Published in final edited form as:

Int Urogynecol J. 2020 February ; 31(2): 359–363. doi:10.1007/s00192-019-03949-2.

Factors in delay of diagnosis of gynecologic ureteral injuries at a rural academic hospital

Robert Shapiro¹, Kylie Fuller¹, Brian Wiseman¹, Christopher Bell¹, Gary Wu¹, Rahul Mannan¹, Omar Duenas Garcia¹

¹Departments of Obstetrics & Gynecology, School of Medicine, West Virginia University, PO Box 9186, Robert C. Byrd Health Sciences Center, Morgantown, WV 26506, USA

Abstract

Introduction and hypothesis—Ureteral injuries are a source of morbidity, and delays in diagnosis can increase the risk for long-term sequelae. Our aim was to quantify and describe iatrogenic ureteral injuries in a rural tertiary care center. Our secondary goal was to evaluate the impact of delayed diagnosis of ureteral injury on patient outcomes and whether cystoscopy had any influence on these outcomes.

Methods—A retrospective chart review was undertaken for ureteral injuries, identified by the ICD-9 code from 1997 to 2017 at West Virginia University (WVU) Hospital. Injuries were categorized by procedure, surgeon specialty, location (WVU versus community hospital), and intraoperative cystoscopy. A delay in diagnosis was defined as a ureteral injury sustained during surgery not diagnosed intraoperatively.

Results—Forty-six patients were identified with iatrogenic ureteral injury at WVU. Twenty-seven occurred during gynecologic procedures (59%). Fourteen ureteral injuries were sustained at community hospitals and transferred to WVU for evaluation and treatment. Fifty percent of those had a known delay in diagnosis. The average delay in diagnosis for transferred patients was 6.5 days vs. 3.6 days for patients with ureteral injury sustained at WVU. Cystoscopy was only utilized in 37% (10/27) of gynecologic cases involving a ureteral injury. When cystoscopy was utilized, it was 80% (8/10) effective in helping to identify ureteral injury.

Conclusions—Within a rural population, approximately half of patients with ureteral injuries were transferred to a tertiary care center for evaluation and treatment. Transferred patients were more likely to have a delay to diagnosis than patients who had injuries sustained at WVU. The delayed diagnosis patients had comparatively worse outcomes. Gynecologic surgeons working in rural hospitals should be adequately trained to perform diagnostic cystoscopy.

Keywords

Ureteral injury; Genitourinary trauma; Cystoscopy; Iatrogenic

Robert Shapiro, rshapiro@hsc.wvu.edu.

Conflicts of interest None.

This manuscript is an original work and has not been previously published or under consideration for publication elsewhere.

Introduction

Ureteral injuries are an uncommon occurrence, representing < 1% of all genitourinary injuries [1]. For surgeons performing pelvic surgery, an injury to the ureter is a feared complication because of the difficulty of intraoperative diagnosis. It is estimated that 52–82% of iatrogenic ureteral injuries occur during gynecologic surgery, specifically with hysterectomies [2]. While the literature suggests gynecologic surgeries have the highest ureteral injury rate, it should be noted these injuries also occur during surgery with other specialties, such as general surgery, vascular, orthopedic, and urologic procedures. The most common mechanism of injury is ligation, followed by other causes such as kinking by suture, transection/avulsion, crush, and devascularization [3].

Early diagnosis of ureteral injury, whether iatrogenic or traumatic, is of critical importance in preventing significant morbidity and mortality. Ideally, an iatrogenic injury is identified and repaired intraoperatively. Unfortunately, the diagnosis is delayed in > 50% of cases [3]. Malignancy, adhesions, pelvic organ prolapse, and lack of surgeon awareness have all been implicated in delayed diagnosis [4]. If the injury is not recognized promptly, it may cause impaired renal function or lead to nephrectomy [5]. In one particular study, ureteral injury diagnosed beyond 3 days from surgery was unlikely to be amenable to stent placement and ultimately resulted in serious complications [6].

Universal cystoscopy has been proposed as a method to avert delayed diagnosis of a ureteral injury. Proponents of routine cystoscopy state that injuries are more likely to be detected and repaired when cystoscopy is routinely performed. Dissenters counter that the available evidence does not support routine cystoscopy at the current rates of lower urinary tract injury, and cystoscopy should only be performed when injury is suspected or when performing hysterectomy with concurrent procedures that increase the risk of lower urinary tract injury [7].

West Virginia University is a rural academic center that treats a population from a wide geographical area. Additionally, it accepts transfers and referrals from many smaller rural hospitals that lack adequate gynecologic/urologic care. Our aim was to quantify and describe iatrogenic ureteral injuries in a rural tertiary care center. Our secondary goal was to evaluate the impact of delayed diagnosis of ureteral injury on patient outcomes and whether cystoscopy had any influence on these outcomes.

Methods

We performed an ICD-9 code search of the electronic medical record system at West Virginia University Hospital, from 1997 to 2017. Local Investigative Review Board (IRB) approval was obtained for this study. For all ureteral injuries, we used the ICD-9 codes: 867.2: injury to the ureter without an open wound into the cavity; 867.3: injury to the ureter with an open wound into the cavity. Patient charts were retrospectively reviewed. Basic demographic information was obtained. Injuries were categorized by type (iatrogenic, traumatic blunt, traumatic penetrating) and location (proximal, mid, distal, and right/left). Iatrogenic injuries were categorized by surgical specialty (gynecologic, general surgical and

subspecialties, urologic, orthopedic), specific type of surgery (open, laparoscopic, transvaginal, etc.), location (WVU versus community hospital), and the use of cystoscopy to aid in diagnosis. All ureteral injuries were evaluated, looking at initial and subsequent management strategies. When available, information regarding delays in diagnosis and transfers from smaller rural hospitals was recorded. Delayed diagnosis was defined as ureteral injury sustained during surgery and not being identified intraoperatively. Patient follow-up was recorded when available as well as any potential long-term sequelae. Sequela was defined as any newly diagnosed urinary pathology related to the initial ureter injury such as recurrent UTI, hydronephrosis, reoperations, strictures, fistulas, etc.

Statistical analysis was performed with chi-square test of association and Fisher's exact test of association with a significance level of $p < 0.05$.

Results

Gynecologic injury

ICD-9 search revealed 46 patients with iatrogenic injuries; 40/46 (87%) of those injuries were in females. The mean age of the patients was 49.3 years (range 21–86). Twenty-seven of 46 (59%) of the iatrogenic injuries occurred during gynecologic surgery, followed by general, urologic, and orthopedic surgery, respectively. The types of surgery and distribution in which the injuries occurred are shown in Table 1.

Of the gynecologic surgery patients, 14/27 (51.8%) were transferred to our facility with a delayed diagnosis of ureteral injury. Of the remaining 13 patients that sustained a ureteral injury at WVU, 3 had a delay in diagnosis (3/13, 23.1%). The average delay in diagnosis for transferred patients was 6.5 days vs. 3.6 days for patients undergoing surgery at WVU. There was no significant difference in the laterality of the ureteral injury with 13 injuries on the left and 14 injuries on the right (Table 2). Our data showed a trend that transferred patients were more likely to have a delay in diagnosis vs. patients who were not transferred ($p = 0.0871$).

Although follow-up data were limited in some patients, review of records indicated complete resolution of the injury without any long-term sequelae in 19/27 (70.3%) of patients with gynecologic ureteral injuries. There were persistent sequelae from the initial injury in 5/27 (18.5%), and 3/27 (11.1%) were lost to follow-up. In transferred patients with delayed diagnoses, 6/14 (42.8%) patients' injuries resolved without sequelae, 3/14 (21.4%) had persistent sequelae (1/3 with vesico-vaginal fistula, 2/3 with overactive bladder/vesicoureteral reflux), and 5 patients were lost to follow-up. In patients with delayed diagnoses that occurred at WVU, all initially required a nephrostomy (100%); 2/3 (66.7%) injuries had persistent sequelae related to the initial injury (1 with persistent hydronephrosis s/p ureteral reimplantation leading to nephrectomy, 1 with recurrent UTI s/p ureteral reimplantation), with 1 patient lost to follow-up.

Injury was also associated with the type of gynecologic surgery, with total abdominal hysterectomy (TAH) accounting for 8/27 (29.6%), laparoscopic/robotic-assisted laparoscopic hysterectomy accounting for 7/27 (25.9%), exploratory laparotomy 3/27

(11.1%), transvaginal hysterectomy 3/27 (11.1%), unknown type of hysterectomy 2/27 (7.4%), pelvic organ prolapse repair 2/27 (7.4%), vaginal prolapse surgery 1/27 (3.7%), and bilateral salpingo-oophorectomy 1/27 (3.7%).

Cystoscopy was only utilized in 37% (10/27) of gynecologic cases involving a ureteral injury. When cystoscopy was utilized, it was 80% (8/10) effective in helping to identify ureteral injury. On two laparoscopic cases where a ureteral injury was subsequently diagnosed, the cystoscopy was normal. This was attributed to delayed thermal injury.

Discussion

Ureteral injuries, although rare, can be potentially devastating and result in significant morbidity. Injuries may occur from blunt or penetrating trauma, but most frequently are iatrogenic, occurring during surgery. Due to the challenges in treating ureteral injuries, the optimal strategy is prevention.

The literature shows that > 50% of iatrogenic ureteral injuries occur in gynecologic surgery [8–12]. This finding is consistent with our study, where gynecologic procedures accounted for 59% of the injuries.

The incidence of iatrogenic ureteral injury also varies depending on the type of surgery being performed. In a review performed by Gilmour et al., ureteral injuries occurred in 1.3 per 1000 total abdominal hysterectomies and up to 7.8 per 1000 in laparoscopic hysterectomy [13]. Most studies suggest risk of injury to the ureter is greater in minimally invasive pelvic surgery versus open pelvic surgery [14]. In our study, laparoscopic hysterectomy (including robotic) had a nearly equivalent number of ureteral injuries compared with total abdominal hysterectomy, 8 (17%) and 9 (20%), respectively. However, when taken together, all hysterectomy procedures, including transvaginal, laparoscopic, robotic, and total abdominal, were responsible for 20 of 46 injuries (43%).

Unrecognized ureteral injury can lead to significant morbidity. Patients may present with a variety of complications including urinoma, abscess, fistula, and worsening renal function [3, 10, 11]. Unfortunately, multiple studies have demonstrated that 50–70% of injuries were not diagnosed until after the operation [13, 14]. This finding is consistent with our study, in which 50% of diagnoses at our hospital were delayed. Delays in diagnosis also have significant implications for long-term outcomes, including the need for more complex repairs and lower rates of long-term resolution [10, 11, 15].

At our academic center, we often receive patients from smaller rural hospitals throughout the state of West Virginia and surrounding counties in Southern Pennsylvania and Western Maryland. Many of the patients are transferred because of medical complications and the lack of appropriate resources. We hypothesized that patients who were transferred to our hospital have prolonged delays in diagnosis leading to worse outcomes. In our study, transferred patients had higher rates of delayed diagnoses (64.2%) compared with those diagnosed “in house” (30.7%).

Review of the literature reveals few articles which provide specifics regarding diagnosis, management, and outcome of ureteral injuries, especially in the context of rural healthcare. West Virginia University (WVU) Hospital provides a unique setting to examine this complication. As one of the only tertiary care institutions in the entire state, WVU hospital is likely to care for most, if not all, of the ureteral injuries in the state because of the complex nature of the injury. Thus, the authors feel this article is an accurate representation of ureteral injuries within a rural population.

Ninety percent of the hospitals in West Virginia are designated Critical Access Hospitals (CAH) [16]. To receive the CAH designation, the hospital must have 25 or fewer acute care patient beds and be located > 35 miles from another hospital [17]. We therefore believe that most of the patients transferred to WVU were from critical access hospitals, since most of the hospitals within WV carry this designation. Limited resources and lack of immediate access to urologic evaluation within these critical access hospitals may contribute to delays in diagnosis.

In general, delayed versus early diagnosis of ureteral injury carries an increased risk of long-term patient sequelae. Based on our results, one could argue that gynecologic surgery should not be performed at CAH. The authors do not support this argument, because this would severely limit access to gynecology services for many patients that depend on these hospitals for care. However, the authors do endorse the opinion of the American College of Obstetrics & Gynecology that, whenever feasible, the vaginal route is the preferred method of hysterectomy [18]. Vaginal hysterectomy has a lower overall complication rate, including ureter injury, cost, and length of hospitalization, compared with other routes [19].

Routine use of cystoscopy should strongly be considered when gynecologic surgery is performed at rural or CAH. University of Michigan instituted a policy of universal cystoscopy after benign hysterectomy and compared detection rates after institution of the policy ($n = 1848$ women) to historical controls ($n = 973$ women). Twice as many injuries were detected during surgery after implementation [47% (916 of 34 injuries) vs. 24% (6 of 25 injuries)], and the prevalence of delayed ureteral injury decreased seven-fold (0.7 vs. 0.1%) [20]. Our study also showed that when cystoscopy was utilized in gynecologic surgery, it was 80% effective in helping to identify ureteral injury.

We acknowledge weaknesses in our study, the most obvious of which is its retrospective design. Additionally, there are also weaknesses inherent to ICD-9 and billing code searches, such as any ureteral injury that was either miscoded or never coded at all. Another fault with our study was the amount of missing or incomplete records, especially with records older than our electronic medical record, which was put in place in 2006. Finally, paperwork documenting injury details were often absent or incomplete in many of our transferred patients from smaller rural hospitals. It is important to note that the incidence of ureteral injuries during gynecologic surgery are quite rare, making the investigation of this topic challenging [21–26].

Conclusions

Ureteral injuries are rare and are associated with significant morbidity. Iatrogenic injuries, especially when the diagnosis is made postoperatively, may result in worse long-term outcomes. For tertiary care centers that draw from a large geographical area, patients transferred from outlying rural hospitals have significant delays in injury diagnosis, which may lead to lower percentages of long-term resolution in these patients. Therefore, we recommend efforts to increase awareness and to continue to educate surgeons at small and large institutions about prompt diagnosis and treatment of ureteral injuries to improve patient outcomes. Gynecologic surgeons working in rural or CAH should be adequately trained to perform diagnostic cystoscopy.

Sources of funding and research support

West Virginia University.

References

1. Elliott SP, Mcaninch JW. Ureteral injuries from external violence: the 25-year experience at San Francisco General Hospital. *J Urol*. 2003;170(4 Pt 1):1213–6. [PubMed: 14501727]
2. Summerton DJ, Djakovic N, Kitrey ND et al. Guidelines on urological trauma. 2015 Available at: <http://uroweb.org/guideline/urological-trauma/>. Accessed Sept 2016.
3. Brandes S, Coburn M, Armenakas N, Mcaninch J. Diagnosis and management of ureteric injury: an evidence-based analysis. *BJU Int*. 2004;94(3):277–89. [PubMed: 15291852]
4. Liapis A, Balkas P, Giannopoulos V, Creatsas G. Ureteral injuries during gynecologic surgery. *Int Urogynecol J*. 2001;12:391–3.
5. Esparaz AM, et al. Iatrogenic urinary tract injuries: etiology, diagnosis, and management. *Semin Interv Radiol*. 2015;32(2):195–208 PMC. Web. 2 Sept. 2018.
6. Oh B, Kwon D, Park K, et al. Late presentation of ureteral injury after laparoscopic surgery. *Obstet Gynecol*. 2000;95(3):337–9. [PubMed: 10711539]
7. Peacock L, Young A, Rogers R. Universal cystoscopy at the time of benign hysterectomy: a debate. *Am J Obstet Gynecol*. 2018;219(1):75–7. [PubMed: 29941279]
8. Parpala-Spärman T, Paananen I, Santala M, Ohtonen P, Hellström P. Increasing numbers of ureteric injuries after the introduction of laparoscopic surgery. *Scand J Urol Nephrol*. 2008;42(5):422–7. [PubMed: 18609278]
9. Ostrzenski A. A review of laparoscopic ureteral injury in pelvic surgery. *Obstet Gynecol Surv*. 2003;58(12):794 Lippincott Williams & Wilkins, Inc. 2003. 0029–7828. [PubMed: 14668660]
10. Best CD, Petrone P, Buscarini M, et al. Traumatic ureteral injuries: a single institution experience validating the American Association for the Surgery of Trauma-organ injury scale grading scale. *J Urol*. 2005;173(4):1202–5. [PubMed: 15758748]
11. Ghali AM, El malik EM, Ibrahim AI, Ismail G, Rashid M. Ureteric injuries: diagnosis, management, and outcome. *J Trauma*. 1999;46(1):150–8. [PubMed: 9932699]
12. Selzman AA, Spirnak JP. Iatrogenic ureteral injuries: a 20-year experience in treating 165 injuries. *J Urol*. 1996;155(3):878–81. [PubMed: 8583597]
13. Gilmour DT, Das S, Flowerdew G. Rates of urinary tract injury from gynecologic surgery and the role of intraoperative cystoscopy. *Obstet Gynecol*. 2006;107(6):1366–72. [PubMed: 16738165]
14. Abboudi H, Ahmed K, Royle J, Khan MS, Dasgupta P, N'dow J. Ureteric injury: a challenging condition to diagnose and manage. *Nat Rev Urol*. 2013;10(2):108–15. [PubMed: 23318355]
15. Burks FN, Santucci RA. Management of iatrogenic ureteral injury. *Ther Adv Urol*. 2014;6(3):115–24. [PubMed: 24883109]

16. Current active Critical Access Hospitals Available AT: <http://www.hca.wvu.gov>. Last accessed in 2018.
17. Joynt K, Orav J, Jha A. Mortality rates for Medicare beneficiaries admitted to critical access and non-critical access hospitals, 2002–2010. *JAMA*. 2013;309(13):1379–87. [PubMed: 23549583]
18. American College of Obstetricians and Gynecologists. Committee opinion no. 701: choosing the route of hysterectomy for benign disease. *Obstet Gynecol*. 2017;129:e155–9. [PubMed: 28538495]
19. Nieboer T, Johnson N, Lethaby A, Tavender E, Garry R, Van Voorst S, Mol B, Kluivers K. Surgical approach to hysterectomy for benign gynaecological disease. *Cochrane Database Syst Rev*. 2009;(3): CD003677 10.1002/14651858.CD003677.pub4.
20. Chi AM, Curran DS, Morgan DM, Fenner DE, Swenson CM. Universal cystoscopy after benign hysterectomy: examining the effects of an institutional policy. *Obstet Gynecol*. 2016;127:369–75. [PubMed: 26942367]
21. Brummer TH, Jalkanen J, Fraser J, Heikkinen AM, Kauko M, Makinen J, et al. FINHYST, a prospective study of 5279 hysterectomies: complications and their risk factors. *Hum Reprod*. 2011;26: 1741e51. [PubMed: 21540244]
22. Harkki-Siren P, Sjoberg J, Makinen J, Heinonen PK, Kauko M, Tomas E, et al. Finnish national register of laparoscopic hysterectomies: a review and complications of 1165 operations. *Am J Obstet Gynecol*. 1997;176:118e22. [PubMed: 9024101]
23. Chan JK, Morrow J, Manetta A. Prevention of ureteral injuries in gynecologic surgery. *Am J Obstet Gynecol*. 2003;188:1273e7. [PubMed: 12748497]
24. Findley AD, Solnik MJ. Prevention and management of urologic injury during gynecologic laparoscopy. *Curr Opin Obstet Gynecol*. 2016;28:323e8. [PubMed: 27327882]
25. Sharp HT, Adelman MR. Prevention, recognition, and management of urologic injuries during gynecologic surgery. *Obstet Gynecol*. 2016;127:1085e96. [PubMed: 27159741]
26. Teeluckdharry B, Gilmour D, Flowerdew G. Urinary tract injury at benign gynecologic surgery and the role of cystoscopy: a systematic review and meta-analysis. *Obstet Gynecol*. 2015;126:1161e9. [PubMed: 26551173]

Table 1

Surgical classifications, types, and their proportion of ureteral injuries

Classification	Number	Type of surgery
Gynecologic	27 (59%)	Total abdominal hysterectomy: 9 (20%)
		Laparoscopic or robotic hysterectomy: 8 (17%)
		Transvaginal hysterectomy: 3 (7%)
		Pelvic prolapse repair: 3 (7%)
		Oophorectomy: 1 (2%)
		Ovarian cyst removal: 1 (2%)
		Exploratory laparotomy for ovarian mass: 1 (2%)
General surgical	11 (24%)	Laparoscopic surgery for endometriosis: 1 (2%)
		Exploratory laparotomy: 4 (9%)
		Low anterior resection: 3 (7%)
		Posterior pelvic exenteration: 2 (4%)
		Retroperitoneal abscess debridement: 1 (2%)
		Excision of pelvic mass: 1 (2%)
		Ureteroscopy: 6 (13%)
Urologic	7 (15%)	Ureteral stent placement: 1 (2%)
Orthopedic	1 (2%)	Hemipelvectomy: 1 (2%)

Table 2

Locations of ureteral injuries in gynecologic cases

Location of injury	Number
Total left	13 (48.1%)
Total right	14(51.8%)
Distal left	11 (40.7%)
Distal right	9 (33.3%)
Mid right	2 (7.4%)
Mid left	0 (0.0%)
Unknown right	3 (11.1%)
Unknown left	2 (7.4%)