Midterm Follow-up of Ureteral Embolization Using Vascular Plugs and *N*-Butyl Cyanoacrylate Glue

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ABSTRACT

This is a retrospective study of 9 consecutive female patients who underwent ureteral embolization via a "sandwich" technique with two vascular plugs and *N*-butyl cyanoacrylate glue for ureteral fistulae unresponsive to urinary diversion. Average age was 61 years (range, 39–77 y), average duration of diversion was 48 days (range, 2–120 d), and average follow-up was 11 months (range, 4–23 mo). Seven patients (78%) experienced immediate resolution of urinary leakage, and the other 2 (22%) required unilateral repeat treatment for resolution of leakage. Symptom resolution lasted throughout the follow-up period for all patients. Bilateral internal iliac artery pseudoaneurysms developed in 1 patient and were treated with embolization and stent placement.

ABBREVIATION

NBCA = *N*-butyl cyanoacrylate

Urinary fistulae to the skin, bowel, or vagina are associated with a high rate of morbidity and can be difficult to manage clinically (1,2). They are frequently associated with or caused by gynecologic surgery, genitourinary malignancies, radiation therapy, inflammatory bowel disease, or a combination thereof (2). Primary surgical repair fails in as many as 35% of cases (2). These patients are frequently poor surgical candidates and are often treated initially with urinary diversion via percutaneous nephrostomy tubes. For patients with persistent urinary leakage, proximal ureteral occlusion can be employed to exclude the distal ureteral fistula (1,2). Many techniques have been described for ureteral occlusion, including the use of detachable balloons, gelatin sponge, coils, liquid embolic agents, and vascular plugs (1–7).

Previously, Saad et al (6) described a "sandwich" technique in three patients (five ureters) for ureterovaginal fistulae that involved *N*-butyl cyanoacrylate (NBCA; Trufill; DePuy Synthes, West Chester, Pennsylvania) injected between two AMPLATZER Vascular Plugs (St. Jude Medical, St. Paul, Minnesota) to achieve immediate and long-term occlusion (6).

The present report describes the use of the sandwich technique for occlusion in eight patients with ureterovaginal fistulae and one with ureteral injury after a complex postoperative course following bladder rupture. Included is a description of a major complication and steps that may help to avoid similar complications.

MATERIALS AND METHODS

A retrospective review from April 2007 to March 2014 yielded nine consecutive patients treated with plugs and NBCA for ureteral fistulae refractory to urinary diversion with nephrostomy tubes. Three of these patients were also previously presented by Saad et al (6). All patients were female, with an average age of 61 years (range, 39–77 y). Diversion was performed with 10-F nephrostomy tubes in eight patients and an 8-F tube in one patient. Average duration of diversion was 48 days (range, 2–120 d). Indications for occlusion included persistent urine leak in seven patients, which required an indwelling Foley catheter

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in five patients. Complex necrotizing perineal wounds developed in the other two patients and required ureteral occlusion for management. One patient underwent embolization for a persistent leak after iatrogenic ureteral injury following a complex postoperative course after interstitial cystitis, bladder rupture, cystectomy with ileal conduit, and parastomal hernia repair. All patients had undergone pelvic surgery, and six (67%) had undergone pelvic radiation therapy as well. Patient demographic data are summarized in the Table. Institutional review board approval was obtained per institutional requirements.

All patients underwent percutaneous ureteral occlusion with the use of plugs and NBCA via the method previously reported by Saad et al (6). Briefly, the technique involved delivery of an 8–12-mm plug via access obtained through an existing percutaneous nephrostomy tube, and through a vascular sheath into the ureter. A variety of sheaths were used, ranging in size from 6 F to 10 F. Next, a microcatheter was placed through a 5-F end-hole diagnostic catheter and used to instill 0.8–1.5 mL of NBCA glue into the ureter proximal to the plug. The NBCA glue was mixed with Lipiodol (Ultra Fluide GMP; Guerbet, Roissy, France) in a 1:1 or 1:2 ratio of NBCA to Lipiodol. The microcatheter and diagnostic 5-F catheter were removed, and a second plug was deployed in the ureter via the sheath immediately proximal to the glue.

An alternative method (Fig 1) involved deployment of a plug in the ureter and placement of an end-hole microcatheter proximally within the ureter. A second plug was then delivered via a sheath proximal to the tip of the microcatheter, and the NBCA:Lipiodol mixture was then injected in the intervening space.

In both techniques, a percutaneous nephrostomy tube was placed into the renal pelvis at the end of the procedure. The first technique was performed in three patients (five ureters), and the second technique was performed in six patients (10 ureters). When placing plugs, the manufacturer recommends 30%–50% oversizing in vascular structures. Use of the plugs and glue were off-label applications; therefore, there were no guidelines on appropriate sizing of plugs within the ureter, and sizing was left to the discretion of the operator. Technical success was defined as successful deployment of the plugs and injection of NBCA without reflux into the renal pelvis or proximal ureter. Clinical success was defined as resolution or reduction of leakage to an extent that no more than one vaginal pad was required per day (4,8). Follow-up was performed in the interventional radiology department during routine nephrostomy tube changes.

RESULTS

Fifteen ureters were occluded in nine patients during a 7-year period. Two plugs were used per ureter in eight patients. Patient 5 (Table) required placement of three plugs in the distal left ureter as a result of incomplete initial occlusion. Three patients underwent occlusion as outpatients, were observed overnight, and were discharged the next day. The other six patients underwent occlusion as inpatients.

The mean plug diameter was 10.75 mm, with a range of 8–12 mm. The most commonly used device size was 12 mm. The volume of NBCA glue was not reported for five of the nine patients. In the remaining four patients, the average volume of glue per ureter was 1 mL, with a range of 0.8–1.5 mL. The mean ureteral diameter was 6.1 mm, with a range of 4–8 mm. Mean clinical follow-up was 11 months, with a range of 4–24 months. Five patients died from underlying malignancy, three were lost to follow-up, and one was still alive at the time of manuscript preparation. Clinical success was assessed before discharge after the procedure and at subsequent follow-up visits. Seven of the nine patients (78%) showed clinical success immediately following the procedure that lasted throughout the respective follow-up periods (Table). All seven patients with indwelling catheters before the procedure were able to discontinue their use. No urinary tract infections occurred, and no patient reported substantial or persistent pain after the procedure.

Two patients (22%) required unilateral retreatment for persistent urinary leakage (ie, more than one vaginal pad per day). In both of these patients, the ureter that required repeat treatment was the smaller ureter, measuring 4 mm in each case (measured as maximum luminal diameter after contrast agent injection). One of these patients originally had two 12-mm plugs, and the other had an 8-mm and a 10-mm plug. Both patients showed clinical success that lasted throughout their individual follow-up periods after placement of a single additional 12-mm plug and NBCA (Table).

In patient 9 (Table), who had previously undergone pelvic radiation, bilateral internal iliac artery pseudoaneurysms developed adjacent to the plugs that had been placed at and slightly below the level of the pelvic brim (Fig 2). Five months after the procedure, the patient presented to the emergency department with left flank pain and vaginal bleeding. Angiography demonstrated a 7-mm × 5-mm left internal iliac artery pseudoaneurysm adjacent to the proximal plug (Fig 3). The pseudoaneurysm was treated with 5-, 6-, and 7-mm 0.035-inch platinum coils (Tornado; Cook, Bloomington, Indiana; Fig 3). The bleeding and pain resolved, and the patient was discharged the following day. She remained asymptomatic with no bleeding or urinary leakage at 3- and 8-week follow-up visits.

Two months later, when presenting for nephrostomy tube change, the patient reported a 2-week history of recurrent vaginal bleeding. Repeat angiography demonstrated a 4-cm × 3-cm pseudoaneurysm arising from the right internal iliac artery, 13 mm cranial to the right superior plug (Fig 3). This pseudoaneurysm was treated with two overlapping VIABAHN covered stents (W.L. Gore & Associates, Flagstaff, Arizona) measuring 6 mm × 25 mm and 5 mm × 25 mm (diameter × length), with resolution of the pseudoaneurysm (Fig 3). These complications were considered class C per Society of Interventional Radiology