

Retrospective view and treatment of iatrogenic ureteral injuries

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Abstract

Aim: Ureteral injuries are rare. Iatrogenic ureteral injury is the most common cause of ureteral traumas. This letter aims, evaluation of iatrogenic ureteral traumas and treatments.

Material and Methods: Thirty two patients with major iatrogenic ureteral trauma were enrolled. Sonography, intravenous pyelography, CT of abdomen (contrast-enhanced and non-contrast enhanced), antegrade X-rays or diagnostic ureterorenoscopy are used for the diagnosis. All patients were undergone endoscopic ureterorenoscopy before the ureter was surgically repaired. Next, the surgical technique was decided. Injuries that can be managed with endoscopic approach were treated by inserting a Double J stent. For patients who were not eligible for endoscopic treatment, treatment was decided according to the location of ureteral injury.

Results: Of the patients, 25 were female and 7 were male and mean age was 46.31±16.485 years. Ureteral injury was secondary to gynecologic intervention in 16 patients, general surgery procedures in 6 patients and urologic surgery in 10 patients. According to AAST, Grade 4-5 injury was identified in 71.9% of 32 patients, while Grade 3 and Grade 2 injuries were noted in 15.6% and 12.5% of patients, respectively. Four patients were treated in late period, while intraoperative or early treatment was instituted for 28 patients.

Conclusion: Iatrogenic ureteral injuries develop mostly after laparoscopic or endoscopic pelvic surgeries. We should prefer endoscopic insertion of Double J stent for the first-line treatment.

Keywords: Iatrogenic; ureter; traumas; treatment

INTRODUCTION

Ureteral traumas are rare and account for approximately 1 to 2.5% of all urogenital system injuries. Etiologies are iatrogenic injury in 75% of ureteral injuries, blunt trauma in 18% of cases and penetrating injury in 7% of patients(1). Gynecologic procedures, general surgery procedures and urologic surgery procedures account for 64 to 82%, 15 to 26% and 11 to 30% of major iatrogenic ureteral injuries, respectively (2-4).

According to classification developed by American Association for the Surgery of Trauma (AAST), ureteral injuries are examined over 5 grades listed below.

Grade 1: only hematoma in the ureter

Grade 2: Laceration <50% transection (caliber of the ureter)

Grade 2: Laceration >50% transection

Grade 4: Complete contusion in ureter <2 cm

Grade 5: Complete contusion in ureter >2 cm

Iatrogenic ureteral injuries do not have specific sign or symptoms; the diagnosis is usually established and only one third of the cases is intraoperatively recognized (5).

Ureteral anatomy should be known well and operation should be carefully and meticulously performed in order to avoid ureteral injuries. Today, surgeons review human pelvic anatomical models along with classical textbooks in order to know the pelvic anatomy better (6).

This letter aims discussing evaluation and treatment of iatrogenic ureteral injuries that have a significant place among all urological injuries in the light of up-to-date literature.

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MATERIAL and METHODS

After the study was approved by tertiary institution ethics committee (Nr. 05 dated 28/09/2018), medical files of 177 patients, who were examined for iatrogenic ureteral injuries and undergone necessary procedures in the last 6 years, were retrospectively reviewed.

Patients are examined according to ureter injury scale of the AAST. Accordingly, the patients with \geq Grade 2 injury were included. The patients with no sufficient medical or follow-up data and with Grade 1 injury were excluded. One hundred forty five patients with Grade 1 ureteral injury were excluded. Thirty two patients with major iatrogenic ureteral trauma were enrolled. Sonography, intravenous pyelography, CT of abdomen (contrast-enhanced and non-contrast enhanced), antegrade X-rays or diagnostic ureterorenoscopy are used for the diagnosis. Three treatment modalities, namely intraoperative treatment, early treatment and late treatment, were instituted for the patients. Intraoperative therapy implies the treatment during primary operation, while early treatment is started within postoperative one week and late treatment implies a modality that is started three months after the primary operation. For the patients in the group of late treatment, nephrostomy was temporarily inserted. Endoscopic ureterorenoscopy was performed for all patients before the ureteral injury was surgically repaired (excluding ureteral injuries identified during open surgery and in the intraoperative period). Next, the surgical technique was decided. For injuries that could be treated with endoscopic technique, Double J stent was inserted. For patients

who were not eligible for endoscopic management, the treatment was decided according to the location of ureteral injury. Open surgery, primary repair, release of ligation, pyeloplasty or end-to-end anastomosis of ureter were the options for the injuries of proximal ureter. Again, open surgery, release of ligation or end-to-end anastomosis of ureter was performed for injuries in the mid segment of ureter. For patients with complete trauma in distal ureter or with avulsion very close to the urinary bladder that end-to-end anastomosis of ureter was not an option, ureteroneocystostomy (UNC) was done and on the other hand, primary repair, end-to-end anastomosis, release of ligation or Boari flap was considered for other distal ureteral injuries depending on grade and location of the injury.

Statistical Analysis

Resultant data is reviewed with SPSS v.22 software. Compliance of continuous data to normal distribution was analyzed with Kolmogorov-Smirnov test. Mean and standard deviation are expressed for the data with normal distribution, while median and maximum and minimum values are expressed for the data that do not comply with normal distribution. Categorical and nominal variables are reviewed over frequency and percentiles. The relation between the grade of ureteral injury and the departments was analyzed with Chi-Square test. Results with Type 1 error value below 0.05 are deemed statistically significant.

RESULTS

Thirty two patients were undergone a procedure for major iatrogenic ureteral injury in our clinic in the last 6 years. Of the patients, 25 were female and 7 were male

Table 1. Patient demographics, location of ureteral injury, grade of ureteral injury, the surgical department that caused the ureteral injury, time of surgery and operations are tabulated

Gender	Age	Traumatized ureter site	According to the(AAST) degree of injury	Surgical section	Treatment time	Operation performed
Female(F)	37	distal ureter	Grade4-5	gynecology	Late treatment	UNC
F	48	distal ureter	Grade2-3	gynecologi	Early treatment	Suture ligation opening + dj insertion
F	59	distal Ureter	Grade4-5	General surgery	Early treatment	UNC
F	40	distal Ureter	Grade2-3	Gynecology	intraoperatif	Suture ligation opening + dj insertion
F	54	distal ureter	Grade2	gynecology	intraoperatif	DJ stent insertion
F	82	distal ureter	Grade4-5	gynecology	intraoperatif	UNC
F	34	proximal ureter	Grade4-5	urology	intraoperatif	pyeloplasty
Male(M)	36	distal ureter	Grade4-5	General surgery	intraoperatif	Boari flep
M	73	distal ureter	Grade3	urology	intraoperatif	Ureter repair + DJ insertion
F	34	distal ureter	Grade4-5	gynecology	intraoperatif	UNC

F	46	bilateral distal ureter	One side Grade 4-5 One side grade 2-3	gynecology	Early treatment	One side Opening the ligation + DJ UNC to the other side
F	47	mid ureter	Grade4-5	gynecology	intraoperatif	Ureter end-to-end anastomosis
F	21	mid ureter	Grade4-5	General surgery	Late treatment	Ureter end-to-end anastomosis
F	71	distal ureter	Grade2	gynecology	intraoperatif	DJ insertion
F	38	distal ureter	Grade4-5	gynecology	Late treatment	UNC
F	46	distal ureter	Grade4-5	gynecology	Late treatment	UNC
F	30	bilateral distal ureter	Grade2	gynecology	intraoperatif	Bilateral DJ insertion
M	18	mid ureter	Grade4-5	urology	intraoperatif	Ureter end-to-end anastomosis
F	47	distal ureter	Grade4-5	urology	intraoperatif	UNC
M	28	mid ureter	Grade4-5	urology	intraoperatif	Ureter end-to-end anastomosis
F	48	mid ureter	Grade4-5	gynecology	Early treatment	Ureter end-to-end anastomosis
F	68	mid ureter	Grade4-5	General surgery	Early treatment	Ureter end-to-end anastomosis
M	44	mid ureter	Grade4-5	General surgery	Early treatment	Ureter end-to-end anastomosis
F	59	distal ureter	Grade4-5	General surgery	Early treatment	Ureter end-to-end anastomosis
F	34	distal ureter	Grade2-3	gynecology	Early treatment	Ligation opening + DJ stenting
F	23	proximal+distal ureter	Grade4-5	urology	Early treatment	Pyeloplasty+UNC
F	25	distal ureter	Grade4-5	gynecology	intraoperatif	UNC
M	49	distal ureter	Grade4-5	urology	intraoperatif	UNC
F	54	distal ureter	Grade4-5	urology	intraoperatif	UNC
F	67	distal ureter	Grade3-4	urology	intraoperatif	Ureter repair + DJ insertion
M	72	distal ureter	Grade4-5	urology	intraoperatif	UNC
F	50	distal ureter	Grade2	gynecology	Early treatment	DJ insertion

32 patient

M:Male F:Female AST: American Association for the Surgery of Trauma UNC: ureteroneocystostomy DJ:Doyle j stent

and mean age was 46.31±16.485 years. Ureteral injury was secondary to gynecologic intervention in 16 patients, general surgery procedures in 6 patients and urologic surgery in 10 patients. Four patients were treated in late period, while intraoperative or early treatment was instituted for 28 patients. Pyelonephritis developed secondary to nephrostomy in 3 patients in the group of late treatment. From the widest perspective, iatrogenic ureteral injury cases enrolled in our study included ligation in 3 cases, partial transection in 3 cases, stricture in 3 cases, complete transection in 8 cases and avulsion in

proximal or distal end of ureter in 15 cases. Of iatrogenic ureteral injuries secondary to gynecologic procedures, etiology was laparoscopic tumor surgery in 9 cases and open surgery in 7 cases. Ureteral injury develop following hysterectomy in 9 patients, caesarean section in 5 patients and resection of ovarian tumor in 2 patients. For ureteral traumas caused by general surgery procedures, the injury developed following laparoscopic colorectal tumor surgery in 3 cases, laparoscopic appendectomy in one case and open colorectal tumor surgery in one case. Ureteral traumas secondary to urologic procedures were

caused by endoscopic stone surgeries in 8 patients and open urinary bladder surgery in 2 patients. The patients with major pelvic mass were preoperatively inserted Double J stent. Double J stents that were inserted to ureter were removed 6 weeks after UNC and end-to-end anastomosis, but they were removed 4 weeks later in patients with partial ureteral trauma. Postoperative urinary drainage that persisted longer than 3 weeks developed in 2 patients in the group of early or intraoperative treatment. Nephrostomy was inserted to one of these patients. Only drainage volume was supervised in the other patient, as there was not hydronephrosis. These two patients were discharged in healthy condition in postoperative Week 4.

Patient demographics, location of ureteral injury, grade of ureteral injury, the surgical department that caused the ureteral injury, time of surgery and operations are tabulated in Table 1.

DISCUSSION

The iatrogenic ureteral injuries include ligation, kinking by suture, transection, avulsion, partial transection, crush and devascularization associated with delayed necrosis or stricture (7).

As also reported in the literature, there is a very wide range of iatrogenic ureteral injuries. In our study, distal ureter avulsion was more frequent and also stricture, ligation and transection were seen. Risk factors for ureteral injuries include previous operations, major pelvic masses, inflammatory diseases, malignant tumors and radiotherapy, while the possibility of ureteral injury increases when the surgeon is not familiar with congenital anomalies (8-10). Ureters should be clearly seen and peristalsis should be inspected, while operation is performed close to the ureters. Although ureteral stents help determining the location of injured ureter, they do not help prevent the injury (11). Ureteral stents are beneficial, if pelvic anatomy impairs due to a reason whatsoever and/or ureter cannot be located with routine methods (especially in large pelvic masses, kyphoscoliotic patients and when ureter cannot be selected completely in preop radiological examinations), and it is not necessary to use them in all cases (12). Incidence of iatrogenic ureteral injuries secondary to laparoscopic procedures increased, as laparoscopic surgery is ever increasingly performed and retroperitoneal dissection is a complex procedure. Gynecologic pelvic surgery is the most common etiology of iatrogenic ureteral injury. The risk of ureteral injury is high in laparoscopic hysterectomy (13).

In our study, tumor surgery was the most common etiology of ureteral injuries that developed following laparoscopic gynecologic and general surgery procedures. Endoscopic removal of ureteral stone was the most common urologic procedure. Although insertion of DJ stent before major pelvic mass surgeries do not prevent iatrogenic ureteral injuries, the stent helps prevention of postoperative complication by facilitating intraoperative detection of the trauma, as double J stent can be seen in the lumen of injured ureter. Of the patients who were intraoperatively

diagnosed with ureteral injury, three were patients with major pelvic mass from gynecology clinic who were preoperatively inserted double J stent. Therefore, we believe that insertion of DJ stent before major pelvic mass surgeries is a beneficial and important procedure.

In present study, 50% of all iatrogenic ureteral injuries developed following gynecologic surgery. These traumas are caused by laparoscopic hysterectomy in 56.25% of patients, caesarean section in 31.25% of patients and ovarian tumor surgery in 12.5% of patients.

Comparing to other surgical departments (gynecology, urology), iatrogenic ureteral injuries secondary to colorectal surgery are rare. However, ureteral injuries are most commonly caused by colorectal surgeries among general surgery procedures. The incidence ranges from 0.3% to 1.5 percent (14).

In these study, 18.75% of all iatrogenic ureteral injuries developed after general surgery procedures. Considering ureteral injuries following general surgery procedures, 83.3% of the cases are caused by colorectal tumor surgery and 16.7% developed after appendectomy. Moreover, ureteral injury developed after laparoscopic surgery in 66.6% of patients and after open surgery in 33.4% of patients. Urologic surgery, including but not limited to ureteroscopy, lymphadenectomy and urinary diversion, may lead to iatrogenic ureteral injuries. The incidence of ureteral injury and stenosis may increase up to 13 percent. Iatrogenic ureteral injury develops most commonly following ureterorenoscopic procedures (15).

In our study, 31.25% of all iatrogenic ureteral injuries developed after urologic surgery procedures. Endoscopic procedures were responsible for 8 patients, while the injury developed in one patient following repair of vesicovaginal fistula and in one patient following open vesical diverticulectomy. Endoscopic treatment of ureteral stone accounts for 80% of iatrogenic ureteral injuries secondary to urologic surgery procedures, while the rest 20% of injuries developed following open surgery.

There is a wide range of therapeutic options for ureteral injuries and strictures, ranging from endoscopic treatment and complex reconstruction to renal autotransplantation, and the final treatment decision is based on length, severity and location of the injury in proximal, mid or distal ureter (16,17). While the distal one third of ureter is a common site of injury (91%), mid and proximal ureters are rarely affected – 7% and 2%, respectively (18).

Treatment of iatrogenic ureteral injuries constitutes the most important part of this study. If the patient is not managed with an appropriate treatment modality, after iatrogenic ureteral injury is detected, the risk is high for infection, renal dysfunction and renal failure (19). Therefore, ureteral injuries should be correctly managed. First, non-invasive methods should be instituted that are followed by invasive modalities (20).

In our study, four patients (12.5%) were started on treatment late and twenty eight (87.5%) patients were

intraoperatively treated or started on treatment early. From a broad perspective, UNC was performed for 40.6% of patients with iatrogenic ureteral injury, while end-to-end anastomosis, endoscopic insertion of Double J stent, release of ligation and insertion of Double J stent, open repair of ureter and insertion of Double J stent, pyeloplasty and Boari flap were performed in 25%, 12.5%, 9.4%, 6.3%, 3.1% and 3.1% of the patients, respectively.

Urinary drainage that exceeded 3 weeks was detected in 2 patients in early postoperative period. Nephrostomy was inserted to one of these patients. Since the other patient did not have hydronephrosis, only drain monitoring was done. There was no return from drains in two patients in postoperative week 4. Since antegrade imaging showed that the ureter was intact in these patients, nephrostomy and drains were removed. On the other hand, pyelonephritis developed secondary to nephrostomy in 3 patients in the group of late treatment. These patients were admitted to the inpatient ward at certain intervals and managed with parenteral antibiotherapy. No postoperative early complication is faced in two patients with Grade 4-5 trauma in both distal and proximal ends of ureter. Since ureteral injury occurred in these two patients in a third party healthcare facility, they presented to our hospital for removal of double J catheter 3 months later. Another patient presented to and followed up by a third party healthcare facility. For the patient who presented to our hospital, the ureter was fibrotic and narrow throughout the entire trace, while double J stent was removed under guidance of URS. Since the ureter was fibrotic and the patient was young, a new double J stent was inserted and immediately referred to an advanced care facility for autotransplantation. When the patient presented for follow-up visit, we learned that the patient was undergone autotransplantation in a third party healthcare facility. When the patient who was followed up in a third party healthcare facility visited our hospital 2 years later, the kidney was not functioning at the surgery side. The patient was placed on follow-up, as the patient was old and had no complaint.

First preference should be insertion of Double J stent for iatrogenic ureteral injuries. If this option fails, percutaneous nephrostomy should be done followed by re-insertion of double J stent several days later. If this option also fails, reconstructive surgery should be done depending on the location of injury (21).

In our study, minimally invasive treatment is our principle for the treatment of iatrogenic ureteral injuries. Endoscopic placement of double J stent is our first preference for Grade 2-3 injuries of the ureter. However, the treatment decision is based on the injured part of ureter in Grade 4-5 ureteral injuries. Referral of the patient to an advanced care facility for autotransplantation or construction of neoureter from ileum without wasting time is very important to protect the kidney in patients with Grade 4-5 injury in both distal and proximal ends of ureter, if the ureter is not vascularized.

CONCLUSION

In conclusion iatrogenic ureteral injuries develop mostly after laparoscopic or endoscopic pelvic surgeries. Although treatment of iatrogenic ureter traumas depends on the degree of injury and the location of the ureter. Yet, our first preference should be endoscopic treatment for iatrogenic ureteral injuries.

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