

# Non-Surgical Treatment of Iatrogenic Postoperatively Diagnosed Ureteral Injuries

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**ABSTRACT:** **Background:** Iatrogenic ureteral injury may be seen following abdominopelvic surgeries. While ureteral injuries identified during surgery should be immediately and surgically repaired, those that are postoperatively diagnosed may be treated non-surgically by draining the ipsilateral kidney. Data regarding the outcome of this approach are still missing.

**Objectives:** To evaluate the success rates of non-surgical management of ureteral injuries diagnosed following abdominopelvic surgeries.

**Methods:** We retrospectively reviewed the files of all patients treated for iatrogenic ureteral injuries diagnosed following abdominopelvic surgeries. Patients' ipsilateral kidney was percutaneously drained following diagnosis of injury by either nephrostomy tube (NT)/nephro-ureteral stent (NUS) or double-J stent (DJS) inserted retrogradely. The tube was left in place until a pyelogram confirmed healing or a conservative approach was abandoned due to failure.

**Results:** Twenty-nine patients were identified as having ureteral injury following abdominopelvic surgery. Median time from injury to renal drainage was 9 days, interquartile range (IQR) 4–17 days. Seven cases (24%) had surgical repair. Among the other 22 patients, in 2 oncology patients the conservative approach was maintained although renal drainage failed to resolve the injury. In the remaining 20, median drainage length was 60 days (IQR 43.5–85). Calculated overall success rates following renal drainage was 69% (18/29), and with NUS approached 78.5%.

**Conclusions:** Ureteral injuries diagnosed following abdominopelvic surgeries can be treated conservatively. Ipsilateral renal drainage should be the first line of treatment before surgical repair, and NUS may be the preferred drainage to obtain spontaneous ureteral healing.

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**KEY WORDS:** ureter, injury, surgery, percutaneous drainage

Iatrogenic ureteral injury is a rare phenomenon following abdominopelvic surgery. In the urologic literature, the procedures accounting for the vast majority of consequent ureteral injuries are obstetric and gynecologic surgeries, followed by colorectal and vascular [1,2]. Technical difficulties

reported as possible risk factors for intraoperative ureteral injuries are heavy bleeding, endometriosis, enlarged uterus, adhesions and obesity [3], while the mechanism of injury, specifically in obstetric-gynecologic patients, may be excessive electrocoagulation of the uterine vessels and the cardinal ligaments near the ureter [3] or suturing of an extended uterine incision in an attempt to control excessive bleeding within the broad ligament [4].

In a large series reviewing thousands of obstetric and gynecologic surgeries, the iatrogenic ureteral injury rate was found to be as low as 0.02%–0.24% [3,5,6]. Once ureteral injury is identified the management may be challenging, since minimal intervention and short hospitalization are of utmost priority for both patients and physicians. A literature review reveals that while ureteral injuries identified during abdominopelvic surgeries should be immediately and surgically repaired, those diagnosed postoperatively may be treated non-surgically by draining the ipsilateral kidney either in an antegrade (percutaneous) or a retrograde fashion [1,4,5,7]. However, data regarding the outcome of this conservative approach are lacking.

We present our conservative approach to such cases and report the success rates of non-surgical management of ureteral injuries diagnosed following abdominopelvic surgeries.

## PATIENTS AND METHODS

After obtaining approval from our Institutional Review Board, we retrospectively reviewed the files of all patients who had been treated in our department for iatrogenic ureteral injuries that occurred during abdominopelvic surgeries but were diagnosed later.

We included ureteral insults caused during general surgery, as well as vascular, urology and obstetrics/gynecology surgery cases referred to us from within our institute or from other medical centers. Of interest were ureteral injuries caused either thermally or mechanically (i.e., stitch, clip). Cases whose ureteral injuries were identified and treated intraoperatively were excluded from the analysis.

In general, renal ultrasound or computed tomography (CT) of the abdomen was performed in patients admitted for ureteral injury workup in order to demonstrate ipsilateral hydronephrosis or urinary leakage (urinoma). Then, in the

setting of our Interventional Radiology Unit, a trocar needle was inserted into the renal pelvis under fluoroscopy guidance followed by insertion of a guide-wire. If the patient was afebrile an attempt was made to further advance the wire into the urinary bladder and insert a nephro-ureteral stent (NUS) over it (i.e., an internal-external drain with an extracorporeal proximal edge and a distal coil located in the urinary bladder). If this attempt was unsuccessful, a nephrostomy tube (NT) was introduced.

Antegrade pyelography was scheduled for 1.5–3 weeks later in all patients for reevaluation of the injured site. Provided no leakage of contrast dye, or complete or incomplete obstruction was demonstrated, the tube was left closed on the patient's flank and removed the following day. If leakage or any degree of obstruction were shown, the tube – either NUS or NT – was left in place and re-imaging combined with tubing exchange was scheduled for 6 weeks with the same policy applied to manage the findings.

In a few exceptional cases, usually according to the patient's request, a double J stent (DJS) was inserted in an antegrade or retrograde fashion instead of the NUS. It was subsequently removed if no ureteral leak was demonstrated on a routine retrograde pyelogram carried out in the operating room at 6 week intervals.

Thereafter, patients were followed bi-annually in an outpatient clinic for a period of 2 years. After 2 years, they were released from regular follow-up if no vaginal urinary leakage was reported and no evidence of hydronephrosis or renal functional deterioration was seen in repeat ultrasound images, renal scans or serum blood tests. For analysis purposes we recorded patient gender, age, type and date of causative surgery, signs and symptoms of ureteral injuries, injured ureteral side and segment, time from injury to renal drainage, drainage length, need for re-implantation/endo-ureterotomy, and date of definitive surgery.

Treatment was considered successful if there was no need for surgical repair, no recurrence of vaginal leak, and no evidence of renal re-obstruction on repeat tests. Statistical values are given in median and range, unless otherwise specified.

## RESULTS

Between the years 2001 and 2013, 29 patients were identified as having ureteral injuries following abdominopelvic surgeries and who met the inclusion criteria. The age of the patients (28 females, 1 male) was 44 years [interquartile range (IQR) 35–50 years].

Time from injury to renal drainage was 9 days (IQR 4–17 days). The signs and symptoms that brought the ureteral injury to medical attention were urinary vaginal leak in 14 patients (48%), ipsilateral flank pain in 10 (35%), abdominal pain with or without systemic fever in 4 (14%), and incidental postoperative sonographic finding of hydronephrosis in one (3%).

**Table 1.** Causative surgery, related segment of injured ureter and number of re-implantations for each surgery

Surgery	No. of patients	Injured segment	Re-implantations
Laparoscopic hysterectomy	9	DU	2
Open hysterectomy	2	DU	2
Radical hysterectomy	2	DU	0
Cesarean section	7	DU	0
Laparoscopic oophorectomy	2	DU	1
Laparoscopic adhesiolysis due to endometriosis	3	DU DU MU	1*
Traumatic labor, cervix suturing	1	DU	0
Hysteroscopy	2	MU DU	1
Low anterior resection of colon	1	MU	0

\*Laser endo-ureterotomy

DU = distal ureter, MU = mid-ureter

Eighteen injuries (62%) involved the right ureter, while 11 were on the left side. Antegrade pyelography demonstrated distal ureteral involvement in 26 cases (90%) and mid-ureteral involvement in 3 (10%). Complete ureteral obstruction was initially demonstrated in 19 cases (65.5%) and partial obstruction in 10 (34.5%). No cases of complete ureteral transection were demonstrated in this case series.

Table 1 summarizes the causative surgeries, related segments of the injured ureters, and the number of re-implantations performed for each causative surgery. Overall, seven cases (24%) culminated in ureteral definitive surgery (ureteral re-implantation in six and ureteroscopy with laser endo-ureterotomy in one), including two with partial ureteral obstruction and five with complete obstruction. Time from injury to definitive surgery was 86 days (55–223 days). Time from renal drainage to a medical decision regarding the need for definitive surgery was 49 days and was based on repeat pyelograms in which neither radiographic improvement of the urinary leakage nor advancement of a guide-wire beyond the obstruction was seen.

In 22 patients (76%), temporary drainage of the ipsilateral urinary system remained the sole definitive treatment. However, this group included two patients with locally advanced, previously irradiated oncologic disease declared not suitable for definitive reconstructive surgery; it was therefore decided to indefinitely carry on with permanent drainage (283 and 1380 days post-insertion). For the remaining 20 patients, median drainage length until healing of the ureteral injury was 60 days (IQR 43.5–85 days). Follow-up was available in 19 of these 20 patients (1 was lost to follow-up), lasting more than 2 years in 13 and between 8 months and 2 years in 6 patients.

None of the patients suffered from repeat urinary leakage or from any obstructive ureteral disease, based on patients' complaints, repeat ultrasound images (excluding moderate/

severe hydronephrosis and showing preserved parenchymal thickness), dynamic renal radioisotope scans (applied at least once during the follow-up and repeated whenever obstruction was suspected), and routine renal functional tests (blood urea nitrogen and serum creatinine levels).

For the entire series, an initial diagnosis of complete obstruction per imaging even in the presence of retroperitoneal or vaginal urinary leak did not rule out subsequent successful advancement of either a NUS or a DJS beyond the injured segment in 13 of 19 cases (68%), with a consequent cure rate of 63% (12/19) compared with 70% (7/10) and 80% (8/10), respectively, in cases of partial obstruction.

Moreover, NUS insertion, either primarily or following NT insertion, was successfully applied in 14 female patients (12 who had initially demonstrated complete obstruction). In 11 of them (78.5%) complete resolution of ureteral injury eventually occurred. Insertion attempts were not applied more than twice in any patient.

## DISCUSSION

Since the introduction of the nephrostomy tube (NT) in the 1980s, we have witnessed a changing trend in management of the injured ureter. While in the past the standard of care was open repair, growing evidence pointed to the safety and efficacy of endoscopic intervention as a sole treatment. Lask et al. [7] reviewed 44 consecutive ureteral injuries treated in their medical center: the first 24 cases were treated with immediate reconstructive surgery and the other 20 with NT insertion alone. Complete recovery rate in the second group was reported to be as high as 80% and resulted in significantly decreased re-operation and morbidity rates. Similarly, Giberti and colleagues [8] compared endo-urological techniques and open surgery in the treatment of ureteric injuries following obstetric and gynecologic surgeries. Sixty-three women were treated for 72 ureteric lesions. In 9 women, 10 ureteric lesions were identified and treated intraoperatively. In 54 women, ureteric injuries were diagnosed 2–120 days postoperatively, of whom 29 required open repair and the remaining 25 were treated endo-urologically. The first-line treatment for all was an attempt to insert a DJS in a retrograde fashion and leave it in situ for 3 months, with or without balloon dilatation/cold knife incision of a stricture. If this maneuver failed, a NT placement would have been the second-line treatment. For the short term, the authors identified comparable cure rates for delayed surgical repair, endo-urological procedure and immediate intraoperative repair (87%, 88% and 90%, respectively). However, for the long term the success rates of the endo-urological approach fell to as low as 64% due to ureteral re-stenosis.

Preoperative radiotherapy was found to negatively affect cure rates of the injured ureter. Later studies [9-11] also reviewed delayed recognized iatrogenic ureteral injuries (mostly follow-

**Table 2.** Clinical characteristics and reported outcomes of previously published series of conservative management of iatrogenic ureteral injuries

	Donnez et al. [6]	Lask et al. [7]	Giberti et al. [8]	Ku et al. [9]	Parpala-Sparman et al. [10]	Ustunsoz et al. [11]
No. of injured ureters	7	44	62	30	72	24
Endoscopic management	7 DJS	24 NT	19 NT 6 DJS	7 NT 9 DJS 1 NT + DJS	33 NT 14 DJS	8 NT only 10 NT+ DJS
Time (days) from injury*	5–10		2–20	52 (2–382)	6 (0–1961)	
Short-term success rate			88%	65%		
Long-term success rate	71%	80%	64%		6% NT only 33% DJS	87% NT for obstruction 56% NT for rupture 63% DJS

\*Median (range)

NT = nephrostomy tube, DJS = double J stent

ing obstetric and gynecologic procedures) and reported various success rates, ranging between 6% and 87%. The clinical characteristics and the reported outcomes are summarized in Table 2.

In accordance with the recommendation published in the literature that “stenting should be considered as a first line of treatment whenever possible” [10], we attempted percutaneous drainage of the kidney by NT/NUS as the first line of treatment in all cases with suspected iatrogenic ureteral injuries. Moreover, as previously reported by others [8], oncologic patients with a past medical history of radiation therapy experienced failure of conservative treatment with either NT/NUS or DJS. Given the relatively low success rates with retrograde DJS insertion in other studies [10,11], which are also reported in the most recent European Association of Urology guidelines on iatrogenic trauma [12], we maintain this method for certain cases where the patient’s preferences played a part in the case management.

In this study we present for the first time the results of percutaneous insertion of a NUS tube as an optional treatment for iatrogenic ureteral injury. In our series this method was successfully implemented in 14 cases (12 of which initially demonstrated complete ureteral obstruction) where it served as the ultimate drainage and culminated in complete resolution of the ureteral injury in 11 (78.5%). This outcome is in line with previous reported success rates [6-11] and does not exceed the time line of 3 months previously reported as the time needed for ureteral recovery with an endo-stent [6,8].

Other advantages of NUS over DJS include the insertion setting (interventional radiology and local anesthesia versus operating room and sedation or general anesthesia) and the approach (antegrade versus retrograde), which is more convenient as it enables repeat antegrade pyelograms without the need for an operating room.

Despite the long-term satisfactory results that are comparable to those reported in previous studies, and despite our unique experience with a NUS which is reported here for the first time,

this study has limitations that should be addressed, such as its retrospective nature and the fact that the series is too small to draw substantial conclusions or precisely predict estimated success rates given the proposed mechanism of injury. Yet, our relatively high long-term success rates with a non-surgical approach for iatrogenic ureteral injuries strongly support the primary percutaneous approach with either a NT or (preferably) a NUS, as first-line treatment before an open surgical approach is considered, even in cases of complete obstruction with or without vaginal/retroperitoneal urinary leak.

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