

Ureteral rupture from aberrant Foley catheter placement: A case report


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ABSTRACT

We present the case of a 59 year old female with history of severe neurologic dysfunction from advanced multiple sclerosis who presented with lethargy and oliguria several hours after urethral Foley catheterization. A contrast-enhanced CT scan of the abdomen/pelvis showed an aberrantly placed Foley catheter with its balloon inflated in the proximal left ureter, a rare complication of Foley catheterization with only 5 other cases reported. Incomplete ureteral rupture was demonstrated and confirmed by a followup CT scan in the urographic phase. One of our institution's Interventional Radiologists then placed a nephroureteral stent across the injured ureter to facilitate healing. The patient expired 9 days after the procedure from unrelated sepsis from a chronic stage IV decubitus ulcer, so long term monitoring could not be performed. Following description of our case, we conduct a literature review of presentations, imaging characteristics, and treatment of ureteral Foley catheter placement.

CASE REPORT

CASE REPORT

We present the case of a 59 year old female who presented from a nursing home with increased lethargy and poor urine output. Her past medical history was significant for advanced progressive multiple sclerosis with autonomic dysreflexia and low baseline functional status, incontinence with chronic indwelling Foley catheter, cirrhosis, type II diabetes mellitus, stage IV sacral and right buttock ulcers, and severe thoracolumbar dextroscoliosis. Vital signs were unremarkable at the time of admission. The patient presented to our institution with a 16Fr Foley catheter which had been placed several hours prior to her admission, with oliguria noted since catheter placement. A urine sample was collected from the small amount of urine which was present in the patient's Foley collection bag and sent for urinalysis. The urine was noted to have a red gross color, with a "large" amount of blood (>182 RBC/HPF, normal = 0 RBC/HPF),

moderate bacteria, and mucus confirmed by microscopic exam. Initial lab reports were significant for leukocytosis (WBC of 15,500/mcL, normal = 4,800 - 10,800/mcL), hemoglobin of 8.5 g/dL (normal = 12.0 - 16.0 g/dL), and a glucose level of 176 mg/dL (normal = 70 - 110 mg/dL). Despite the oliguria, BUN and creatinine were 9 mg/dL (normal = 5 - 20 mg/dL) and 0.8 mg/dL (normal = 0.5 - 1.2 mg/dL), respectively (values near the patient's baseline).

A CT scan of the abdomen/pelvis with oral and intravenous contrast demonstrated an inflated Foley catheter balloon in the proximal left ureter with resultant severe ureteral dilatation (up to 4.0 cm) with adjacent air locules and hematoma which implied ureteral rupture. There was new moderate left hydronephrosis and proximal hydroureter, with air locules also noted in the dilated left renal collecting system (see figures 1a-1d), as well as new pancolitis. Severe thoracolumbar dextroscoliosis, bilateral pleural effusions,

ascites, anasarca, hepatic cirrhosis, and cholelithiasis were redemonstrated and unchanged from the patient's most recent prior CT examination (from roughly two months prior).

The malpositioned Foley catheter was subsequently urgently removed after balloon deflation. Delayed (by about 5 hours) images without further oral/intravenous contrast administration were obtained for urographic phase evaluation (figures 2a-2d). These images confirmed left midureteral disruption, as contrast extravasation into a contained collection was seen at the level of the previously noted malpositioned Foley balloon. Interval improvement of left collecting system dilatation was seen with mild to moderate residual. Intraluminal filling defects (likely from clotted blood) were also observed in left upper pole calyces. The right renal collecting system remained unremarkable. A Foley catheter was now seen within the bladder. No other significant changes were seen.

The patient was taken to the Interventional Radiology suite (figures 3a-3d). After gaining access to a left upper pole calyx, antegrade contrast injection showed significant dilatation of the left midureter with contrast extravasation in the expected location of rupture. Successful passage of a Berenstein catheter and guidewire down the intact portion of the perforated ureter required several attempts, as the guidewire routinely exited the ureter at its point of discontinuity. After successful passage into the bladder, an 8Fr x 24 cm nephroureteral stent was advanced over the guidewire into position, and its distal end was then pigtailed in the bladder. A post-procedure contrast bolus confirmed successful bypass of the ureteral rupture. The proximal catheter end was secured and connected to gravity drainage to promote ureteral healing.

Shortly following the procedure, the patient's oliguria resolved. However, clinical status continued to decline as a result of sepsis from osteomyelitis of stage IV sacral decubitus and right buttock ulcers (blood cultures were positive for polymicrobial growth). The patient unfortunately expired about 9 days after the procedure, thus prohibiting monitoring of ureteral healing and long-term outcome.

DISCUSSION

Injury to the ureter is usually iatrogenic or from external trauma [1,2]. Iatrogenic injury is seen following urologic (42%), gynecologic (34%), and general surgical (24%) procedures, with the vast majority of injury seen to the distal ureter (91%) [1]. Possible ureteral injuries from such procedures include perforation, stricture, transection, avulsion, false passage, intussusception, and prolapse into the bladder [1].

The two most common complications of Foley catheter placement are urethral trauma and retention of the Foley balloon in the urethra [3]. Inadvertent placement of a Foley balloon within the ureter is a rare complication of urethral catheterization, with only six cases reported in the medical literature [4-9]. Three of these involved the right ureter [4,5,9]

and three involved the left ureter [6,7,8], (with our case making a fourth).

Patient presentations were variable, as two patients presented with persistent urine leakage [6,7], one patient presented with groin pain [5], another with back pain [7], and two patients were asymptomatic with aberrant Foley catheter placement discovered incidentally during laparotomy [8,9]. Hydroureteronephrosis can also be a presentation, as it was in a case of Foley catheter placement at the ureteral orifice (as well as our case) [10]. Interestingly, in four of the five cases, the patient had a chronic indwelling Foley catheter [4-6, 9], and in two of the five cases there was a history of paraplegia [4,9]. While our patient also had a chronic indwelling catheter and significant neurologic dysfunction (although not frank paraplegia), it is unknown if and how these factors are related to ureteral passage of a Foley catheter. Although a patulous ureter would be an expected risk factor, it was only reported in one case [6]. It has also been argued that ureteral catheterization is more common when the patient is catheterized with an empty bladder [11].

On imaging, an aberrantly placed Foley balloon would have a similar appearance if placed in the bladder, but the balloon will be seen along the expected course of a ureter. Since patient presentation is quite variable, additional findings would also vary depending on which associated complications the patient had sustained.

As our case well demonstrates, on CT, the aberrantly placed Foley balloon will be seen as an easily recognizable spherical hypodense structure filled with water attenuation. Hydroureter and hydronephrosis may sometimes be seen. Should ureteral rupture be present, then a urine collection (likely of water density, unless admixture with blood is present) will be seen in the area of rupture and possibly in the dependent region of the pelvis. On contrast-enhanced CT, urographic phase imaging will show contrast extravasation in the region of rupture with resultant free contrast in the abdomen and pelvis. As with our patient, air may also be seen in the collecting system following ureteral rupture (and presumably in small amounts in the peritoneum, although this was not visualized in our patient), likely originating from insertion of the catheter and/or balloon inflation.

Similarly, abdominal radiographs would show the aberrant Foley balloon shadow along the expected course of a ureter instead of its expected location in the bladder. Enlargement of the renal shadow will be seen if there is accompanying hydronephrosis, and a tiny amount of intraperitoneal free air may be detected on an upright or decubitus view.

On ultrasound, a spherical hypoechoic (or anechoic if inflated with pure water) Foley balloon may be seen in the abdomen (based on technique and operator ability). More proximal hydroureter and hydronephrosis may also be seen due to ureter obstruction. If the ureter is ruptured, it is feasible that a urine jet may be detectable with extravasation of urine from the more proximal ureter stump. Intense shadowing and "comet tail" artifacts from air may be seen in the area of rupture or in the collecting system.

On MRI, the aberrant Foley balloon will be seen as a spherical T2 hyperintense structure in a ureter. Should there be accompanying hydronephrosis, then enlargement of the affected kidney with loss of corticomedullary differentiation on T1WI, enlargement and T2 hyperintensity of the collecting system, increased signal intensity on diffusion weighted imaging, and decreased apparent diffusion coefficient will be seen [12]. If ureteral rupture is present, extravasated urine will be seen as T2 hyperintense fluid collections in the region of rupture or the pelvis.

Foley balloon placement in the bladder should be confirmed prior to inflation by urine aspiration [9]. If aberrant placement is suspected, the diagnosis can be confirmed with CT (as in our case), ultrasound (although this is quite operator dependent) [10], or emergent cystoscopy [5]. If inadvertent ureteral catheterization is strongly suspected or confirmed, then consideration can be given to attempt removal by gentle pulling on the catheter after deflating the bulb [13]. Surgical treatment may also be warranted.

If ureteral injury is present, management requires either stent placement or surgery depending on the type of injury and elapsed time until detection [14]. If the injury is recognized late and there are complications that would interfere with ureteral healing such as abscess formation, urinary tract infection, or urinary fistula formation, then proximal urinary drainage by percutaneous nephrostomy should be performed [14]. These patients should also be monitored for ureteral stricture development over the following months/years [15].

In the six cases of ureteral Foley balloon inflation described above, five patients sustained ureteral injury. Two patients [4,8] experienced successful ureteral healing within 4 weeks, one of which was treated with nephrostomy [4], and the other with nephroureteral stent [8]. Another patient [5] required endoscopic incision of the ureteral orifice and catheter removal. Another patient [7] received a ureteral stent and recovered with persistent ureteral dilatation. The last patient who required treatment received uretero-ileal anastomosis and the formation of an ileal conduit [8]. The patient with a patulous ureter did not have ureteral injury [6].

Inadvertent ureteral placement of a Foley catheter is a rare complication of urethral catheterization, with our patient being the sixth such reported case in the medical literature. Given the incredibly frequent performance of Foley catheterization, we believe that this case is important to highlight potential patient presentations, imaging appearances, and treatment options of Foley catheterization of the ureter, a complication which clinicians and radiologists may have been unfamiliar with.

TEACHING POINT

Inflation of a Foley balloon inadvertently placed in a ureter will cause high-grade ureteral obstruction with resultant unilateral hydronephrosis and possible ureteral rupture with urine/contrast collection formation. The injured ureter may be either stented or surgically repaired.

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FIGURES

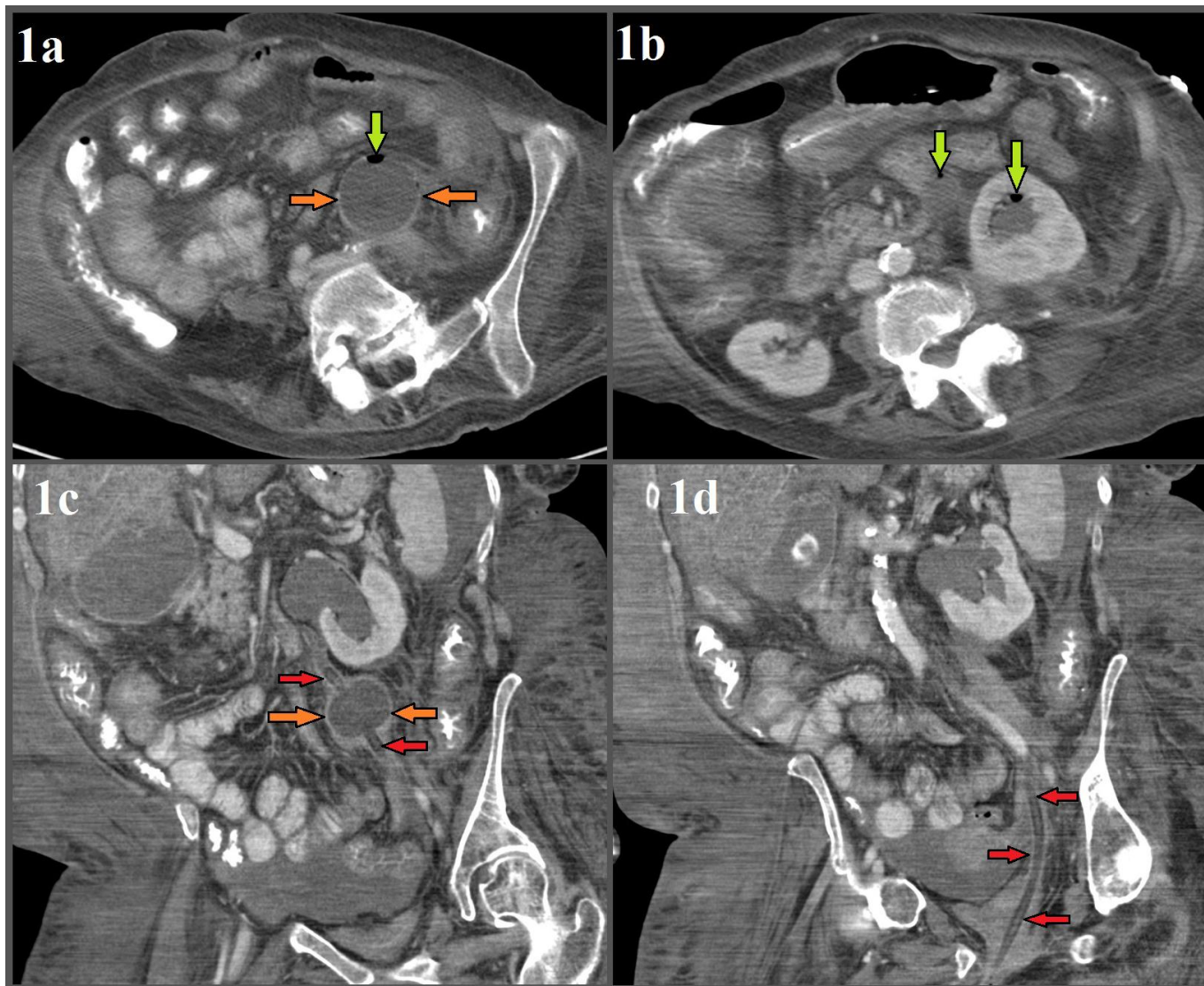


Figure 1: 59 year old female with ureteral rupture following placement of a Foley catheter balloon. Axial (1a-1b) and coronal (1c-1d) images from a CT with oral/intravenous contrast (arterial phase) using soft tissue windows showed a Foley catheter (red arrows) with an inflated balloon (orange arrows) in the proximal left ureter with air locules (green arrows) which tracked superiorly into the dilated more proximal ureter and collecting system, findings which collectively implied ureteral rupture. Pancolitis, anasarca, bilateral pleural effusions, ascites, and scoliosis were also seen (not marked by arrows since not directly relevant to acute diagnosis).

The CT was performed on a GE® 64-slice CT scanner. All images are from the patient's initial abdomen/pelvis CT scan performed about 60 seconds following administration of 70cc of Ultravist® 300 nonionic intravenous contrast (for arterial phase evaluation). The patient had ingested about 1 liter of oral barium contrast about 90 minutes prior to scanning. Standard soft tissue windows were used (width = 350, center = 50). 5mm axial slices were acquired, using 140 kVp and variable mAs, which ranged from 218 mAs to 387 mAs for the provided axial images.

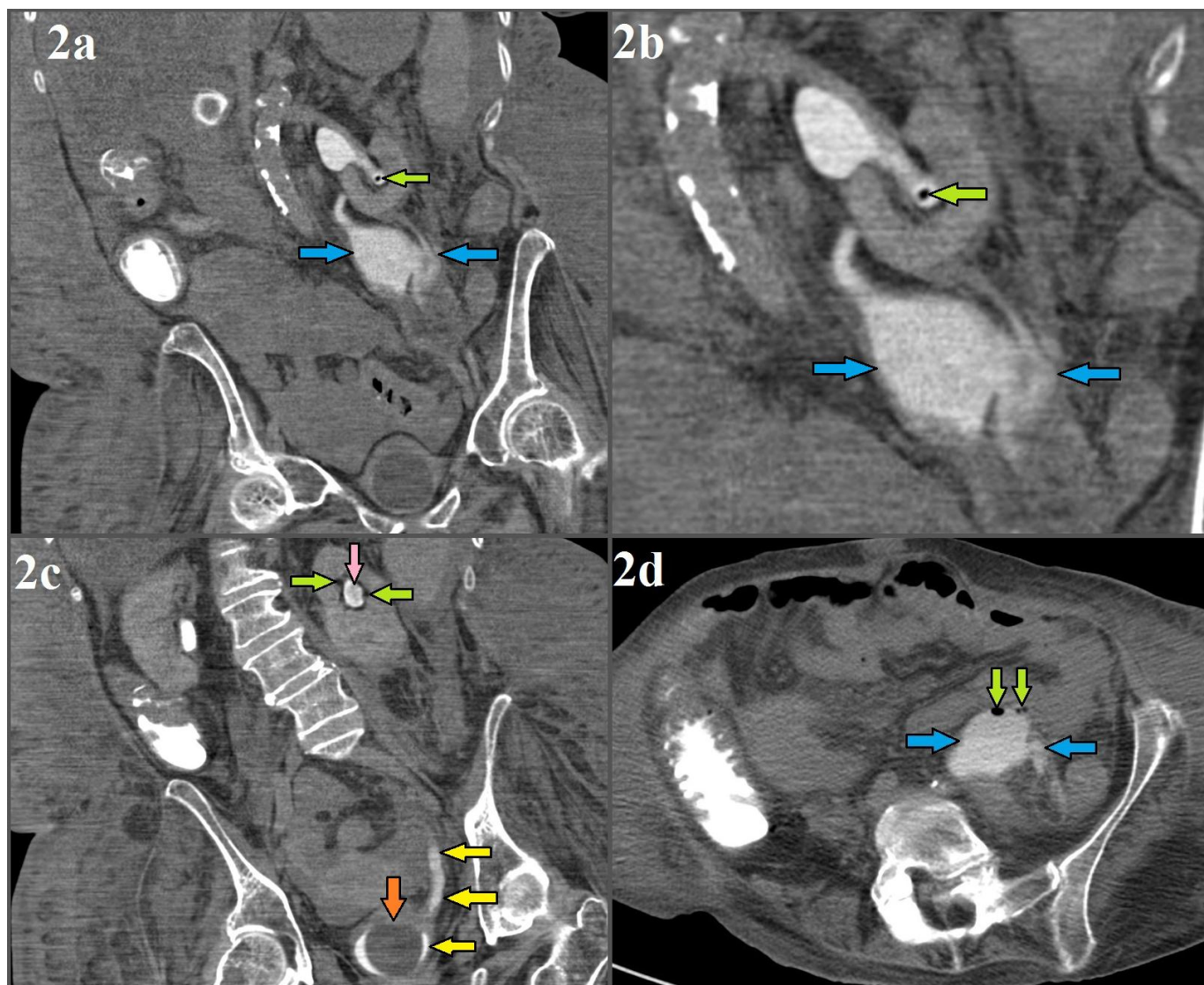


Figure 2: 59 year old female with ureteral rupture following placement of a Foley catheter balloon. Coronal (figure 2a, magnification view as figure 2b, and a more posterior cut as figure 2c) and axial (figure 2d) images from a delayed (by about 5 hours) CT scan of the abdomen/pelvis without further contrast injection from the immediate prior, which showed left ureteral contrast extravasation with formation of a contained collection at the site of ureteral rupture (blue arrows). Air (again marked by green arrows) and filling defects (likely blood/clot, pink arrow in figure 2c) were seen in the left collecting system. Some contrast was seen passing through the more distal left ureter into the bladder (yellow arrows), which indicated that some of the ruptured ureter was intact. There was marked interval improvement of left renal collecting system dilatation from relief of the acute ureteral obstruction, as there had been interim removal of the malpositioned Foley catheter. The Foley balloon was now seen properly positioned in the bladder (orange arrow). Contrast is also seen in the right renal collecting system. Pancolitis, cholelithiasis, scoliosis, anasarca, and ascites were again seen without change (again not marked).

The CT was performed on a GE® 64-slice CT scanner. The abdomen/pelvis CT scan was performed about 5 hours after the prior CT depicted in figures 1a-1d without further intravenous/oral contrast administration. Standard soft tissue windows were used (width = 350, center = 50). 5mm axial slices were acquired, using 120 kVp and variable mAs, which ranged from 202 mAs to 385 mAs.

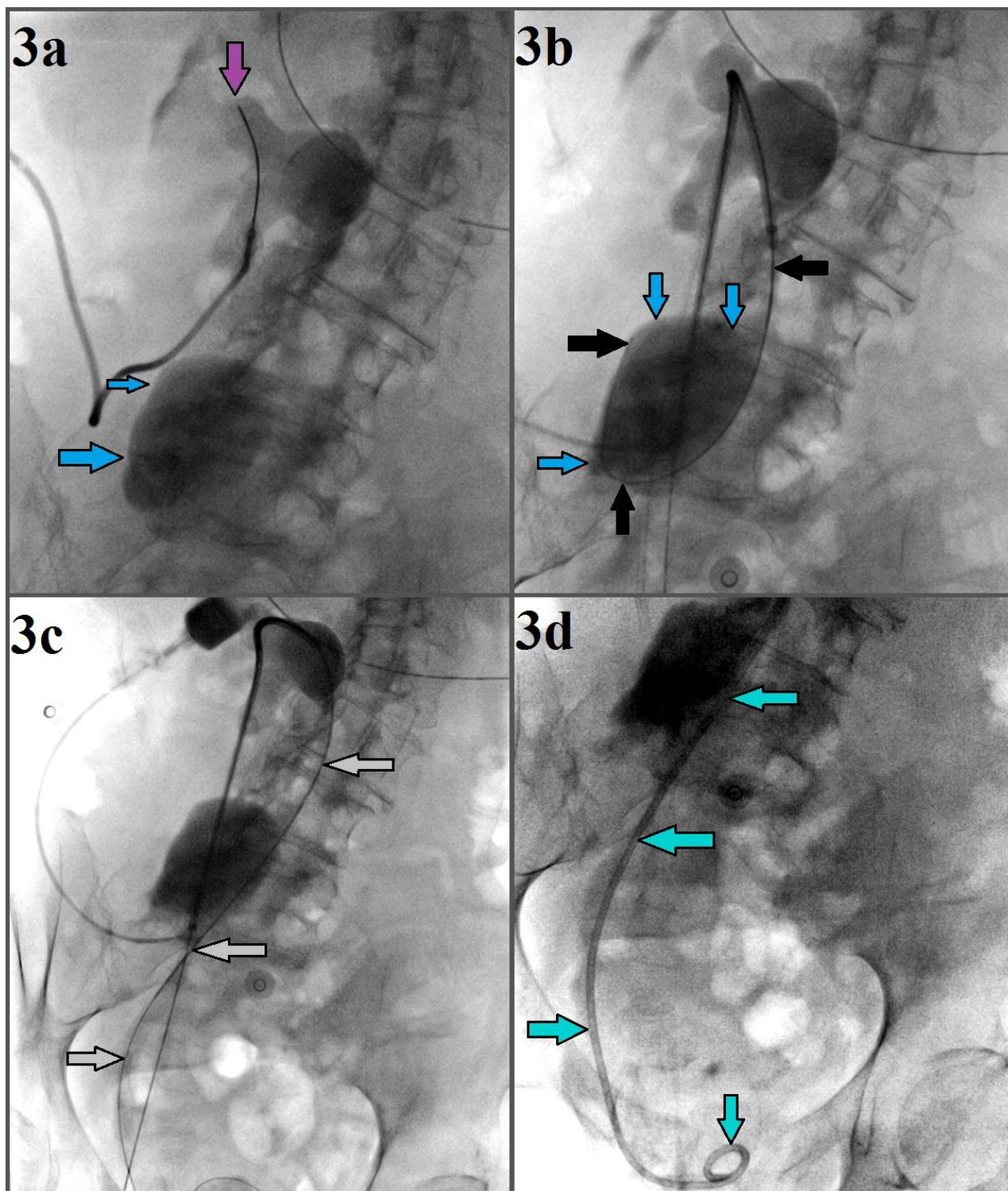


Figure 3: 59 year old female with ureteral rupture following placement of a Foley catheter balloon. Selected fluoroscopic images from the patient's nephroureteral stent placement procedure which occurred about 90 minutes after the followup CT depicted in figures 2a-2d. Needle access was gained to a left upper pole calyx (purple arrow, figure 3a) and the collecting system distended with contrast. The known contrast collection from proximal ureteral rupture was again seen (again marked with blue arrows). A guidewire (marked with black arrows) was then passed down the ureter, where it repeatedly exited the ureter at its site of rupture and entered the contained contrast collection (again marked by blue arrows, figure 3b). After several attempts, a Berenstein catheter (grey arrows) was advanced over a guidewire and successfully passed through the intact portion of the left ureter and into the bladder (image 3c). A nephroureteral stent (turquoise arrows) was then passed over the guidewire and into the bladder, where its distal end was pigtailed (image 3d).

The fluoroscopy was acquired about 90 minutes following the followup CT scan depicted in figures 2a-2d on a GE® fluoroscopy machine. Penetration settings were variable (figure 3a: 66.1kV and 157.0 mAs, figure 3b: 68.4 kV and 97.0 mAs, figure 3c: 68.4 kV and 96.0 mAs, figure 3d: 65.0 kV and 135.0 mAs). About 30cc of Ultravist® 300 nonionic intravenous contrast were used during the procedure.

Etiology	Improper placement of a Foley catheter balloon in the ureter instead of desired intra-vesicular positioning.
Incidence	Rare, only 5 other cases reported.
Gender ratio	None reported.
Age predilection	None reported.
Risk factors	-No definite established risk factors. -However, there are arguments that a patulous ureter or Foley catheterization in a patient with an empty bladder would increase likelihood of ureteral catheterization. -Our case and literature review show an increased incidence of significant neurologic dysfunction and chronic indwelling Foley catheter, although the exact nature of this association is unknown
Treatment	-Varies and depends if ureteral injury is present. -If there is ureteral injury, either stent placement or surgery should be considered. -If ureteral injury is recognized late and/or there have been complications which would affect ureteral healing, then proximal urinary drainage should be achieved [14].
Prognosis	Good, as the injured ureter appears to heal following stent placement.
Findings on imaging	<i>Radiography</i> - Foley balloon opacity may be discernible in an unexpected abdominal location with associated unilateral renal shadow enlargement from hydronephrosis. If upright or decubitus views were obtained, a very small amount of pneumoperitoneum may be seen. <i>CT</i> - Ureteral Foley balloon should be readily seen as a spherical, fluid-filled structure connected to tubing. Adjacent (and dependent) fluid/contrast collection and free air may be seen which would suggest ureteral rupture. <i>Ultrasound</i> - Although operator dependent, hypoechoic/anechoic spherical Foley balloon may be seen with possible associated ipsilateral hydronephrosis and adjacent (or dependent) fluid collection. Should air be encountered from ureteral rupture, shadowing and “comet tail” artifacts may be seen. <i>MRI</i> - Aberrant Foley balloon should be easily seen as a T2 hyperintense spherical structure. Renal enlargement, loss of T1 corticomedullary differentiation, increased diffusion weighted imaging signal, decreased apparent diffusion coefficient, and enlargement/T2 hyperintensity of the collecting system will be seen if hydronephrosis is present [12]. If there is ureteral injury, extravasated urine will be seen as T2 hyperintense fluid collections in the region of rupture or the pelvis.

Table 1: Summary table for ureteral rupture from aberrant Foley catheter placement

Imaging modality	Findings
Radiography	-Foley balloon shadow may be seen in the affected hemiabdomen. -Ipsilateral renal shadow enlargement if hydronephrosis is present. -A tiny amount of free air may also be seen if ureteral rupture has occurred.
CT	-An incorrectly placed fluid-filled Foley balloon should be readily seen in a ureter. -Hydronephrosis may also be seen. -Free air locules and a fluid collection may be seen in the region of rupture or elsewhere in the abdomen/pelvis if ureteral rupture occurred.
Ultrasound	-Highly operator dependent. -Hypoechoic/anechoic, fluid-filled Foley balloon may be seen. -Ipsilateral hydronephrosis, and a pelvic fluid collection may also be seen, should ureteral obstruction and rupture be present, respectively.
MRI	-Spherical, T2 hyperintense Foley balloon will be seen in a ureter -Possible ipsilateral hydronephrosis (as suggested by decrease in T1W corticomedullary differentiation, collecting system prominence and increased T2 signal, increased diffusion signal, and decreased apparent diffusion coefficient [12]). -T2 hyperintense fluid collection may be seen in the pelvis or region of ureteral rupture, should it present.

Table 2: Differential diagnosis table for ureteral rupture from aberrant Foley catheter placement.

In light of the highly unique appearance of a Foley catheter seen along the course of a ureter with possible associated hydronephrosis and/or ureteral rupture, there are essentially no other diagnostic considerations which could create a similar radiologic presentation. Thus, the differential table has been limited to a single diagnosis.

ABBREVIATIONS

- BUN - blood urea nitrogen
- CT - computed tomography
- HPF - high power field
- MRI - magnetic resonance imaging
- RBC - red blood cell
- T1WI - T1 weighted images
- WBC - white blood cell

KEYWORDS

Ureteral Foley placement; ureteral rupture; ureter; Foley; interventional radiology case report; urinary obstruction

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