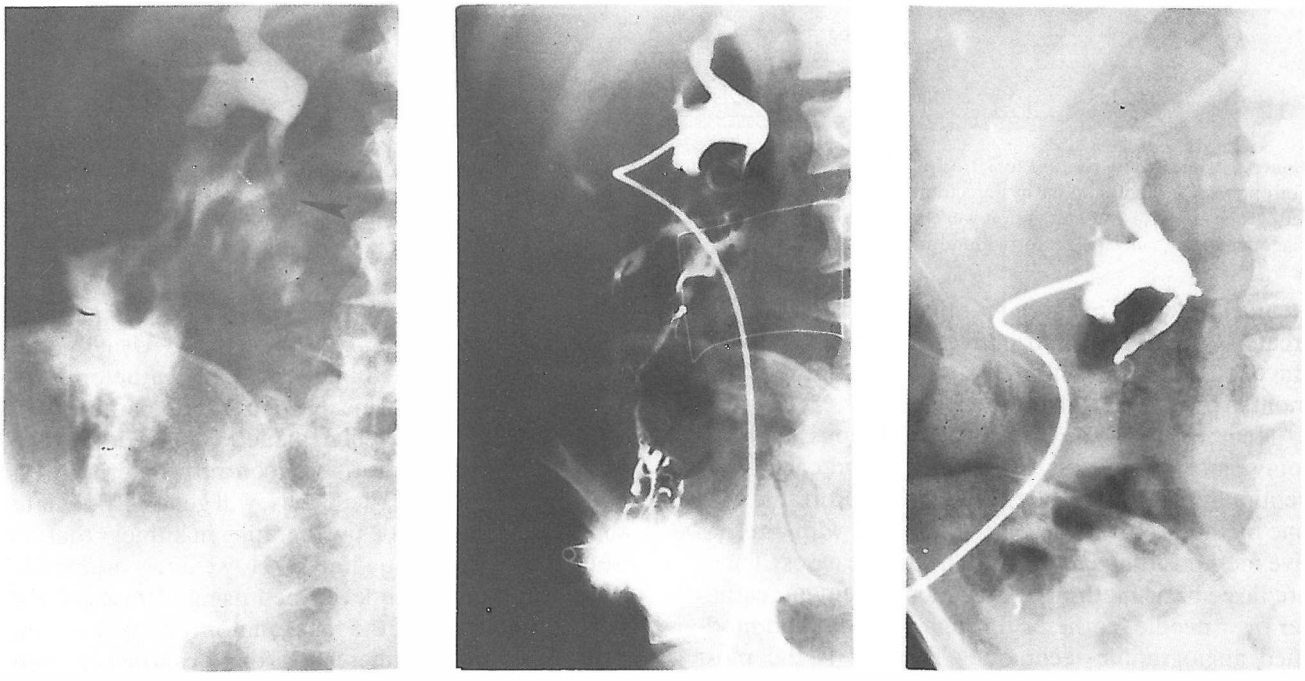
Excluding the use of percutaneous nephrostomy for access to the upper urinary tract to treat urolithiasis, the most common indication in general practice is relief of supravesical obstruction, particularly secondary to primary or metastatic pelvic malignancies.[4] The most frequent indication in the present study was complicated supravesical obstruction due to malignant processes. While azotemia may present alone, due to bilateral obstruction or obstruction of a single functioning kidney, this was frequently accompanied by infection.

Nephrostomy is indicated in those patients with malignant disease who hold some promise of survival and in whom further cancer therapy is anticipated. When proposing intervention for the patient with malignancy, medical judgment must always be tempered by the wishes of the patient and the family.

The most gratifying response is usually evident in patients with urosepsis. This was achieved in six patients with pyohydronephrosis, and decompression of the obstructed system resulted in almost immediate relief of symptoms within 24-48 hours.

Urinary leaks and fistulae may be due to trauma, surgery, or adjacent inflammatory disease. Percutaneous nephrostomy coupled with an antegrade stent catheter in these instances provides time for the fistulae and leaks to heal.[5] There are five types of fistulae: uretero-vaginal fistula, uretero-cutaneous fistula, uretero-enteric fistula, lymphatico-ureteral fistula, and uretero-retroperitoneal fistula or uriniferous pseudocyst.[6] Four patients had ureteral fistulae. A uretero-cutaneous fistula resulted from penetrating trauma in one patient (Figure 1). In this patient, stenting was impossible because of ureteral cut off. Another uretero-cutaneous fistula developed after cystectomy with uretero-sigmoidal anastomosis for bladder carcinoma. Uretero-retroperitoneal fistulae developed in two cases after surgical repair for ureteropelvic junction obstruction. All 4 patients were managed by percutaneous nephrostomy, and their fustulae healed completely. The urinomas were also aspirated coincidentally.

Percutaneous antegrade stenting was carried out in three patients: one for relief of obstruction in a ureteral stricture due to prostatic carcinoma, another for stricture by inactive urinary tract tuberculosis and the last for treating a stricture attributable to ligation of the ureter following abdominal hysterectomy (Figure 2). In the latter patient, a no. 7 French straight external



A B C

Figure 1. (A) An excretory urogram one day after missile injury showing complete right ureteral obstruction (arrowhead) with massive flow via uretero-cutaneous and uretero-retroperitoneal fistulae. (B) One week after percutaneous nephrostomy placement. (C) Four weeks after urine diversion through the catheter; the fistula has completlyclosed, and the patient referred for reconstructive surgery.

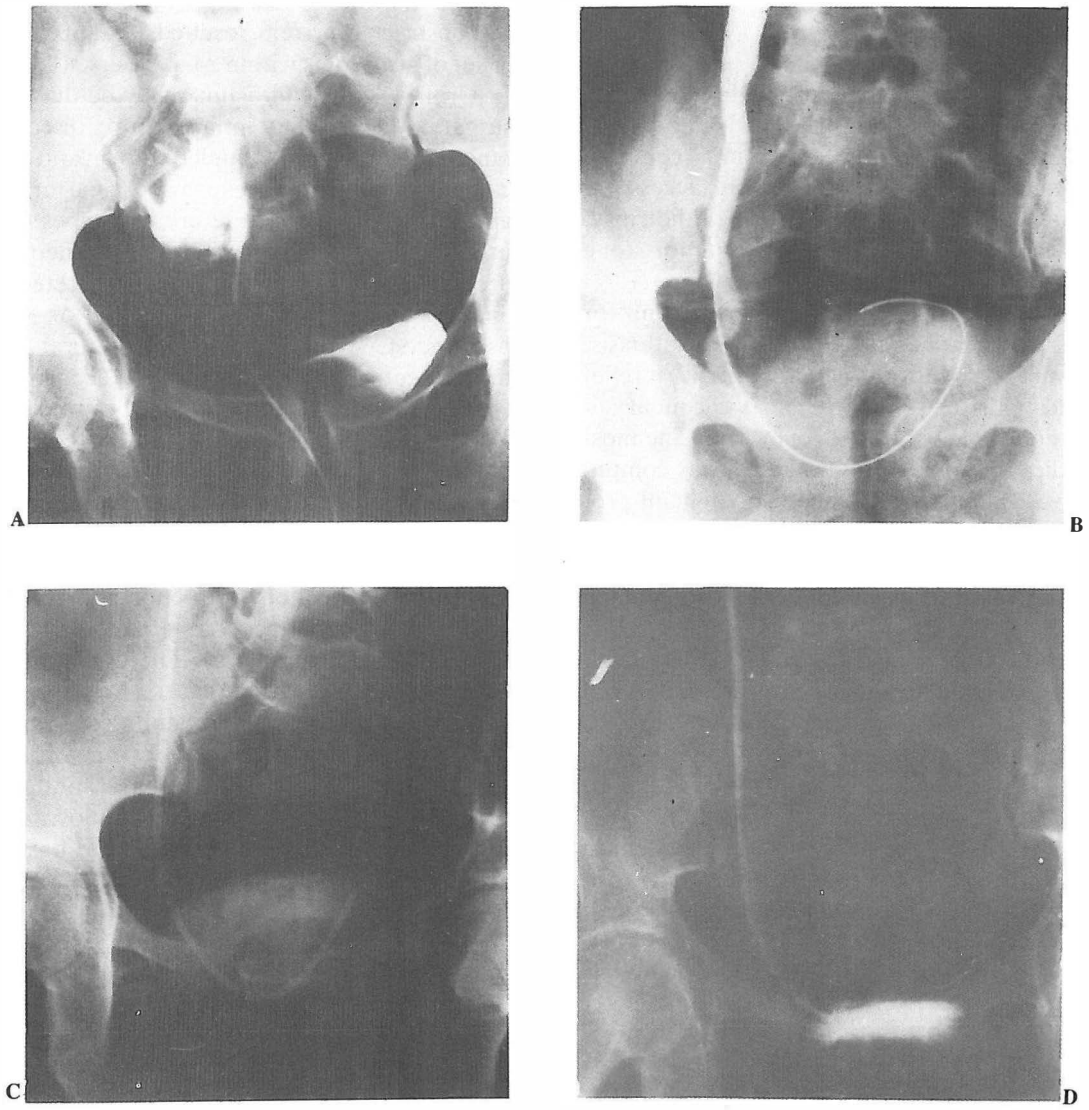


Figure 2. Percutaneous stenting for iatrogenic distal ureteral obstruction one week after abdominal hysterectomy. (A) Attempts for right retrograde ureteral catheterization were unsuccessful. (B) Percutaneous nephrostomy was performed and an angiographic guide wire negotiated through the strictured ureter. (C) A 6 Fr straight stent catheter was passed over the wire and subsequently into the bladder. (D) Catheter was safely removed after two months, and follow-up sonographic findings were normal during the next six months.

stent was placed for three months, which successfully treated the ureteral stricture. Follow up with intravenous urogram and ultrasound for another three months proved satisfactory recovery.

Numerous techinques for percutaneous nephrostomy placement have been described and each interventional radiologist should become comfortable with one method, but should also be familiar with alternative methods that can be used in specific cases. There are three basic methods of catheter placement: catheter over needle, catheter through cannula, and modified angiographic technique. The last is the most commonly employed method which requires a guide wire, dilator, and serial catheter exchanges.[4]

Different methods for puncture site localization can be considered in different patients. Currently, fluoroscopic guidance with or without a biplane option, seems to be the most frequently used method.[7] Usually, the best position is prone oblique with the catheter entry site in a posterolateral location, so that the catheter will traverse the least vascular plane of the kidney. The intravenous administration of contrast material, with opacification of the renal pelvis, will generally obviate the need for antegrade pyelography in kidneys that do not function adequately. However, antegrade pyelography is often performed using ultrasound for needle placement. If the renal anatomy is known from prior urographic studies, ultrasound can be obviated and a blind puncture will usually be successful.

The use of sonographic methods for initial needle punture significantly reduces the number of puncture attempts, potential iatrogenic risk, and eliminates the

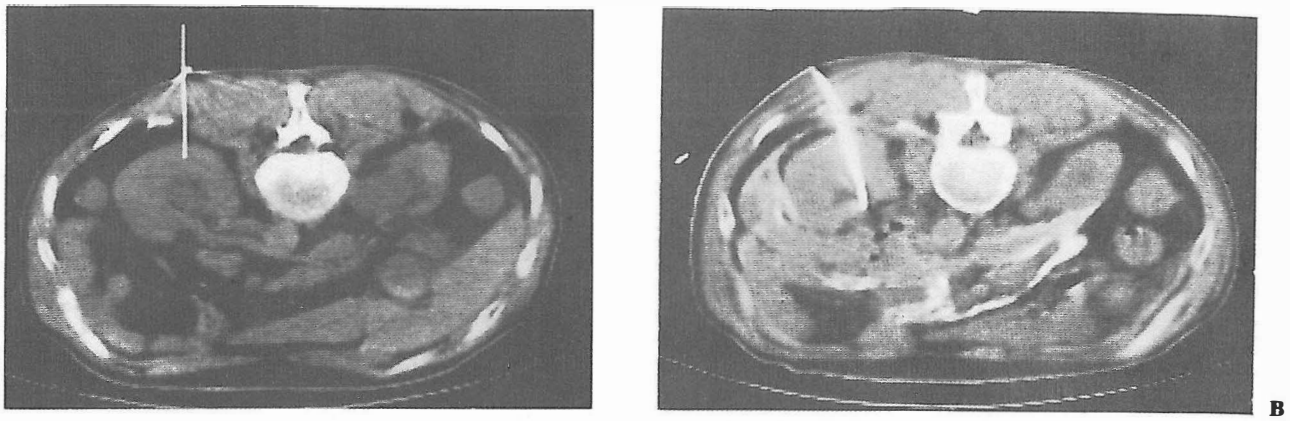


Figure 3. Bilateral obstructive nonfunctioning kidneys in a patient with rectal carcinoma. Prone CT-scan obtained for demonstrating anatomic detail and localization of puncture site. (A) Reveals slight dilatation of the collecting system on the left side. Percutaneous nephrostomy was performed on the left side. (B) Demonstrates catheter inserted into renal pelvis and some extravasation of contrast material along fascial planes.

need for intravenous administration of contrast material. In a comparative study using sonographic and fluoroscopic guidance, the average number of needle punctures was 1.2 for sonographic punctures and more than three times for fluoroscopic insertions.[8] In the present study, fluoroscopic guidance was used in almost all patients, with an average number of three needle punctures for access to the pelvocalyceal system.

Although the use of CT guidance for percutaneous nephrostomy may seem cumbersome, time consuming, and expensive for routine use, it is useful in patients with impaired renal function, undilated pelvocalyceal systems (Figure 3), and cross-sectional anatomic display. In addition to these purposes, CT accurately displays the perinephric space so that assessment of complications is possible.[9]

In most respects, interventional procedures do not differ in children and adults.[10] Needles, guide wires, and catheters are generally of the same caliber as in

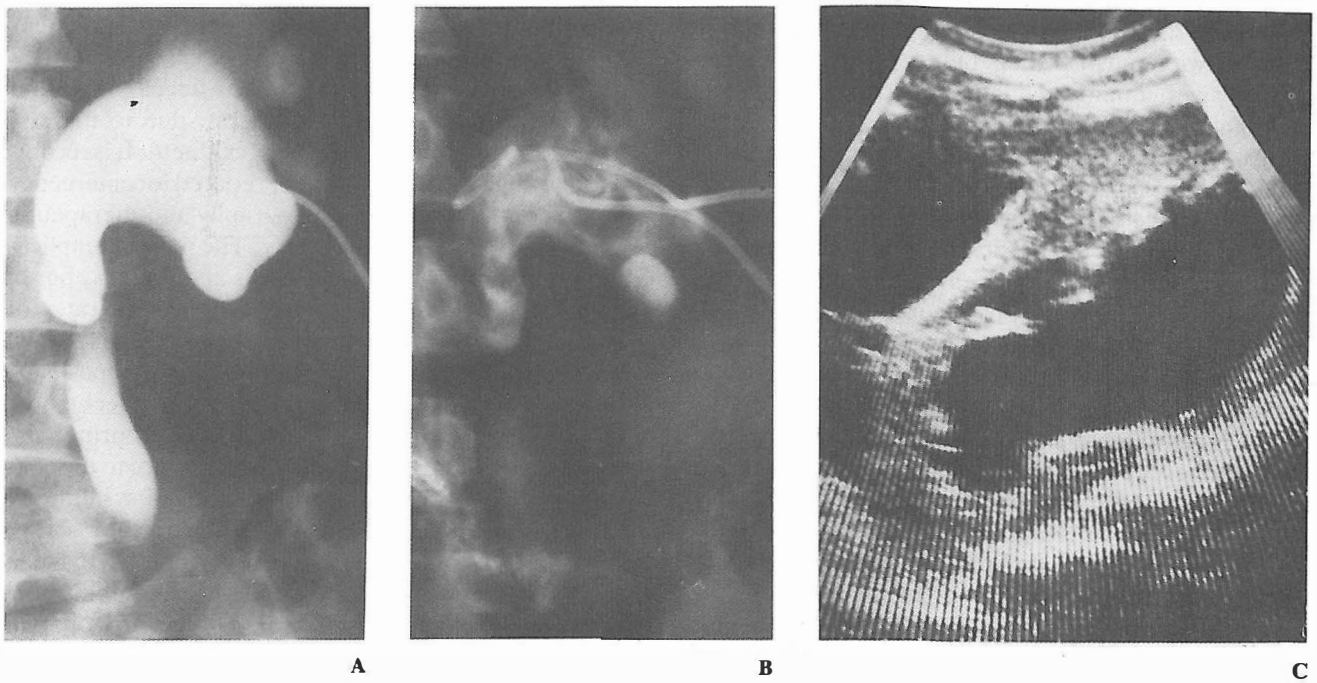


Figure 4. A 25-year-old female with chronic renal failure due to right pyelonephritic kidney and left ureteral obstruction by metastatic sigmoid carcinoma. Percutaneous nephrostomy was performed without difficulty on the left side. (A) Nephrostomogram immediately after catheter placement showing complete ureteral obstruction at the level of pelvic brim. (B) 48 hours later a second nephrostomy was performed because of inadequate drainage due to blood clots obstructing the pelvocalyceal system. (C) Lateral decubitus longitudinal real-time sonographic examination of the left kidney reveals perirenal hematoma at the superolateral aspect of dilated collecting system.

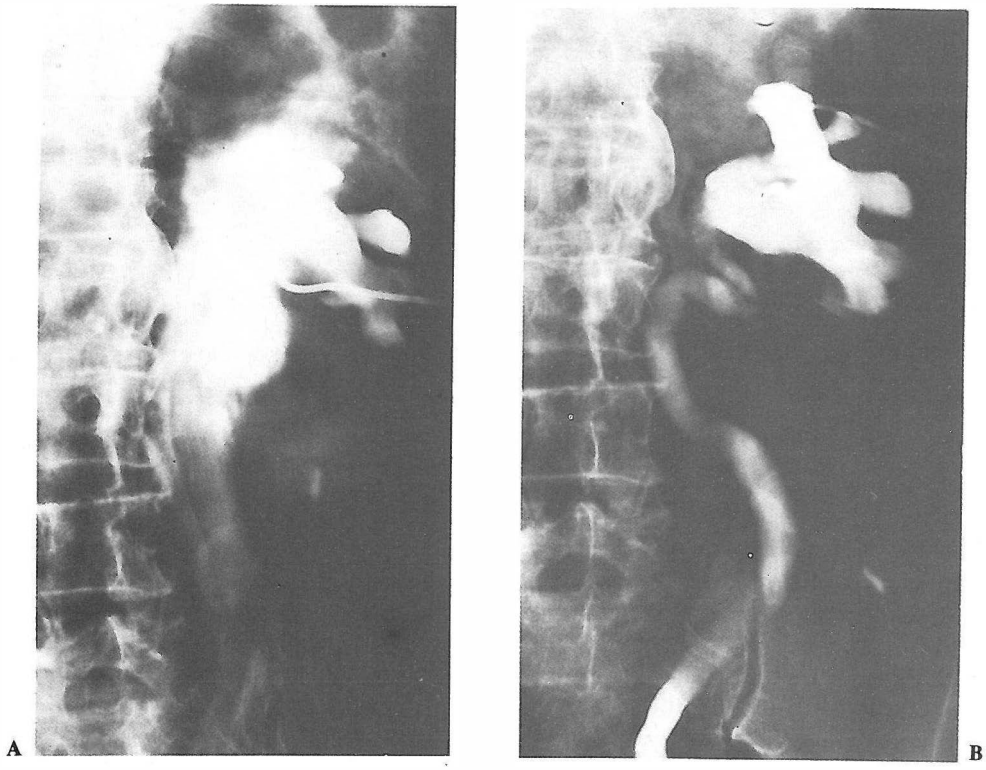


Figure 5. (A) Massive extravasaion along the ureter after percutaneous catheter placement for distal ureteral obstruction in a patient with prostatic carcinoma. (B) Nephrostomogram performed 48 hours later, showing complete resolution of extravasation.

adults. In this study, four nephrostomies were performed in three children without significant complication but with one placement failure involving a 3-year-old boy with minimally dilated collecting systems containing inspissated pus and multiple calculi. Percutaneous access to one of his kidneys was unsuccessful.

Ureteral obstruction can lead to renal failure without causing detectable dilatation of the pelvocalyceal system proximal to the obstruction, and antegrade pyelography is the best procedure to demonstrate the level of obstruction.[11,12] This phenomenon occurred in two patients of the present study.

Diuresis and a decrease in azotemia occurred as a result of percutaneous nephrostomy. Years of experience at many centers throughout the world have confirmed the safety, efficacy, and reduced morbidity of percutaneous nephrostomy.

The mortality of this procedure has been reported as 0.2% and the main complication has been massive hemorrhage with significant coagulopathy in the majority of cases.[13] Of our 56 patients, fatal hemorrhage occurred in one (1.8%). The underlying cause may have been due to platelet dysfunction and/or injury to an intralobar renal artery. No bleeding diatheses other than those associated with severe uremia could be identified (Figure 4). Injury to an intralobar renal artery and hypertension due to massive hemorrhage in the subcapsular and perirenal space has been reported.[14-15] CT and ultrasound may be of value in identifying early homorrhage. In the latter patient these two procedures revealed a subcapsular and perirenal hematoma, and hypertension developed within 24 hours after percutaneous access, due to marked compression of the kidney (Page's kidney). It is recommended that the radiologist be prepared for emergency interventions, including angiography and therapeutic embolization of bleeding artery. The major complication rate in this limited study was about 5.4%, but in large series, there are major complication rates of about 1-4%, primarily sepsis and hemorrhage.[3,13] The most frequent major complication is symptomatic infection.[6] It can be reduced by using sterile technique, appropriate antibiotic therapy in infected urine, and adequate drainage. Care must be taken not to overdistend the collecting system. If obstructed systems are already infected, this increases the risk of sepsis. Transient hematuria is seen so frequently that it is considered a normal sequel rather than a complication, and usually clears within 24 to 48 hours. Blood clots within the renal pelvis may cause inadequate drainage. These clots usually dissolve within 48 to 72 hours under the action of urinary urokinase.

Irrigation of the renal pelvis with normal saline can prevent heavy clot formation. Obstruction of the ureteropelvic junction occurred in one patient due to irritative edema resulting from guide wire manipula-

tions. This edema resolved within 48 hours. Perforation of the collecting system and extravasation of contrast media during forceful manipulation may occur (Figure 5).

However, if adequate drainage is maintained, no serious complication will occur. If extravasation continues longer than 72 hours, a large laceration or nephrostomy tube malplacement outside of the renal collecting system must be suspected. Catheter dislodgement may occur as a result of inadequate fixation, placement of a short segment into the collecting system, and a few weeks later because of dilatation of the nephrostomy tract. Use of monlar disc, sutures, and adequate dressing material while percutaneous catheters are in place will avoid dislodgment. Occasionally the nephrostomy catheter may coil into the perinephric space after successful nephrostomy tube placement. This may result from positional changing during movement, respiratory excursion, and ptosis of the kidney.

Reestablishment of a nephrostomy tract after catheter dislodgement is difficult and time consuming except in mature tracts. Failure to define a tract after contrast media injection usually suggests that the catheter has been dislodged for more than 48 hours, and requires repuncture.[16]

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