

**American College of Radiology
ACR Appropriateness Criteria®**

Clinical Condition: Radiologic Management of Urinary Tract Obstruction

Variant 1: Adult patient with urinary diversion after remote history of cystectomy for cancer. Patient has no fever. Patient has normal white blood cell (WBC) count and urine output. Loopogram shows no reflux into distal ureters. Computed tomography (CT) scan shows new moderate bilateral hydronephrosis.

Treatment/Procedure	Rating	Comments
Medical management without decompression	3	
Retrograde ureteral stenting	4	This is for an operable candidate with benign disease; however, brush biopsy should be performed first to verify benignity. An internal double J ureteral stent is not recommended because of distal end obstructions.
Percutaneous nephrostomy	7	Brush biopsy should be performed after nephrostomy placement to verify benignity of the stricture. For nonoperable candidates, consider converting to retrograde tube exiting into ostomy.
Percutaneous antegrade ureteral stenting (with or without safety nephrostomy)	6	Double J ureteral stent is likely to be occluded in the ileal loop due to mucus production. Conversion to a retrograde tube exiting the ostomy into the ostomy bag is the standard.
Percutaneous nephrostomy follow by delayed surgery	7	Surgery refers to re-anastomosis, not endoureteral therapies, which have low long-term patency rates. Brush biopsy should first be performed to verify benignity.
<u>Rating Scale:</u> 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate		

Variant 2: Adult patient with a 7-day history of right flank pain, fever, and leukocytosis. Urinalysis is positive for blood and infection. CT scan shows a 10-mm calculus in the mid right ureter without hydronephrosis.

Treatment/Procedure	Rating	Comments
Medical management without decompression	2	
Retrograde ureteral stenting	8	This should be followed by stone removal when the infection is controlled.
Percutaneous nephrostomy	5	This may be appropriate if retrograde stenting is not possible. This should be followed by stone removal when the infection is controlled.
Percutaneous antegrade ureteral stenting (with or without safety nephrostomy)	2	This involves excessive manipulation for a patient with an active infection.
Percutaneous nephrostomy follow by delayed surgery	5	This may be appropriate if retrograde stenting is not possible. This should be followed by stone removal when the infection is controlled.
<u>Rating Scale:</u> 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate		

Clinical Condition: Radiologic Management of Urinary Tract Obstruction

Variant 3: Adult pregnant (20+ weeks) patient with a 3-day history of left flank pain, fever, and leukocytosis. Urinalysis is positive for infection. Ultrasound scan shows new, moderate left hydronephrosis.

Treatment/Procedure	Rating	Comments
Medical management without decompression	2	
Retrograde ureteral stenting	8	With minimal radiation to the fetus, this is the treatment of choice.
Percutaneous nephrostomy	7	
Percutaneous antegrade ureteral stenting (with or without safety nephrostomy)	2	This involves excessive manipulation in the setting of infection as well as radiation exposure to the fetus.
Percutaneous nephrostomy follow by delayed surgery	1	The cause is likely obstruction related to pregnancy, and the need for delayed surgery is highly unlikely.
Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate		

Variant 4: Adult patient with advanced cervical carcinoma presenting with decreased estimated globular filtration rate <15. Normal WBC, positive pelvic pressure, no flank pain. CT scan reveals new bilateral hydronephrosis and hydroureter due to local invasion by a pelvic mass.

Treatment/Procedure	Rating	Comments
Medical therapy without decompression	1	
Retrograde ureteral stenting	8	
Percutaneous nephrostomy	8	Consider bilateral nephrostomy.
Percutaneous antegrade ureteral stenting (with or without safety nephrostomy)	8	If able to cross obstruction.
Percutaneous nephrostomy followed by delayed surgery	4	Surgical options are typically limited in this scenario.
Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate		

Variant 5: Adult patient with a prolonged history of right flank pain, fever, and leukocytosis. Urinalysis is positive for blood and infection. Patient appears septic and is hypotensive. CT scan shows dilated right ureter and renal pelvis with perinephric stranding. No etiology for ureteral obstruction identified with current imaging.

Treatment/Procedure	Rating	Comments
Medical therapy without decompression	1	
Retrograde ureteral stenting	6	This is appropriate if the patient is coagulopathic.
Percutaneous nephrostomy	8	This procedure needs urgent decompression, which is best achieved with percutaneous nephrostomy (PCN) rather than retrograde stent.
Percutaneous antegrade ureteral stenting (with or without safety nephrostomy)	2	Minimize manipulation in the setting of sepsis.
Percutaneous nephrostomy followed by delayed surgery	5	
Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate		

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Variant 6: Adult patient with urinary ascites after recent abdominal surgery. Elevated blood urea nitrogen/creatinine, moderate abdominal pain, and no peritoneal signs. CT urogram reveals contrast leak from left pelvic ureteral injury. Current therapy consists of Foley catheter in the bladder.

Treatment/Procedure	Rating	Comments
Medical therapy without decompression	1	
Retrograde ureteral stenting	7	May want to divert with PCN first, then attempt to cross injury.
Percutaneous nephrostomy	9	
Percutaneous antegrade ureteral stenting (with or without safety nephrostomy)	8	May want to divert with PCN first, then attempt to cross injury.
Percutaneous nephrostomy followed by delayed surgery	7	Use of this procedure depends on the degree of injury.
<u>Rating Scale:</u> 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate		

RADIOLOGIC MANAGEMENT OF URINARY TRACT OBSTRUCTION

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Summary of Literature Review

Introduction/Background

In use for more than 50 years [1], percutaneous nephrostomy (PCN) catheter placement provides access into the renal collecting system for urinary decompression and, more recently, facilitates endourologic surgery. This procedure was originally performed with limited imaging guidance, and its acceptance was limited initially. Over the ensuing decades, with the improvement in catheters and interventional radiological techniques and the standard use of imaging guidance, the procedure has become increasingly safe. It has been performed with increasing frequency as indications have expanded.

PCN access entails placing a drainage catheter into the renal collecting system and typically uses imaging guidance and the Seldinger needle-wire technique. The placed catheter permits either external urinary decompression (external PCN catheter) or internal drainage through the ureter and bladder by a longer internal ureteral catheter component (percutaneous nephroureteral stent). The following are the most common procedural indications for PCN along with its subsequent success and complication rates.

Urinary Tract Obstruction in the Setting of Infection

In patients who have pyonephrosis (hydronephrosis with infection), urinary tract decompression can be lifesaving. Although drainage can be obtained with retrograde ureteral catheterization, PCN drainage is often preferred for patients who are unstable or have multiple comorbidities. PCN is often performed on an emergent basis [2-4]. The decision regarding emergent, urgent, or elective PCN placement depends primarily on clinical symptoms of sepsis. However, recent data suggest serum C-reactive protein may be a useful, less subjective parameter [5].

In the setting of pyonephrosis, PCN is almost always technically successful and often results in marked clinical improvement [2-4,6-8]. PCN can yield important bacteriological information and alter antibiotic treatment regimens by correctly identifying the offending pathogen and improving the sensitivity of bladder urine cultures [9,10]. In a retrospective analysis, patient survival was 92% when PCN was used, compared with 88% for surgical decompression and 60% for medical therapy without decompression [7]. In addition, hospitalization times were shorter in the nephrostomy group. Postprocedural bacteremia and sepsis are common when infected urinary tracts are drained [11]. Preprocedural antibiotics may not be necessary for patients at low risk for infection [12,13]. However, when urosepsis is suspected or known to be present, preprocedural antibiotics are recommended [3,4,6,7,14].

In neonatal renal candidiasis, fungus balls obstruct the upper urinary tract and predispose to obstructive uropathy and fatal systemic candidiasis. In this setting, PCN drainage allows for both urinary tract decompression and the direct administration of antifungal agents into the renal collecting system [15-17]. Although the literature in this setting is limited, this technique seems to be valuable in eradicating funguria and is an attractive alternative to surgical decompression.

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Obstructing Stone Disease

Acute ureteral obstruction is most commonly related to stone disease and accounts for as many as one-fourth of PCNs performed [18]. In cases of acute ureteral obstruction, extracorporeal shock-wave lithotripsy and retrograde double-J ureteral stenting have been shown to be more successful for complete stone eradication and passage than simple nephrostomy placement [19]. A prospective, randomized, controlled trial of hydronephrosis secondary to stone disease was conducted to compare PCN with retrograde double-J stenting. The technical success rates were 80% for retrograde stenting compared with 100% for PCN. In addition, the dwell time for the PCN tubes was significantly shorter than that for the double-J ureteral stent. [20]. Although some ureteral stones will pass spontaneously with a nephrostomy tube in place, many will not. In these scenarios, PCN access can be a conduit for definitive antegrade ureteral stone treatment [7].

Malignant Urinary Tract Obstruction

Although PCN and nephroureteral stent placement can provide urinary diversion in a variety of obstructing pelvic neoplasms, most of the literature addresses gynecological malignancies, such as cervical cancer, for which ureteral obstruction is a relatively frequent complication.

PCN and/or stent placement will improve renal function in most cases [21,22]; some investigators have reported improved survival benefits [23] as well as quality of life [24-27]. However, the patients most likely to benefit from this technique are those who have reasonable treatment options for their malignancy [28-31].

In patients with advanced disease for whom only palliative treatment is planned, PCN may offer little benefit, as its performance status and patient survival rates are frequently poor, and further procedures may be necessary [32-35]. PCN, however, can be used in the palliative treatment of certain patients with advanced disease, particularly in appropriately selected patients who have pelvic malignancies, such as prostate carcinoma and transitional carcinoma [28,36-39].

In patients who have pelvic malignancies, PCN decompression has been shown to be valuable in improving renal function and survival [28,36,37]. When intervention is being considered for patients who have an underlying pelvic malignancy, PCN could have a higher technical success rate in relieving obstruction, compared with retrograde double-J ureteral stenting, especially in cases due to extrinsic compression in the emergent setting [40,41].

Urinary Obstruction in the Setting of Pregnancy

Hydronephrosis in pregnancy can often be seen after week 20, as the enlarging uterus compresses the ureter. It is also thought that hormonal changes contribute to this by reducing ureteric peristalsis. However, obstructive uropathy, most commonly due to stones, can occur. Although many small stones pass spontaneously, urinary tract intervention is occasionally necessary. In settings where ureteral catheterization is not technically possible, PCN can safely provide temporary urinary tract decompression, although the data are from small observational series [42-45]. The incidence of spontaneous abortion or preterm labor related to PCN tube placement is exceedingly low [43-46]; however, because of the small sample sizes, this issue requires further study [47].

To limit radiation to the fetus, PCN can sometimes be performed using ultrasound guidance alone, thus obviating the need for radiation [45]. In many cases, however, fluoroscopy will be necessary to safely place the tube [43]. Usually, nephrostomy catheters are left in place until after delivery, and definitive stone intervention is then performed postpartum [43,45,46].

Preoperative and Postoperative Nephrostomy Catheter Placement

Because endourologic approaches replace some conventional open surgical procedures, the indications for PCN and nephroureteral catheter access have expanded to facilitate these procedures. PCN has been shown to be useful in obtaining access for stone interventions [7,11,48,49], particularly when the stone burden is so large that extracorporeal shock-wave lithotripsy is unlikely to completely fragment and eradicate the stone disease. The ease or complexity of percutaneous stone removal depends on precise nephrostomy access [11,48], which occasionally necessitates high intercostal space access [49] with an associated small increase in risk for pleural effusion or pneumothorax development. Similarly, PCN access has been shown to be helpful for endopyelotomy, which affords less morbidity and shorter recovery times than open pyeloplasty for ureteropelvic junction stenoses [50].

For patients who have pyonephrosis or noninfected obstruction of a nonfunctioning kidney, preoperative PCN could increase the rate of wound infections following nephrectomy [51].

Ureteral leaks and strictures occasionally occur after both ureteral and nonureteral open surgical procedures. In the setting of such complications, when retrograde ureteral catheterization fails, PCN access, often with nephroureteral stenting, is useful [7,11,52,53]. Use of PCN decompression as the primary management of ureteral injuries results in a decreased need for reoperation and decreased morbidity rates [53]. PCN can provide access for definitive treatment of ureteral strictures [7,11] and leaks [52,53] and, thus, obviates the need for repeated surgery [52,53]. In the acute trauma setting, PCN can act as a bridge to surgery in the treatment of fistulas, urinomas, and urinary ascites [54].

PCN has been shown to be similarly useful in the management of renal transplant ureteral complications. In cases of post-transplant ureteral leaks, fistulas, strictures, and obstructions, PCN decompression may preserve or improve renal function [55].

In such settings, nephrostomy access is established when retrograde ureteral access is not possible [56]. In surgical ureteral repair, failure rates are 13% when PCN placement is performed, compared with 87% when it has not been used [57]. Accordingly, PCN is considered very helpful in optimizing transplant patient and renal-unit survival.

Alternatives

The most common alternative to PCN catheter placement is cystoscopic retrograde ureteral decompression with double-J stents. Compared with PCN, retrograde ureteral catheters may be associated with a higher risk of urosepsis in some patients who have an extrinsic ureteral obstruction [58]. PCN may be the preferred option in patients at high risk for anesthesia, or in a setting such as pyonephrosis, when larger tube decompression may be warranted [6,9,59].

Retrograde nephrostomy catheter placement has also been described [60,61], but experience with this technique is limited, compared with antegrade nephrostomy placement. Subcutaneous urinary diversion is occasionally used in patients who have malignant obstructions [21,62,63]. Open surgical nephrostomy tube placement is rarely used [23,64]. Interestingly, in a recent opinion survey conducted in the UK, PCN was favored more often by urologists than by radiologists (mean of 69% versus 48%, respectively, for the treatment of uncomplicated obstructive nephropathy) [65].

In the majority of cases a ureteral stent can be placed, either via the bladder or via the kidney, after nephrostomy. In specialty situations, combined procedures with “rendezvous” [66] techniques or even a 1-step antegrade stent [67] placement (without leaving the nephrostomy as a safety measure) can yield similar successful alternative approaches. Standard plastic, as well as newer, metal/reinforced stents, have been used with similar results [68].

Success and Complications

When performed with imaging guidance, the technical success for PCN placement by experienced operators approaches 100%, as demonstrated by large UK registry data from over 3,000 PCN procedures [3,4,18,69]. More conservative thresholds have suggested that the technical success of PCN is >95% when using dilated collecting systems and approximately 80% to 90% when using nondilated systems [70,71].

The Society of Interventional Radiology quality improvement guidelines (SIR QI) set threshold percentages for technical success rates for PCN at 95% for urinary obstruction without stones as well as renal transplant obstruction [72]. For nondilated collecting systems, SIR QI set the threshold for technical success at 80%, and for complex stone disease including staghorn calculus, it set the minimal threshold at 85% [72]. Although often performed as an inpatient procedure, PCN can be performed safely in selected low-risk patients as an outpatient procedure with same-day discharge [13,73]. Most operators use ultrasound [74] for initial access and then fluoroscopy to place the nephrostomy tube. Additional imaging modalities have included CT and MR in special circumstances [71,75].

Complication rates related to PCN are low in most series and are usually reported at $\leq 10\%$ [18,76]. Recent UK registry data showed an even lower rate of 6.3% [69], although much higher rates have been reported in patients who have advanced malignancies [34]. The SIR QI guidelines have suggested thresholds for PCN complications, including septic shock at 4%, septic shock in pyonephrosis at 10%, hemorrhage requiring transfusion using PCN alone at 4%, hemorrhage requiring transfusion using percutaneous nephrolithotomy at 15%, vascular injury requiring embolization or nephrectomy at 1%, bowel injury at <1%, pleural complications with PCN (pneumothorax, empyema, or hemothorax) at 1%, and pleural complications from percutaneous nephrolithotomy at 15% [72].

Adverse events are attributed mostly to catheter displacement, bleeding, and sepsis [69]. Potential risk factors for postprocedural sepsis include diabetes and renal calculi, but these have not been shown to be predictive of postprocedural infection [18].

Clinically asymptomatic bleeding is a common finding. Mild hematuria is present in approximately 50% of patients after PCN [69,77], and CT has shown evidence of retroperitoneal hemorrhage in 13% of patients [78]. Clinically significant bleeding, either into the collecting system or into the retroperitoneum, is less common [11,12,18,69,76]. Bleeding occurs more commonly in patients who have thrombocytopenia [18]. Persistent bleeding should prompt consideration of arteriographic evaluation for renal artery abnormality, such as pseudoaneurysms, fistulas, or frank extravasation [79]. These vascular injuries can almost always be treated using transcatheter embolization [80,81].

Less common complications related to PCN include bowel injury [48,82], splenic injury [83], gallbladder puncture [84], and pneumothorax [18,49]. Pneumothorax is more common when an upper-pole calyceal puncture is used [18], but occasionally such an intercostal approach may be necessary to allow optimal access for stone removal [49]. In uroepithelial neoplasms, tumor growth along the nephrostomy tract has been reported but is believed to be a very uncommon phenomenon [85]. As with any indwelling drainage catheters, PCN tubes are subject to fracture, dislodgement, and occlusion [86].

Summary

- Management of urinary obstruction varies depending on the obstruction location and local expertise.
- PCN placement is a highly successful procedure that has a relatively low complication rate and permits the relatively quick decompression of urinary obstruction, frequently preserving renal function.
- After decompressing an obstructed kidney, the obstruction is frequently managed on an elective basis, using percutaneous, endourologic, or surgical procedures.

Safety Considerations in Pregnant Patients

Imaging of the pregnant patient can be challenging, particularly with respect to minimizing radiation exposure and risk. For further information and guidance, see the following ACR documents:

- [ACR Practice Guideline for Imaging Pregnant or Potentially Pregnant Adolescents and Women with Ionizing Radiation](#)
- [ACR-ACOG-AIUM Practice Guideline for the Performance of Obstetrical Ultrasound](#)
- [ACR Manual on Contrast Media](#)
- [ACR Guidance Document for Safe MR Practices](#)

Supporting Documents

- [ACR Appropriateness Criteria® Overview](#)
- [Evidence Table](#)

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The ACR Committee on Appropriateness Criteria and its expert panels have developed criteria for determining appropriate imaging examinations for diagnosis and treatment of specified medical condition(s). These criteria are intended to guide radiologists, radiation oncologists and referring physicians in making decisions regarding radiologic imaging and treatment. Generally, the complexity and severity of a patient's clinical condition should dictate the selection of appropriate imaging procedures or treatments. Only those examinations generally used for evaluation of the patient's condition are ranked. Other imaging studies necessary to evaluate other co-existent diseases or other medical consequences of this condition are not considered in this document. The availability of equipment or personnel may influence the selection of appropriate imaging procedures or treatments. Imaging techniques classified as investigational by the FDA have not been considered in developing these criteria; however, study of new equipment and applications should be encouraged. The ultimate decision regarding the appropriateness of any specific radiologic examination or treatment must be made by the referring physician and radiologist in light of all the circumstances presented in an individual examination.