Treatment of Iatrogenic Ureteral Injury

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ABSTRACT

Ureteral injury is a rare but potentially serious complication that can occur during a variety of abdominal and pelvic surgical procedures. Knowledge of the course of the ureter is the first step toward preventing ureteral injuries. While some injuries are noticed intraoperatively, most are missed and present later with pain, sepsis, urinary drainage, or renal loss. The choice of treatment is based on the location, type and extent of ureteral injury. When the injury involves the distal ureter, ureterocystostomy can be performed. For mid-ureter injuries, a ureteroureterostomy is satisfactory, and with respect to the proximal ureter, most of the injuries can be managed by transureteroureterostomy. In complex situations, intestinal interposition, autotransplantation or even nephrectomy can be considered. In this review, we summarize the surgical treatment options in patients suffering from ureteral injury.

Key words: Ureter, Trauma, Surgery, Treatment

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ÖZET

İyatrojenik Üreteral Yaralanmaları Tedavisi


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Ureters are small and very mobile tubular organs. They are well protected in the retroperitoneal area. Ureter length from the kidneys to the bladder ranges from 22-30 cm[1]. Ureters transport the urine from the kidney to the bladder. Ureteral injury puts the ipsilateral kidney at risk. Gynecological, obstetrical, general surgical, and urological operations can be the cause of iatrogenic ureteral injury. Ureteral stone treatment with ureterorenoscopy (URS) in urology, colorectal surgery in general surgery and hysterectomy in gynecology are the most common procedures causing iatrogenic ureteral injuries[2]. A D-J stent insertion before the surgery can help to avoid ureteral injury due to gynecologic and abdominal surgeries, especially in patients with prior abdominal or pelvic surgery and in those with large masses[3]. The underlying idea behind this method is to facilitate the surgeon’s easy identification of the ureters during the surgery. However, there is no a consensus regarding this approach. Some authors report that preoperative D-J stent insertion is not successful in diagnosing intraoperative ureteral injury in all cases. Palaniappa et al.[4] showed that intraoperative identification of injury was possible in only two of the four patients in whom preoperative stents were placed.

Traumatic ureteral injuries occur in the upper ureter in 40% of cases, mid-ureter in 30% and distal ureter in 30%[5]. The incidence of ureteral injury is reported to range between 0.5 and 10% in published studies[6,7]. Knowledge of the location of the ureters in the retroperitoneal area is the first important point for surgeons to avoid iatrogenic ureteral injury during surgery. The second important point is to not overlook a perioperative ureteral injury. Perioperative ureteral injuries can occur as mucosal injury only, submucosal false passage, ureteral wall perforation, suture ligation, sharp partial incision or complete transection, avulsion, devascularization, overheating, or cryoablation. Although ureteral injuries due to transection, ligation or avulsion are easily realized during the surgery, the injuries related to devascularization, heat or cryoablative therapy may not be diagnosed intraoperatively[5]. Late diagnosis of iatrogenic ureteral injury puts the ipsilateral kidney at risk, resulting in ureteral stricture, retroperitoneal urine collection and loss of renal function. Therefore, early diagnosis is a must for better surgical results.

The most serious iatrogenic ureteral injury is avulsion, i.e. rupture of the full thickness (whole layers) of the ureter from the proximal portion alone or from both proximal and distal parts[8]. Ureteral avulsion occurs while performing endoscopic stone extraction or URS. Treatment of one-sided avulsion is relatively easy. It may be possible to perform ureteroureteral anastomosis after careful debridement of the ruptured edges and mobilization of the kidney[9]. Treatment of complete avulsion is a very challenging problem for the surgeon and the patient.

The aim of the treatment in ureteral injury is to preserve renal function. There are a wide range of treatment options for injured ureters, including D-J stent insertion, nephrostomy tube placement, primary ureteroureteral anastomosis, ureteroneocystostomy, psoas hitch repair, Boari flap repair, primary anastomosis and distal reimplantation, transureteroureterostomy, ileal or appendiceal interposition, autotransplantation, and nephrectomy[10]. Selection of the treatment method is based on the type of ureteral injury as partial or complete, cause of ureteral injury as clean or dirty, location of ureteral injury, the surgeon’s experience, and the patient’s general condition[5].

**a. A double-J stent insertion:** Mucosal damage is the most common type of ureteral injury. Small mucosal damage due to endoscopic ureteral procedures can be treated with only double-J stent insertion for 1-2 weeks. If mucosal damage is extensive, double-J stent should be kept in place for 3-6 weeks[11].

**b. Nephrostomy tube placement and late repair:** In some cases with poor clinical condition, dirty wound and/or loss of ureteral segment, this method should be considered after the patient’s condition has stabilized and/or antibiotic treatment is given for dirty wound[10].

**c. Primary ureteroureteral anastomosis:** This method is suitable in cases of ureteral injury without loss of ureteral segment. Ureteroureterostomy by interrupted anastomosis using absorbable sutures after careful debridement is the most commonly performed type of repair for upper and mid-ureteral injuries after mobilization of the kidney to achieve a tension-free anastomosis over a double-J stent. Ureteral anastomosis should be performed in oblique shape, as circular anastomosis carries a risk of stricture[12].

**d. Ureteroneocystostomy:** This is the best way to repair distal ureteral injury with no segmental loss[5]. A double-J stent is placed for 4-6 weeks. With this method, an antireflux technique may be performed. For the antireflux mechanism, the ratio of luminal size to intramural length should be 1 to 5.
e. Psoas hitch repair: More extensive loss of distal ureteral length can be bridged with a psoas hitch. The bladder is mobilized in the space of Retzius. Ligating the contralateral superior vesical pedicle aids in mobilization. The bladder is opened vertically and tented up against the ipsilateral psoas muscle by placing two fingers in the bladder. Nonabsorbable monofilament sutures are placed in the bladder wall outside the epithelium and in the psoas muscle away from the genitofemoral nerve.[13]

f. Boari flap repair: The Boari tubularized bladder flap is an excellent means of bridging long gaps in ureteral continuity. However, the procedure using this flap is time-consuming and best reserved for the stable patient or in the elective reconstruction setting. This method provides an opportunity to repair loss of a very long ureter segment. The bladder capacity should be large enough to prepare the flap for ureteral replacement[10]. We had a case of complete ureteral avulsion during rigid URS for ureteral stone treatment (Figure 1). We decided to perform Boari flap ureteroplasty for this patient. First, renal mobilization was done to lower the kidney. The bladder was also mobilized to the left side. The bladder was opened, and a 2 cm wide, semicircular flap from the front bladder wall was prepared. This flap was tubularized over a 14 feeding tube under x 2.5 magnification using 5/0 Vicryl suture in a two-layer fashion (Figure 2). First, the mucosa was continuously closed over the catheter, and then the seromuscular layer was continuously closed. The flap length was approximately 13 cm (Figure 3). As the kidney and bladder were mobilized, this flap was sufficient to achieve renal pelvis anastomosis without tension[10].

g. Primary anastomosis and distal reimplantation: In case of one-sided avulsion, primary anastomosis is a valid option. In case of both proximal and distal avulsion, primary anastomosis and distal reimplantation may be considered even if there is no clear evidence for the results of this method in the international literature. We had a study including four patients with complete ureteral avulsion. In that study, two patients underwent primary anastomosis.

Figure 2. Tubularization of bladder flap over the feeding catheter (Source: Ankara Numune Training and Research Hospital Third Department of Urology archive).

Figure 3. Length of tubularized bladder flap is about 13 cm (Source: Ankara Numune Training and Research Hospital Third Department of Urology archive).
The outcome was successful in one of them. This method may be preferable in patients with limited bladder capacity for Boari flap repair\textsuperscript{[10].}

**b. Transureteroureterostomy:** Transureteroureterostomy may be indicated for loss of the distal part of the ureter. For this method, the proximal ureteral should be long enough to transfer to the opposite side. The injured ureter is passed through the sigmoid colon mesentery superior to the inferior mesenteric artery to avoid kinking\textsuperscript{[14].}

**i. Ileal or appendiceal interposition:** When ureteral injury occurs in the mid-ureter, appendiceal interposition may be appropriate for the right-sided ureter, and ileal interposition may be appropriate for both sides. However, these are very complex repair methods and bowel preparation is not possible in each case. Therefore, they may not be appropriate in the acute trauma setting\textsuperscript{[15,16].}

**j. Autotransplantation:** This is a very complex procedure. It may not be appropriate in the acute trauma setting. Therefore, it should be performed as an elective surgery by an experienced surgical team\textsuperscript{[8,12].}

**k. Nephrectomy:** Nephrectomy is a very rare indication after ureteral injury. If complex reconstructive procedures are not possible due to patient’s poor condition, nephrectomy can be considered. The patient’s approval must be obtained before this procedure is performed\textsuperscript{[10,12].}

In conclusion, surgeons should be aware of iatrogenic ureteral injury during abdominal or pelvic surgery, especially in previously operated patients and/or in patients with malignancy. Early diagnosis provides better results. Late diagnosis may result in kidney loss. There are many methods for repairing ureteral injury. Selection of the method of repair is based on the type of injury, location of the injury, the surgeon’s experience, and the patient’s general condition.

**REFERENCES**


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