DIAGNOSIS AND MANAGEMENT OF URETEROILIAC ARTERY FISTULA: VALUE OF PROVOCATIVE ARTERIOGRAPHY FOLLOWED BY COMMON ILIAC ARTERY EMBOLIZATION AND EXTRAANATOMIC ARTERIAL BYPASS GRAFTING

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ABSTRACT

Purpose: We describe an effective multidisciplinary approach to the diagnosis and management of ureteroorarterial fistulas that reduces morbidity and mortality.

Materials and Methods: Five ureteroorarterial fistulas in 4 patients were studied with standard and provocative arteriography (arteriography combined with ureteral manipulation). After establishing the diagnosis, each lesion was treated with percutaneous embolic occlusion of the common iliac artery followed by extraanatomic arterial bypass grafting. All patients had chronic ureteral stenting, prior pelvic irradiation, prior pelvic surgery and intrapelvic malignancy, and all fistulas presented with urinary tract hemorrhage.

Results: Standard arteriography was nondiagnostic but provocative arteriography demonstrated the fistula in each case. Successful embolization of the common iliac artery followed by extraanatomic arterial bypass grafting precluded the need for laparotomy and preserved ipsilateral renal function.

Conclusions: Provocative arteriography followed by arteriographic common iliac artery embolization and extraanatomic bypass grafting was successful for the diagnosis and treatment of ureteroorarterial fistulas. There was no mortality, limb loss or renal loss.

KEY WORDS: ureter, fistula, hemorrhage, stents, radiation

Ureteroorarterial fistulas are rare with a reported mortality of nearly 40%. Risk factors associated with the development of ureteroorarterial fistulas include pelvic surgery, pelvic malignancy, pelvic radiation, pelvic vascular disease and chronic ureteral intubation. Diagnosis is difficult in the absence of active bleeding. We describe our multidisciplinary approach to the diagnosis and management of 5 ureteroorarterial fistulas in 4 patients, which resulted in salvage of all affected renal units and no mortality (see table). Cases 3 and 4 have been reported previously in the radiological literature.1

CASE HISTORIES

Case 1. A 24-year-old woman was referred for evaluation of gross hematuria. Unresectable osteosarcoma of the sacrum was diagnosed 7 years previously, which was treated with combination chemotherapy and 7,000 cGy. external beam radiation. Radiation cystitis, proctitis and enterocolitis were treated with small bowel resection, right hemicolectomy and jejunostomy. Bilateral distal ureteral stenosis developed, and chronic bilateral ureteral stenting was instituted 6 years previously.

At fluoroscopic assisted right ureteral stent exchange 7 weeks before presentation brisk, bloody ureteral efflux was present upon stent removal. The stent was replaced over a guide wire, and bleeding subsided after approximately 3 minutes. At repeat right ureteral stent exchange 2 days before presentation brisk, bloody ureteral efflux was present again upon stent removal and, subsided with stent replacement. The following day clot retention developed which was treated with continuous bladder irrigation. Three units of packed red blood cells were transfused because of persistent hemorrhage.

Arteriography was performed from a left common femoral artery approach. Initial pelvic arteriography failed to demonstrate extravasation (fig. 1, A). Therefore, bleeding was provoked by removing the right ureteral stent over a guide wire. brisk bleeding ensued during which selective arteriography demonstrated extravasation of contrast material from the right common iliac artery to the distal right ureter (fig. 1, B). Bleeding was quickly controlled by intraureteral placement of a 4 cm. × 6 mm. angioplasty balloon catheter over the guide wire and inflating the balloon in the region of the fistula. The right common iliac artery was successfully occluded by coil embolization (fig. 1, C). Axillobifemoral bypass was performed because of severe coexisting pelvic vascular disease. The right ureteral stent was replaced uneventfully.

A year later gross hematuria recurred during contralateral ureteral stent exchange. Again standard arteriography failed to demonstrate the lesion. The stent was removed over a guide wire. An angioplasty balloon catheter was advanced over the wire to the level of the left iliac artery overpass. The catheter was alternately advanced and withdrawn until bleeding was provoked. Arteriography then demonstrated a left ureteroorarterial fistula. Arteriographic coil occlusion of the left common iliac artery was performed, followed by revision of the axillobifemoral bypass graft. No ischemic complications developed. At 6-month followup, peripheral vascular studies were normal, and the ureters remained stent dependent.

Case 2. A 68-year-old woman came to the emergency room with clot retention. Endometrial carcinoma was diagnosed 21 years previously, which was treated with 115 mg. intruterine radium implants, followed by abdominal hysterectomy.

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<table>
<thead>
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<th>Case No.</th>
<th>Risk Factors</th>
<th>Precipitating Incident</th>
<th>Treatment</th>
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<tr>
<td>1</td>
<td>Osteosarcoma of sacrum, radiation, bowel surgery, chronic ureteral stenosis × 5 yrs.</td>
<td>Rt. ureteral stent exchange</td>
<td>Rt. common iliac artery embolization, auxiliary artery-to-femoral artery bypass graft, ureteral stent replacement</td>
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<td>2</td>
<td>Endometrial Ca, radiation, hysterectomy, coectomy, partial cystectomy, Lt. nephrectomy, chronic ureteral stent × 12 yrs.</td>
<td>Stent exchange</td>
<td>Common iliac artery embolization, cross femoral artery bypass graft, temporary nephrostomy, ureteral stent replacement</td>
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<tr>
<td>3</td>
<td>Squamous cell Ca cervix, radiation, pelvic exenteration, chronic ureteral stents × 4 mos.</td>
<td>Stent exchange</td>
<td>Common iliac artery embolization, cross femoral artery bypass graft, ureteral stent replacement</td>
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<tr>
<td>4</td>
<td>Squamous cell Ca cervix, Radiation, pelvic exenteration, chronic ureteral stents × 10 mos.</td>
<td>Pancytopenia</td>
<td>Common iliac artery embolization, cross femoral artery bypass graft, ureteral stent replacement</td>
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Pelvic arteriography was nondiagnostic and provocative arteriography was diagnostic in all cases.

Subsequently, adenocarcinoma of the colon developed with multiple recurrences that were treated with total colectomy and ileostomy. Left nephroureterectomy, partial cystectomy, and partial cystectomy were performed 12 years previously because of pelvic recurrence of endometrial carcinoma, and 5,000 cGy external beam radiation were delivered to the pelvis. Chronic renal failure and stent dependent right distal ureteral stent stenosis developed. At fluoroscopic assisted right ureteral stent exchange 2 days before presentation brisk, bloody ureteral efflux occurred on stent removal, which resolved minutes after stent replacement, and 2 days later clot retention developed which was treated with continuous bladder irrigation. Six units of packed red blood cells were transfused during the next 4 days because of intermittent hemorrhage and hypotension.

An initial pelvic arteriogram was normal. The right ureteral stent was removed over a guide wire. brisk bleeding ensued. Arteriography revealed a fistula between the right common iliac artery and the distal right ureter. Hemorrhage was quickly tamponaded by intraureteral injection of an angioplasty balloon during coil embolization of the right common iliac artery (fig. 2). Femoral-to-femoral arterial bypass grafting was performed. A percutaneous nephrostomy tube was placed and later removed after successful placement of a ureteral stent. No further intervention was required. At 27-month followup the ureter remained stent dependent.

Case 3. A 53-year-old woman was referred for evaluation of gross hematuria. Squamous cell carcinoma of the cervix was diagnosed 20 years previously, which was treated with intracavitary and external beam radiation to the pelvis. Pelvic exenteration and ileal conduit urinary diversion were performed most commonly for pelvic malignancy.

**Summary of risk factors and treatment results in 4 patients with ureteroarterial fistula**

The right ureteral stent was removed over a guide wire and significant hemorrhage ensued from the conduit stoma. Bleeding was rapidly tamponaded by placement of an angioplasty catheter over the guide wire and inflating the balloon over the ureterocolonic anastomosis. Pelvic arteriography after deflating the balloon failed to demonstrate the fistula. The deflated balloon was then alternately advanced and withdrawn until active bleeding was provoked. Simultaneous arteriography demonstrated a fistula between the right common iliac artery and the distal right ureter. Coil embolization of the right common iliac artery was performed, followed by femoral-to-femoral bypass grafting. The right ureteral stent was replaced. At 10-month followup, no further intervention had been required.

Case 4. A 43-year-old woman was referred for evaluation of gross hematuria. Invasive squamous cell carcinoma of the cervix was diagnosed 19 months before presentation, which was treated with pelvic exenteration, ileal conduit urinary diversion and external beam radiation. Stent dependent left distal ureteral obstruction developed 9 months later, and gross hematuria developed due to hospitalization for chemotherapy-induced pancytopenia.

Because the history was suggestive of a ureteroarterial fistula, the left iliac artery was catheterized from the right femoral approach before stent manipulation. The right ureteral stent was removed over a guide wire and no significant bleeding occurred. The initial left common iliac arteriogram was normal. A deflected angioplasty catheter was positioned over the guide wire at the site of the ureterocolic artery overpass. The catheter was moved back and forth several times until pulsatile hemorrhage developed. Subsequent arteriography demonstrated a left common iliac artery to right distal ureteral fistula. Bleeding was controlled by inflating the angioplasty balloon, the left common iliac artery was embolized with coil springs and the ureteral stent was replaced. Femoral-to-femoral bypass grafting was performed. No further intervention was required.

**DISCUSSION**

Ureteroarterial fistula is a rare but potentially increasing problem. The number of reported cases of ureteroarterial fistulas has increased during the last 15 years (fig. 3). In 1990, 1 of us (F. S. K.) reported a review of 28 well-documented cases of ureteroarterial fistulas. A recent search of the literature revealed an additional 26 cases of ureteroarterial fistulas. Before 1980 only 13 cases had been reported, 19 cases were reported in the 1980s, and between 1990 and 1994 more ureteroarterial fistulas were reported than in the entire preceding decade.

**Morbidity and mortality.** Ureteroarterial fistulas result in significant morbidity and mortality. Mortality in cases reported before 1980 was 69% (9 of 13 reported cases). Since 1980 the mortality rate has decreased to 23% (10 of 43 reported cases), resulting in a cumulative mortality rate of 34% (6, 8, 16, 18, 20, 21). Exploratory laparotomy was performed in 88% of reported patients (7 patients who died before intervention were excluded from this analysis). The patients 32% lost function of the ipsilateral renal unit to nephrectomy, renal artery embolization, ureteral ligation without drainage or renal irradiation. Of the patients 89% had a history of pelvic surgery, which was performed most commonly for pelvic malignancy.

URETEROARTERIAL FISTULA

FIG. 1. Case 1. A, pelvic arteriogram shows caliber of common iliac artery within normal limits and no evidence of contrast material extravasation. B, selective right common iliac arteriogram after removal of right ureteral stent demonstrates rapid extravasation of contrast material into right distal ureter (arrows). C, pelvic arteriogram after coil embolization of right common iliac artery reveals occlusion of right common iliac artery with no further contrast material extravasation into right ureter. Faint opacification of distal right external iliac artery is noted from collateral reconstitution (arrow).

FIG. 2. Case 2. Radiograph shows 4 cm. x 6 mm. angioplasty balloon inflated in right ureter to prevent hemorrhage during procedure (arrows).

FIG. 3. Increase in number of reported cases of ureteroarterial fistulas during last century. Each data point represents total number of cases reported since previous data point.

(30 cases, 59%) 1, 2, 5, 7, 8, 11, 14, 15, 19-22 and pelvic vascular disease (17 cases, 33%). 1, 3, 6, 9, 12, 13, 16-18 Ureterolithotomy was done in 5 patients and appendectomy in 1. 1 The most common malignancies associated with the development of ureteroarterial fistulas are uterine (cervical or endometrial carcinoma, 16 cases) and transitional cell carcinoma of the bladder (11 cases). Most patients with prior surgery for vascular disease had bypass grafting for arterial aneurysms or severe atherosclerosis (10 cases). 3, 6, 9, 12, 13, 17 Three patients had only common iliac endarterectomy, 14 and at least 3 patients had common iliac aneurysms diagnosed only at the time of evaluation for hematuria. 4, 29, 31 Of the patients with ureteroarterial fistulas 43% also had received pelvic irradiation, and all of them also had undergone prior pelvic surgery. We are aware of no reports of ureteroarterial fistulas in patients who received pelvic radiation only (that is without surgery). Chronic ureteral intubation was noted in 67% of patients with ureteroarterial fistulas. The duration of ureteral intubation before development of the fistula was noted in 23 cases, the median of which was 4 months (range 15 days to 12 years). Ureteroarterial fistulas occurred with equal incidence in the left and right ureters. Prior pelvic surgery, irradiation and/or pelvic vascular disease should be considered relative contraindications to chronic ureteral stenting.

Diagnosis and treatment. Ureteroarterial fistulas have been difficult to diagnose without surgical exploration. However, surgical exploration before establishing the diagnosis of ureteroarterial fistulas has resulted in increased mortality and morbidity. 1 Various techniques have been used in attempts to establish safely the diagnosis of fistula before surgical exploration. Despite the hemorrhage that accompanies these lesions, no imaging technique, including standard arteriography, has demonstrated better than 50% diagnostic sensitivity. Retrograde ureterography and arteriography are the most sensitive tests, yet they were only diagnostic in To our knowledge there are no reports of a fistula demonstrated on excretory urography.

Numerous types of vascular and urological interventions have been used for the treatment of ureteroarterial fistulas. However, there is no consensus regarding the most appropriate treatment for these lesions. The most common urological interventions are nephrectomy and ureteral ligation, 1, 4, 6-9, 13, 18, 20, 22 while others have attempted autotransplantation, renal irradiation and renal embolization. 1, 5, 22 Despite the morbidity associated with these procedures, none effectively treats the underlying pathology in the distal ureter. Massive hemorrhage from the ureteral stump may occur within 24 hours of nephrectomy or renal embolization. 1, 6, 20, 22

The most common vascular interventions include primary vascular repair (13 cases), 1, 5, 7, 9, 13, 15, 20, 22 iliac artery ligation with (3 cases) 2, 4, 14 or without (7 cases) 1, 8, 17, 18 femoral artery bypass, and placement of an arterial interposition graft (6...
cases). Some authors describe limb ischemia requiring delayed arterial bypass or limb amputation after common iliac artery arterial ligation, and others have reported death during open vascular repair.

Dauplat et al first described a case of ureteroarterial fistulas treated with arteriographic common iliac artery embolization followed by extraanatomic arterial bypass grafting in 1985. In 1992 Quillin et al reported 4 cases of ureteroarterial fistulas, the largest series to date. Their series included 2 patients who were treated successfully with arteriographic common iliac artery embolization followed by extraanatomic arterial bypass grafting, 1 treated with arteriographic internal iliac artery occlusion alone and 1 treated with primary vascular repair. To our knowledge, our series represents the largest to date describing ureteroarterial fistulas managed uniformly with common iliac artery embolization followed by extraanatomic arterial bypass grafting.

CONCLUSIONS

These cases demonstrate several points regarding the diagnosis and management of ureteroarterial fistulas. Although standard arteriography is frequently nondiagnostic, ureteroarterial fistulas can be demonstrated successfully by provocative arteriography (100% sensitivity in our experience). A standard initial arteriogram is performed, and if nondiagnostic, the indwelling ureteral stent is removed over a guide wire. If the suspect ureter is unstimulated, then the ureter is cystoscopically or percutaneously accessed with a guide wire. If no bleeding occurs a 4 cm × 6 mm. angioplasty balloon catheter is advanced over the wire to the ureteroarterial overpass. The deflated balloon is alternately advanced and withdrawn until bleeding is provoked, during which diagnostic arteriography is performed.

Ureteroliiac artery fistulas can be permanently managed by arteriographic coil embolization of the common iliac artery alone. This technique eliminates the morbidity associated with surgical exploration in these patients, many of whom have had previous radiation and pelvic surgery. Immediate revascularization of the ipsilateral lower extremity via extraanatomic arterial bypass grafting was uniformly successful in preventing lower extremity ischemia. Nearly all reported patients with ureteroarterial fistulas treated with common iliac artery ligation or embolization underwent simultaneous lower extremity revascularization or had undergone revascularization before fistula development. However, in select patients it has been possible to delay revascularization until evidence of ischemia developed, while in others revascularization has been avoided entirely.

Manipulation of chronic indwelling ureteral stents in patients with ureteroarterial fistulas may result in life threatening hemorrhage. The provoked hemorrhage can be effectively tamponaded by intraureteral placement of a 4 cm × 6 mm. angioplasty balloon catheter, although stent replacement alone may temporarily control the hemorrhage. After successful embolization, these stents may be exchanged safely and routinely for the management of chronic ureteral obstruction. A high index of suspicion is required for successful diagnosis and management of ureteroarterial fistulas. A proposed algorithm for the management of ureteroarterial fistulas is depicted in figure 4.

Ureteroarterial fistula is a rare but increasing problem with significant morbidity and mortality. Prior pelvic surgery, pelvic irradiation and long-term ureteral stenting are risk factors for the development of ureteroarterial fistulas. Although each case is unique and treatment options vary, arteriographic common iliac artery embolization followed by extraanatomic bypass grafting has been uniformly successful in treating these lesions with minimal morbidity and no mortality.

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