Ureteral Injuries during Gynecologic Surgery: Treatment with a Minimally Invasive Approach

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ABSTRACT

Purpose: To report the safety and efficacy of percutaneous nephrostomy and primary antegrade recanalization for treatment of iatrogenic ureteral strictures after gynecologic surgery.

Patients and Methods: Ten women had symptoms suggestive of ureteral obstruction during the immediate postoperative period (5 days to 1 week after surgery). Under analgesia and conscious sedation, standard percutaneous nephrostomy was performed, and a long 7F sheath was placed in the upper ureter. The obstructions were traversed with the aid of a 0.0035-inch Glidewire and a 5F angled Glide catheter (Terumo, Japan). Subsequently, the areas were dilated with angioplasty balloons to a maximum diameter of 7 mm. Finally, an 8F percutaneous internal/external nephroureteral drainage stent was inserted to secure ureteral patency. Follow-up was carried out by serial nephrostomography until removal of the stent and by renal ultrasonography thereafter.

Results: Twelve obstructions with a mean length of 1.4 cm (range 0.4–1.9 cm) were managed. The technical success rate was 100%. No major complications occurred, and normal renal function was restored. The mean follow-up was 12 months. In 60% of the patients, a patent ureter was depicted at 1 week, whereas in four patients, repeat dilation of the obstructed segment was required. The stents were removed after a mean period of 4.8 weeks.

Conclusion: Percutaneous nephrostomy and primary antegrade ureteral balloon dilation is safe and efficacious for treating ureteral injury after pelvic surgery and obviates open surgical manipulations.

INTRODUCTION

Ureteral injury is a serious concern during abdominal and pelvic surgery and represents one of the most dreaded complications during gynecologic operations, with an overall incidence ranging from 0.5% to almost 30%. Recent reports quote a reduction of inadvertent ureteral trauma to as low as 0.1% to 2.5%. Iatrogenic ureteral trauma encompasses ligature, crush, laceration, avulsion, stretch, and devascularization.6,7 The rate of ureteral injury is increased when technically demanding laparoscopic and ureteroscopic manipulations are undertaken.4,8,9 and suture ligation accounts for almost half of the cases.3 Ureteral injury may be recognized intraoperatively and treated without any complications, or it may be overlooked and present in the immediate or late postoperative period, leading to substantial morbidity, threatening kidney viability, and justifying medicolegal litigation.7,10,11

Ureteral surgical reconstruction constitutes the mainstream therapy of choice for patients presenting with symptoms suggestive of ureteral obstruction in the postoperative period. Traditional methods include end-to-end ureteroureteral anastomosis, ureteral reimplantation, ureteroneocystotomy, or some combination.4,7,12 Percutaneous and endoscopic minimally invasive techniques represent alternative strategies that have been proposed to reduce morbidity and the duration of hospitalization.9,13–17 The goal of the present paper is to report our expe-
rience with 10 patients who presented with iatrogenic ureteral strictures after gynecologic surgery and were treated with percutaneous nephrostomy and primary antegrade recanalization.

PATIENTS AND METHODS

Between 2000 and 2003, 10 women with a mean age of 45.5 years (range 30–50 years) suffered ureteral injury during gynecologic operations and were referred to our institution for management of hydronephrosis or compromised renal function attributable to ligature obstruction. The gynecologic surgical procedures had been performed for benign (N = 4) or malignant (N = 6) pelvic disease. Four patients had undergone radical hysterectomy, four total abdominal hysterectomy, one oophorectomy, and one cesarian section. None of the patients had received radiotherapy in the region of interest. All patients gradually developed symptoms suggestive of unilateral (N = 8) or bilateral (N = 2) ureteral obstruction in the early postoperative period (5th to 7th day). Seven patients complained of ipsilateral flank and loin pain or low-grade fever without any signs of septicemia, whereas eight patients presented with oliguria or anuria. In two patients, ureteral trauma was discovered incidentally owing to a high degree of clinical suspicion.

Routine blood-chemistry studies showed increased concentrations of blood urea and creatinine (97.50 ± 13.00 mg/dL [range 80–111 mg/dL] and 1.95 ± 0.18 mg/dL [range 1.5–2.3 mg/dL], respectively), and subsequent imaging confirmed the diagnosis of ureteral obstruction. Renal ultrasonography, which was performed as the primary imaging study, depicted marked dilation of the renal collecting system and upper third of the ureter in all patients. Standard intravenous urography showed the exact location of the ureteral obstruction. Interruption of continuity at the distal third with proximal ureteropelvic dilatation was observed in 12 ureters (8 right-sided lesions and 4 left-sided lesions). The underlying cause was absorbable-suture ligature in all cases, as corroborated by the operating surgeons.

Preoperative evaluation included blood coagulability tests and a detailed history of any hypersensitivity to drugs or contrast media. All patients underwent thorough evaluation by a liaison psychiatrist and were referred for further psychological or pharmaceutical management when needed. After intravenous administration of prophylactic antibiotics, patients received conscious sedation (Nubain and Dormicain) according to ventilation rate and level of consciousness.

A standard percutaneous nephrostomy route was created through the afflicted kidney (Cook nephrostomy set). Antegrade recanalization of the obstructed ureteral segment and ureteral stenting to secure patency were undertaken in a single session. A long 7F vascular sheath was placed in the ureter just proximal to the site of the obstruction in order to increase support. The next step was the bypass of the ureteral obstruction with the aid of a hydrophilic 0.035-inch guidewire and an angled hydrophilic 5F catheter (both from Terumo). Initially, contrast medium was infused through the sheath to opacify the whole proximal collective system and delineate the obstructive segment precisely (Fig. 1A). Then, the soft tip of the Glidewire was oriented toward the sutured point of the ureter with the help of the angled catheter and forced gently against the obstructed segment (Fig. 1B). After numerous efforts with gradually escalating force, the Glidewire was negotiated through the obstruction into the distal ureter and bladder (Fig. 1C). Extra care was taken to avoid overstretching and perforation of the ureteral wall, because then the Glidewire would always elect the easy extraluminal route. Subsequently, the hydrophilic guidewire was exchanged for an Amplatz Superstiff 0.035-inch guidewire (Cook), which was anchored safely in the bladder (Fig. 1D). Lidocaine instillation through the catheter in the bladder helps alleviate patient discomfort caused by bladder irritation and distraction by the guidewire. The site of obstruction was then gradually dilated with a standard low-profile high-pressure angioplasty balloon to a maximum diameter of 5 to 7 mm (Fig. 1E). These were noncompliant balloons permitting maximum dilation of 5 to 7 mm, thus avoiding ureteral damage. Balloons were inflated to almost 20 atm until the “waisting” at the point of the ligature was abolished. Restoration of ureteral patency was confirmed with concomitant antegrade nephrostomography through the sheath. Finally, an 8F percutaneous internal/external nephroureteral drainage stent (Boston Scientific) was inserted percutaneously through the obstruction to secure short-term patency. The appropriate stent length was chosen on the basis of the patient’s height, according to published instructions.18 In three cases, the obstruction had to be dilated repeatedly to allow the stent to cross it.

After the conclusion of the intervention, patients were given ciprofloxacin 500 mg twice daily and follow-up instructions and were released from the hospital the following day if the procedure was uneventful. Follow-up consisted of clinical examination and blood chemistry tests, contrast antegrade nephrostomography at 1-week intervals until removal of the guardian stent, and renal ultrasonography thereafter. The weekly follow-up consisted of retrieval of the internal/external drainage stent and antegrade nephrostomography. When the ureter was patent, the nephrostomy tube was removed. If the ureter was not patent, repeat cannulation and balloon dilation of the stricture and replacement of the internal/external nephroureteral drainage stent were required.

Success was defined on the basis of antegrade nephrostomography and with ultrasonography thereafter. We did not perform intravenous urography or contrast CT scans when there was no ultrasonographic evidence of hydrenephrosis.

RESULTS

The mean length of the obstructed segments was 1.4 ± 0.4 cm (range 0.4–1.9 cm). The overall technical success rate was 100%. In two cases, however, primary attempts at ureteral recanalization failed because of suture rigidity and perforation of the ureter by forceful Glidewire maneuvering. The patients were left with external drainage for 5 days, and the strictures were managed during a second session following the same procedure.

The whole procedure was well tolerated by all patients, and no major complications occurred. There was no hematuria for >1 week, hemorrhage, or any signs of septicemia as a result of either the nephrostomy access itself or the subsequent intraureteral manipulations. The mean hospital stay was 1.1 ± 2.3 days (range 0–5 days), and three women were treated as outpatients.
FIG. 1. Treatment technique. (A) Antegrade nephrostotomogram depicting left-ureteral stricture. (B) Glidewire was advanced to bypass stricture segment. (C) Wire and angled Glide catheter were gradually advanced within ureteral lumen. (D) Amplatz Superstiff guidewire is positioned in bladder, enabling further therapeutic manipulations. (E) Balloon dilation of stricture. (F) Postoperative antegrade nephrostotomogram showing ureteral patency.
The mean follow-up period was 12 months (range 9–17 months). Ureteral patency was documented with antegrade nephrostomography, which was performed through a short 7F vascular sheath placed by an over-the-wire technique in the renal pelvis after stent removal (Fig. 1F). In 60% of the patients, a patent ureter was depicted at 1-week follow-up, whereas in four patients, repeat cannulation and balloon dilation of the stricture and stent replacement were required. All stents were removed permanently after a mean of 4.8 weeks (range 1–8 weeks).

Minor complications, mainly dysuria and suprapubic discomfort in 50% of the patients, were attributed to bladder irritation by the stent. The stents were well tolerated by the rest of the subjects without any restriction of everyday activities. Blood urea and creatinine values gradually descended, and normal renal function was restored in all patients during the first 4 weeks after intervention. During the 1-year follow-up after definitive ureteral recanalization and stent removal, all patients were clinically well with normal serum urea and creatinine values and no ultrasonographic signs of hydrenephrosis. There was no case of severe upper-tract infection necessitating hospitalization or intravenous antibiotics, and no need for open surgical manipulations because of deteriorating renal function.

**DISCUSSION**

The ureter is a vulnerable anatomic structure and can easily be compromised along its course in the retroperitoneal space during pelvic or abdominal surgery. The quoted rate of intraoperative iatrogenic ureteral injury in modern series ranges from 0.1% to 2.5%. Such injury is encountered more frequently during total abdominal hysterectomy; and conditions such as hemorrhage, endometriosis, infection, previous operation, pelvic adhesions, enlarged uterus, neoplasms, and distorted regional anatomy predispose to untoward ureteral trauma. Furthermore, the advent of endoscopic surgery and the introduction of new complex and aggressive ureteroscopic and laparoscopic techniques have been associated with a higher rate of iatrogenic ureteral trauma. A higher complication rate during the ascending slope of the learning curve of all new techniques is to be expected.
Prevention of ureteral injuries necessitates a thorough knowledge of regional anatomy, prompt recognition of underlying pelvic disease, and application of meticulous surgical techniques by skilled personnel. Intraoperative recognition and subsequent immediate treatment of ureteral trauma is of paramount importance, ensuring an excellent prognosis with minimal morbidity and no need for additional surgery. Injuries occurring within a 5-cm margin of the bladder are best managed by surgical tension-free nonrefluxing reimplantation techniques, whereas injuries at the level of the pelvic brim or more than 6 to 12 cm from the bladder are more suitably treated with an end-to-end ureteroureteral anastomosis around a supporting stent.

Ureteral obstruction after gynecologic surgery is most often attributed to suture entrapment of the distal third of the ureter, where it travels laterally to the cervix. Ureteral ligature usually presents as costovertebral and abdominal pain secondary to distention of the ipsilateral urinary outflow, whereas bilateral ligature may manifest as anuria, vomiting, elevated urea/creatinine values, and electrolyte disorders. Gynecologists and urologists should bear in mind that ureteral trauma may even be asymptomatic and lead to silent progressive kidney loss. In extreme cases of bilateral ureteral ligation, acute renal failure and even death may ensue.

Ureteral injuries diagnosed postoperatively are more complex and difficult to manage than those repaired intraoperatively. Delayed diagnosis seems to be the single most controllable factor adversely influencing outcome. Treatment options encompass open surgery, endourologic alternatives, or both. Open surgery, which is still the mainstream therapeutic approach, is accompanied by higher perioperative morbidity, prolonged hospitalization, and higher treatment costs. The natural course of internal surgical sutures is absorption with time; hence, percutaneous ureteral drainage by a standard nephrostomy tube and a “cut-to-the-ureter” approach may be adequate. An 80% rate of spontaneous recovery of ureteral integrity after a mean period of 1 month has been reported with standard nephrostomy and external diversion of urine alone. Endourologic options differ according to the operator’s personal experience and preference. Endoscopic endoluminal incision with a cold knife, laser, or electrocautery and utilization of conventional or Acucise balloon catheters yields acceptable results. Technical success rates range from 61% to 78% according to the age and length of the stricture. Alternatively, in cases of complete obliteration of the ureter, endoscopic ureteroureterostomy with a “cut-to-the-light” approach or a retroperitoneal rendezvous have been reported to achieve comparable results with a 70% to 75% success rate. Generally, patients with short strictures and delayed treatment represent the ideal candidates for endoscopic management.

In our series, the application of hydrophilic instruments enabled intraluminal traversal of all ligature strictures in the immediate postoperative period. Balloon dilation was equally successful in rupturing the suture bands and restoring ureteral patency. Balloon dilation has been suggested to induce controlled rupture of all serosal and muscular ureteral layers, achieving healing with a larger final lumen. However, complete rupture of the ureter and leakage of urine and iodinated contrast medium into the retroperitoneum invokes an irritant reaction, with subsequent periureteral fibrosis and adhesions. Hence, balloon inflation pressures should be cautiously controlled. The goal of the procedure was to eliminate the obstruction and concomitantly avoid complete ureteral rupture and extravasation of contrast medium.

The optimal time to intervene is a controversial issue. Some authors propose that repair should not be attempted before 3 to 6 months to allow regression of regional edema and complete suture absorption. Nevertheless, delayed definitive management is associated with greater patient suffering and discomfort. Our results suggest that immediate percutaneous restoration of ureteral continuity is both feasible and highly effective. After the 1-week time frame, the absorbable sutures have loosened, permitting penetration of the hydrophilic guidewire and propulsion of the Glide catheter through the stricture in an over-the-wire manner. Election of treatment should always be individualized according to factors such as time of diagnosis, general patient status, site and type of injury, underlying pathology, and the patient’s personal wishes. Patients who are suffering from pelvic inflammation or who have undergone regional radiotherapy definitely are candidates for later intervention.

Insertion of a percutaneous internal/external nephroureteral drainage stent is always deemed necessary in order to secure patency in the early post-interventional period. In addition, the stents ensure satisfactory healing of the traumatized ureteral wall and avoid recurrence of obstruction.

CONCLUSION

Prevention or prompt diagnosis and proper management of ureteral injuries is of paramount importance to minimize morbidity after pelvic and abdominal surgery. A percutaneous approach with standard nephrostomy and antegrade intraluminal recanalization by hydrophilic instruments and balloon dilation is a safe minimally invasive treatment alternative, restoring ureteral continuity and obviating open surgery.

REFERENCES


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ABBREVIATION USED
CT = computed tomography.