

# Ureteral Complications during Surgery

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**Abstract:** Historically, ureteral complications during surgery have been occurring since the earliest performances of major abdominal or pelvic surgery. In the early 1960s, few diagnostic techniques were available to diagnose ureteral injury and determine the subsequent timely treatment required. Illustrations from two different time periods of possible operative ureteral injury, ligation, or transection following major complicated surgical procedures are presented, along with the diagnostic and therapeutic approach currently followed. The first individual had apparently sustained a ureteral injury during a prior surgical procedure, which, with limited diagnostic options, was not recognized until she visited us years later—as was the case for many early ureteral injuries. Major abdominal or pelvic surgery may be extensive and complicated, especially when dense fibrosis, scarring, and benign or malignant mass formation are present. Unfortunately, surgical complications, including bleeding and ureteral concerns, may develop during these extensive procedures. A more recent patient underwent major, life-threatening retroperitoneal surgery due to a chronic aortoenteric fistula (17 months total preoperative hospitalization elsewhere), during which the left ureter was transected. In our second patient, recognition and correction of the ureteral transection during the aortic surgery, upon completion of the aortic repair, prevented a potential major renal complication. The timely diagnosis of the operative ureteral injury and the repair prior to wound closure prevented major postoperative complications. As some physicians believe that surgically induced ureteral injuries are increasing in frequency, we present this report to enhance awareness of the possibility of injury and the potential value of recognition prior to abdominal closure. In addition, current operative and postoperative strategies available to identify and reduce potential ureteral injury complications when they occur are discussed.

**Keywords:** ureter; ureteral ligation; ureteral transection; ureteral repair; retroperitoneal tumor; retroperitoneal scarring



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## 1. Introduction

Major abdominal, retroperitoneal, or pelvic surgical interventions are frequently required for treatment of pain, bleeding, mass formation, or trauma [1]. Historically, availability of diagnostic testing for both medical and surgical complications of difficult surgical interventions was limited. Thus, urological, and especially ureteral, complications could develop, either requiring additional intervention—including surgery—or, frequently, going undiagnosed [2,3]. During the 1950s and 1960s, when abdominal surgery was performed for nonurological disease, the process occasionally led to major undiagnosed urological concerns, including ureteral complications. Today, when an injury is noted during or immediately after the surgical procedure, it may be treated more promptly. We present a case series of two patients requiring non-urinary-system surgery who developed major ureteral concerns (ligation or transection) and who required surgical evaluation of the

possible injury to avoid major urinary consequences. As surgical ureteral injuries continue to occur and may be increasing in number, we present these two patients as examples to provide a stimulus for ureteral awareness during and prior to wound closure [4–6].

## 2. Case Reports

### 2.1. Case Report 1

The first patient (DMR), a 38 year-old female, was treated in 1963 for a large bulging mass in the right lower abdomen that was producing abdominal discomfort. She had a past history of a left “oophorectomy”, for which the pathology report was unavailable. She had been receiving antitubercular drug therapy for four months, namely INH (isoniazid) and PAS (para-amino salicylic acid).

During surgery, the preoperative diagnosis of cholelithiasis was confirmed and a large right ovarian benign cystic tumor, a partially calcified left lower quadrant mass, and a pelvic lymphadenopathy which extended into the left inguinal canal were noted. Upon palpation, the superior pole of the “enlarged” left kidney appeared to be irregular, as did the distal portion of the pancreas. The retroperitoneal and matted pelvic lymph nodes contained a “cheesy” material that was sent to the laboratory for microscopic examination and multiple cultures, including acid-fastness studies for mycobacterium. A right oophorectomy and appendectomy were performed. After specifically checking for the ureter location, a single silver clip marker was placed in the left lower quadrant near the bladder, without any suture placement. At the conclusion of the operation, the hernia was repaired.

#### Case 1: Operative Course Outcome

This first patient had a long history of antituberculosis treatment and a pelvic mass due to caseous matted pelvic lymph nodes and a large ovarian cyst. Because of mild postoperative flank discomfort and a left kidney that could not be visualized on intravenous pyelogram a few weeks after surgery, she was returned to the operating room for cystoscopy and retrograde urological studies. Upon cystoscopy, the right ureteral orifice was readily visualized and intravenously administered toluidine blue dye was seen to exude from the right ureteral orifice but not from the left side of the bladder. We had placed no sutures during surgery in either the left ureteral or left pelvic areas. Unfortunately, we were unable to locate the remote Alaskan pelvic surgery operative report from years before. Our concern was that the single clip we had placed during surgery might be on the left ureter and thus could be the etiological reason for the lack of left kidney function. After considerable thought, review of the patient’s past history, and the nonvisualization of the left ureteral orifice in the bladder by cystoscopy, we concluded that the left ureter had been occluded years before and that no further surgery was indicated. The patient did well thereafter.

### 2.2. Case Report 2

The second patient, a 70-year-old Caucasian male, was referred to us by the Head of Cardiovascular Surgery at a nearby university hospital after having been hospitalized there for nine months. The referring physician related that the patient had an aortoduodenal fistula, an infected femoropopliteal Dacron graft, and was “too sick to be operated upon”. Initially, the patient underwent an aortocoronary saphenous vein bypass with cardiopulmonary support, resection of a salmonella-infected abdominal aortic aneurysm, and insertion of an aortic Dacron bypass graft at a community hospital (#1). He then received inpatient treatment at three different hospitals for his aortoenteric fistula (Table 1).

**Table 1.** Hospital Timeline of the Transected Ureter Patient.

Inpatient Hospital Stay	Timeline
Hospital #1—Community Resection of Salmonella-Infected Aortic Aneurysm and Coronary Bypass	Day 1 to 4 Months *
Home	4 Months
Hospital #2—University #1 Aortoduodenal Fistula	4 Months *
Hospital #3—University #2 Aortoduodenal Fistula	9 Months *
Home	3 Weeks
Hospital #1 Surgical Repair of Aortoduodenal Fistula and Ureter Transection	6 Weeks *
Home Care (No fistula)	6.5 Years
Total Hospital Inpatient Time = 18.5 months	

\* = Hospital Inpatient.

Three weeks after referral to ourselves the patient developed massive bleeding per rectum while at home. The family called us and the ambulance. The only operating room available nearby for emergency surgery was at his first hospital. He was taken directly from the ambulance (who reported a hypotensive patient—60 maximum systolic and bloody stools) to the operating room for exploratory laparotomy and repair of his aortoduodenal fistula. During surgery, the aorta was cross-clamped above the renal arteries to control the bleeding. The dense extensive retroperitoneal fibrosis, which involved both the Dacron graft and the duodenum, made dissection and structure identification very difficult. The duodenum was then freed and closed with absorbable sutures. Following further dissection of the extensive dense retroperitoneum, the aorta was encircled below the renal arteries. The old Dacron graft was dissected free and removed [1]. A new 16 mm Dacron graft was then inserted into the old aortic bed, after a 15-min betadine–bacitracin soak of the old aortic bed.

After completion of the aortic anastomosis and transfusion of 10 units of blood, the patient's blood pressure and shock state (systolic 50–60 mmHg) slowly improved to 80 systolic. While checking the area for bleeding, we removed the metallic clips (Weck) from various structures for further identification. One structure, a small tubular structure, then began to drain a slightly turbid brownish fluid. Further examination proved this transected structure to be the left ureter. Both the proximal and distal ends of the transected ureter were cleaned for a short distance. The ureteral ends were beveled and an intraluminal looped catheter was placed within the ureter. The two transected ends of the ureter were anastomosed with absorbable sutures, and the retroperitoneal space, the aortic graft, and the ureter were covered with omentum. The patient was transferred to intensive care where he received intravenous cephalosporin antibiotics for the next 30 days.

#### Case 2: Operative Course Outcome

This patient had no difficulty with urine production postoperatively and tolerated the ureteral catheter. Six weeks after surgery and two weeks after discharge from the intensive care unit, following urological consultation, the ureteral catheter was removed via cystoscopy under local anesthesia. Despite severe peripheral vascular arteriosclerotic disease and the subsequent loss of his left leg, the patient survived another 6 1/2 years with no further urological complications until his death due to coronary disease.

### 3. Discussion

Traumatic injuries to the urinary system are fairly common [3]. Renal structures, external genitalia, and the urinary bladder are the most frequently injured urinary system

structures. Urethral and ureteral traumatic incidents are fairly infrequent, with ureteral trauma the rarest [2]. Most ureteral injuries are a result of either penetrating trauma, especially gunshot wounds; blunt trauma, especially motor vehicle injuries; or surgical intervention [6,7]. The timely location of the ureteral injury is the predominant factor determining the outcomes of diagnosis and repair, which are frequently delayed.

Surgical procedures are the most common causes of iatrogenic ureteral injury [7]. Gynecological, urological, and pelvic surgeries—including resection of large pelvic masses, malignancy, and inflammatory processes, and/or laparoscopy—are the procedures during which injury most frequently occurs [8,9]. These ureteral injuries, which occur primarily in adults, may be divided by anatomical location, for example, distal or pelvic, mid or upper ureter. Distal injuries, especially when not recognized during surgical intervention, may present the most difficult reconstruction challenges [10].

Literature reports suggest an increasing incidence of iatrogenic ureteral trauma, especially during gynecological and general surgery [11]. Following the ICARUS guidelines, the diagnosis and management of laparoscopic injury of the ureter, including awareness during surgery and in the postoperative period, has been extensively reviewed by Wijaya et al. [9,12]. With the increasing incidence worldwide of major surgical interventions, both endoscopic and open, surgical complications involving the urinary system and the ureter remain a concern [4]. Thus, both a historic pelvic case and a more current retroperitoneal ureter case were chosen for the present discussion, in view of the continuing occurrence of iatrogenic ureteral operative injury.

Structural urological complications due to surgical procedures or trauma continue to occur, and reportedly may be increasing in the current surgical and laparoscopic era [3,4,6,7]. As surgical complications involving the ureter continue to occur, it is hoped that a majority of these injuries can be detected and corrected prior to awakening the patient. Two patient case studies are presented here to emphasize the need for awareness of possible ureteral injury. When a patient undergoes an open surgical procedure during which the ureter is injured or transected, the defect, when recognized, may be corrected, repaired, or drained prior to closure of the incision. However, when the injury remains unrecognized until after completion of surgery and awakening of the patient, the patient may become toxic or develop urinary output or drainage concerns. Today's physicians have more and better diagnostic methods to both detect and monitor ureteral injury and urinary drainage abnormalities than were available sixty years ago. Preoperative and postoperative CT scans, MRI scans, and angiography may all assist in the determination of ureteral injuries and urinary leakage etiologies, in addition to the historic IVP and cystoscopy.

The modern open or endoscopic surgeon is more aware of the possible injury to the ureter than in previous years, thanks to a combination of preoperative planning, awareness, and surgical techniques. Even large retroperitoneal tumors (up to 10 to 30 cm in diameter) may now be dissected and removed without damaging a displaced and stretched ureter. Moreover, when inadvertent injuries are recognized during the interventional therapy, many may be corrected prior to wound closure and awakening of the patient. On occasions where this is not the case (especially in gynecological or retroperitoneal surgeries), the patient may require a second or third intervention, as noted in the first case study, especially in cases of retroperitoneal fibrosis [13].

In writing this review, our aim was to raise awareness of the topic of iatrogenic ureteral injury. Our intent was to alert the reader to the value of a brief review of the anatomy and any possible inadvertent ureteral or other structural damage. Prophylactic approaches, including preoperative cystoscopy with placement of ureteral catheters, have been frequently utilized in the past to avoid such occurrences. However, this approach is no longer routine for all patients. Not placing a metallic marker clip in a dense inflammatory process might avoid the need for additional cystoscopy or other intervention, as well as possible acute long-term complications.

#### 4. Outcome

Two cases are presented of surgical patients who required abdominal exploration and treatment for highly complicated pathology. These two patient cases are examples of surgical ureteral injury, which may occur during complicated abdominal, pelvic, or retroperitoneal surgical intervention. Such injuries may be occlusive, trans-sectional, or perforated. The necessity of being alert to the possibility of ureteral injury or occlusion during a surgical procedure is emphasized. These patients developed ureteral concerns related to nonurological surgical intervention. The first patient did fairly well postoperatively except for some initial left-sided abdominal discomfort, most likely due to blunt removal of a caseous node. Thus, the question of whether to further explore the left ureter arose as a result of a single metallic clip having been applied as a marker after checking for the ureter, while no sutures were placed on the left side of the pelvis. The lack of a left-sided ureter IVP or cystoscopy function may have been related to the patient's previous remote surgery or past tuberculosis [3]. As a historical case, this patient underwent both surgeries prior to the availability of CT (computerized tomography), MRI (magnetic resonance imaging), or selective renal angiography for evaluation.

Our second patient case study presents a recognized surgical complication, namely ureteral injury (transection or ligation) sustained during a surgical procedure. This patient had received inpatient hospital treatment in three hospitals over 17 months due to an aortoenteric fistula with intermittent bleeding episodes. As an additional surgical challenge, the extensive dense retroperitoneal fibrosis encountered during surgery made structural identification difficult in this depleted hypotensive patient.

#### 5. Conclusions

As ureteral injury during surgery continues to occur, we have shown the value of being alert to the possibility of ureteral complications and the potential for correction of an injured ureter prior to awakening the patient in order to maintain normal urinary function and avoid major long-term complications, whether related to drainage, infection, or obstruction. Awareness of these issues remains relevant as more procedures are performed in outpatient departments where postoperative monitoring is limited.

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