ELSEVIER

Techniques in Vascular and Interventional Radiology

Urinary Drainage Procedures in Interventional Radiology

Raymond H. Thornton, MD, and Anne M. Covey, MD

Urinary drainage procedures are used to treat a wide range of clinical situations including pyonephrosis, preservation of renal function in patients with ureteral obstruction, as a means to access the collecting system for stone retrieval or lithotripsy and to divert urine from a distal leak or fistula. Several different drainage devices are available and include those that provide obligatory external drainage (nephrostomy), both internal and external drainage (nephroureteral stent) and internal drainage (double-J stent). Each device requires some maintenance and effort on the patient's part—from having to undergo routine exchange of double-J stents every 3-6 months to the daily management of an external catheter and drainage bag. Ideally, the desired outcome can be attained with minimal effect on patient lifestyle. In this article, we present our approach to patients who require urinary drainage, with a focus on choosing and placing the most appropriate device in a variety of clinical scenarios.

Tech Vasc Interventional Rad 19:170-181

KEYWORDS Nephrostomy, Percutaneous nephrostomy, Urinary diversion, Ureteral catheterization urinary catheterization

Introduction

Urinary drainage can be accomplished with an array of techniques and devices. Technique and device selection depends on a given patient's clinical problem and, to some extent, their preferences. The indication for drainage and the goals of care must be clear from the start, including the endpoint for catheter drainage. Careful review of anatomical and functional imaging as well as relevant laboratory data are the keys in determining the optimal drainage strategy and how likely it is to achieve the desired outcome. With this information in hand, the interventional radiology (IR) physician can develop an appropriate plan with the referring physician and the patient. Clear communication of expected lifestyle alterations, predictable functional changes, frequency of follow-up appointments, and anticipated duration of drainage is a critical part of preprocedure consultation.

What is acceptable to one patient may not be to another; and a patient's preferences and desires may change over time when urinary drainage is a long-term commitment. By presenting a complete picture of benefits, risks, and alternatives, the patient should be sufficiently knowledgeable to participate in decision-making about their care. In this article, we will review common indications for urinary drainage, the pros and cons of different urinary drainage devices, clinical and anatomical scenarios that may lead one to prefer 1 device over another, and technical considerations and pointers.

Department of Radiology, Section of Interventional Radiology, Memorial Sloan Kettering Cancer Center, New York, NY.

Address reprint requests to Anne M. Covey, MD, Department of Radiology, Section of Interventional Radiology, Memorial Sloan Kettering Cancer Center 1275 York Ave, New York, NY 10065. E-mail: coveya@mskcc.org

Indications for Urinary Drainage

Pyonephrosis is infection of the urine within the collecting system, and it usually occurs in the setting of obstruction. Obstruction can be caused by stone disease, urinary tract malignancy or metastasis, extrinsic compression, stricture, or inadvertent surgical ligature. Sometimes described as "pus under pressure," pyonephrosis can rapidly deteriorate into life-threatening sepsis as infection gains access to the vascular system.[1,2] Therefore, urgent intervention is typically required. Most patients suspected of having pyonephrosis arrive to the IR suite having already received an appropriate intravenous (IV) antibiotic. Because these patients are high risk for sepsis, it is critical to confirm they receive an appropriate antibiotic within 60 minutes of

 1089-2516/16/$ - see front matter
http://dx.doi.org/10.1053/j.tvir.2016.06.002

starting the procedure.[3] Attention should be focused on swift insertion of nephrostomy catheter(s) with minimal manipulation to decrease the risk of bacterial translocation from the urine into the bloodstream. If the needle position is not adequately visualized by ultrasound (US), only a small amount of contrast should be injected to confirm access to the collecting system before insertion of a transitional microintroducer or sheath insertion. Infected urine should then be permitted to drain to decrease pressure in the collecting system before further manipulation, because adding contrast material to an already pressurized collection system increases the likelihood of sepsis.[1]

Even carefully performed nephrostomy placement creates a connection between the urinary and vascular systems, so the IR team must anticipate and be prepared to treat signs of sepsis during and after the procedure. Rigors, hypotension, tachycardia, and altered mental status are signals that should prompt immediate attention including continuous monitoring of vital signs, fluid resuscitation, and early critical care consultation.[3]

Particular attention is warranted for patients with bilateral hydronephrosis or unanticipated intraprocedural discovery of pyonephrosis. Patients with bilateral hydronephrosis and suspected pyonephrosis may require placement of bilateral nephrostomy catheters, even in the setting of atrophic kidney(s). Patients at high risk for pyonephrosis include those with indwelling stents or prior ureteroenteric anastomoses (eg, ileal conduit and neobladder).[4] The initial characteristics of urine aspirated from the access needle can be misleadingly normal because the supernatant of infected urine may look clear. It is, therefore, advisable to observe the fluid characteristics in the drainage bag following tube insertion and complete decompression, as the initially clear urine may become purulent as the collecting system is decompressed.

Noninfected urinary obstruction caused by stone disease is a common indication for percutaneous renal drainage. Nephrostomy placement serves several functions in this situation—preservation of renal function, relief of renal colic caused by repeated muscular contractions of the ureter against the obstructing calculus, and access for definitive stone therapy once the acute episode has resolved.[5,6] In some cases, when renal colic is relieved, small stones may pass unassisted through the ureterovesical junction.

Noninfected urinary obstruction caused by malignancy is another common indication for drainage. The clinical goal for such patients is to preserve or to recover renal function. Review of prior imaging with attention to the timecourse of urinary obstruction is especially important in this setting. Unilateral and bilateral ureteral obstruction can result in varying degrees of renal atrophy over time, and this is best appreciated on serial imaging. The approach to drainage in this situation should address the question "Will drainage of this kidney achieve the desired clinical outcome?" When uncertainty exists, it is essential to discuss this with the patient because of the potential for placement of a percutaneous catheter without clinical benefit, and any intervention can introduce the potential for complications and inconveniences for the patient. Drainage of a chronically obstructed and noninfected atrophic kidney is unlikely to recover meaningful renal function.[7] Nuclear renal scans are helpful in determining the functional contributions of each kidney in this circumstance.[7,8]

Occasionally, oncology patients with preserved estimated glomerular filtration rate or serum creatinine level are referred for urinary drainage because they have imaging evidence of hydronephrosis and require nephrotoxic chemotherapy.[9] If imaging suggests that urinary drainage can ultimately be internalized with a double-J ureteral stent—and that is always a best guess until attempts to cross the obstruction have been made—then the potential for a long-term exteriorized catheter can be presented as "unlikely, but uncertain" to the patient. This engages the patient to consider the realistic range of outcomes.

When bilateral hydronephrosis is present in such instances, we often begin with drainage of 1 kidney followed by review of serial serum creatinine values to determine if "one is enough." Our guiding philosophy is that internalized drainage is the desired endpoint in most cases, and when that is not possible, we aim to place the least number of tubes to accomplish the clinical goal.

Postoperative Urine Leaks

Following ureteral reimplantation into the bladder or after cystectomy and formation of an ileal conduit or neobladder, ureteral obstruction may occur because of ureteral ischemia and stenosis, surgical mishap, or recurrent urothelial tumor.[10] Ureteral injury is also a known risk of some nonurologic surgeries.[11] Initial management of a urine leak includes drainage of the urinoma or urinary ascites, and is often followed by nephrostomy or ureteral stent placement for urinary diversion. When the laterality of ureteral injury can be determined by imaging studies, drainage of a single kidney is usually adequate. When laterality cannot be determined or in cases of injury to the urinary bladder, bilateral nephrostomy placement is indicated for complete urinary diversion.[12] Diverting nephrostomy catheters, though effective, do not always capture the entire volume of excreted urine. To optimize diversion, we typically place at least 10 French catheters in such patients.

Urinary diversion may also be used in patients with severe hemorrhagic cystitis, or vesicovaginal or vesicocolic fistulae resulting in uncontrolled drainage of urine from the vagina or rectum. The principle technical challenge in these cases is the absence of hydronephrosis because of internal decompression of the collecting system. The same technical challenge exists for the small subset of patients with nondilated obstructive uropathy and acute renal failure, for whom percutaneous renal drainage is effective.[13] Several techniques that can be used to gain access to the nondilated collecting system are discussed later.