

Original Article

# Very Low Rates of Ureteral Injury in Laparoscopic Hysterectomy Performed by Fellowship-trained Minimally Invasive Gynecologic Surgeons

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**ABSTRACT** **Study Objective:** The objective of this case series is to evaluate the rates of ureteral injury at the time of laparoscopic hysterectomy among high-volume fellowship-trained surgeons. **Design:** A retrospective chart review was performed, evaluating laparoscopic hysterectomy cases between 2009 and 2019 performed exclusively by fellowship-trained surgeons. **Setting:** Division of Minimally Invasive Gynecologic Surgery (MIGS) at the Brigham and Women's Hospital and Brigham and Women's Faulkner Hospital, a Harvard Medical School teaching hospital in Boston. **Patients:** All patients undergoing laparoscopic hysterectomy by one of 5 surgeons with fellowship training in MIGS. **Interventions:** None. **Measurements and Main Results:** A total of 5160 cases were handled by MIGS surgeons between 2009 and 2019 at our institution. Of these cases, 2345 were laparoscopic hysterectomy cases with available intraoperative and postoperative documentation. Most patients had undergone previous surgeries, and the most common indications for hysterectomy included uterine myomas, pelvic pain/endometriosis, and abnormal uterine bleeding. At the time of hysterectomy, 1 ureteral injury (0.04%) was noted. No additional delayed ureteral injuries were observed. Most patients were discharged home the same day (64.9%) and did not have any postoperative complications (63.9%) as designated by the Clavien-Dindo classification. **Conclusion:** Ureteral injury, although rare, is more prevalent in gynecologic surgery than in other surgical disciplines that have some focus on the pelvis. No study to date has evaluated the effect of surgical training and volume on rates of ureteral injuries. This study retrospectively examined ureteral injury rates for one group of high-volume fellowship-trained surgeons and found their rates to be lower than the national average. Proposals are presented for optimizing training and delivery of gynecologic surgical care to minimize complications. *Journal of Minimally Invasive Gynecology* (2022) 29, 1099–1103. © 2022 AAGL. All rights reserved.

**Keywords:** Fellowship-trained gynecologic surgeons; Laparoscopic hysterectomy; Surgical training; Ureteral injury

Hysterectomy is the most common major gynecologic procedure, with up to one-third of women in the United States undergoing hysterectomy by the age of 60 years [1]. It is the eighth most common procedure performed inpatient

and the 12th most common outpatient, despite only 50% of the population being eligible for the procedure [2,3]. Although rates of hysterectomy are declining with the advent of alternative treatment options, it is and will remain

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Institutional review board approval was obtained from Mass General Brigham (protocol 2021P001001) approval date is April 8, 2021.

Data will be held for 7 years and made available for independent review on request.

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a mainstay of surgical therapy for women. Thus, efforts at decreasing surgical risks can have profound public health impacts.

Studies have shown that gynecologic surgeons incur most ureteral injuries (64%–82%). In comparison, surgeries with longer training requirements including colorectal, vascular pelvic, and urologic surgery have lower incidence of ureteral injury ranging from 11% to 30% [4]. Hysterectomy carries an inherent risk of injury to the urinary tract given the normal anatomic course of the ureter. This risk is increased with pathologies often encountered in patients requiring hysterectomy, including distorted tissue planes from adhesions, lower uterine segment myomas, or endometriosis [5]. Studies of all hysterectomies performed nationally reveal a rate of ureteral injury of 0.78% [6]. No data exist on rates of ureteral injuries among gynecologic subspecialties requiring additional surgical training, such as Gynecologic Oncology, Female Pelvic Medicine and Reconstructive Surgery, and Minimally Invasive Gynecologic Surgery (MIGS).

Laparoscopic hysterectomy is preferable to laparotomy because it prioritizes smaller incisions, shorter recovery times, faster return to normal activity, less blood loss, and lower risk of an infection [7]. There is no reliable estimate for a national rate of ureteral injury with laparoscopic hysterectomy. Heterogeneous studies report incidences ranging from 0.08% to 1.8% [6,8,9]. A Cochrane review of various routes of hysterectomy suggests the rate of urinary tract injury might be higher when performed laparoscopically than when performed using the open approach, although these data are outdated [10]. A 2018 systematic review reported a ureteral injury rate of 1.8% among laparoscopic hysterectomies, and a large prospective Finnish study of 5279 hysterectomies reported a ureteral injury rate of 0.3% for both abdominal and laparoscopic approaches [10,11].

No study to date has evaluated the effect of surgical training and volume on rates of ureteral injuries. The objective of this case series is to evaluate the rates of ureteral injury in laparoscopic hysterectomy performed by high-volume fellowship-trained surgeons.

## Materials and Methods

Internal review board approval was obtained from Mass General Brigham (Protocol 2021P001001). A retrospective chart review was performed, evaluating gynecologic surgery cases between 2009 and 2019 performed exclusively by 5 different fellowship-trained surgeons in the MIGS division at the Brigham and Women's Hospital and Brigham and Women's Faulkner Hospital, a Harvard Medical School teaching hospital in Boston. Each surgeon not only had completed fellowship training but also routinely performed greater than 50 hysterectomies per year.

All cases handled by the 5 fellowship-trained minimally invasive gynecologic surgeons were collected over the study period. All benign laparoscopic hysterectomy cases

were identified from this cohort. Laparoscopic-assisted vaginal hysterectomy cases were excluded.

Patient and procedure characteristics were collected from the medical records. This included demographic information, obstetric and surgical history, indication for the procedure, operative time, and estimated blood loss. Postoperative information including length of hospital stay, weight of uterine specimen, and the occurrence of any postoperative complication, as defined by the Clavien-Dindo classification within 2 months of the procedure, was also recorded [12]. The rate of ureteral injury was assessed.

## Results

A total of 5160 cases were handled by MIGS surgeons between 2009 and 2019 at Brigham and Women's Hospital and Brigham and Women's Faulkner Hospital. Of the 5160 gynecologic cases, 2345 were identified as laparoscopic hysterectomy cases with available intraoperative and postoperative documentation. This included 1753 total laparoscopic hysterectomies and 592 supracervical laparoscopic hysterectomies. At the time of hysterectomy, 1 ureteral injury (0.04%) was noted. No additional delayed ureteral injuries were observed.

Patient demographic data, indications for surgery, and procedural outcomes can be found in Table 1. The median age of patients undergoing laparoscopic hysterectomy in our study was 46 years. Most patients undergoing hysterectomy at our institution were of Caucasian race (72.0%), with 10.7% black, 6.0% Hispanic or Latino, and 4.5% Asian comprising the remaining population. The median patient body mass index (BMI) was 27.4 kg/m<sup>2</sup>. The lowest reported BMI was 15.3 kg/m<sup>2</sup> and the highest reported BMI 70.0 kg/m<sup>2</sup>.

Most patients had undergone previous surgeries, with only 828 (35.3%) with no previous procedures reported. There were 847 patients (36.1%) with at least 1 previous laparoscopy and 990 patients (42.2%) with at least 1 previous laparotomy. Most patients were multiparous, with 566 patients (24.1%) reporting no previous births. The most common indications for hysterectomy based on review of preoperative office visit notes included uterine myomas (47.7%), pelvic pain/endometriosis (36.8%), abnormal uterine bleeding (35.1%), and other diagnoses (10.7%) such as pelvic organ prolapse (305 cases, 13.0%), adnexal masses (123 cases, 5.2%), adenomyosis (71 cases, 3.0%), suspected Essure-related issues (55 cases, 2.3%), premalignancy (39 cases, 1.7%), and gender affirming surgery (16 cases, 0.7%).

Uterine weight ranged from 10 g to 3400 g, with a median weight of 201.5 g. Median operative time was 102 minutes, ranging from 28 to 387 minutes. Median estimated blood loss was 50 mL, ranging from 0 mL to 2000 mL. Most patients were discharged home the same day (64.9%) and did not have any postoperative complications (63.9%) as designated by the Clavien-Dindo classification.

**Table 1**

Parameters	Values
Demographic information	
Patient characteristics (n = 2345)	
Age (y)	46 (42–50)
Race	
White/Caucasian	1688 (72.0)
Black/African American	252 (10.7)
Hispanic or Latino	141 (6.0)
Asian	105 (4.5)
BMI (kg/m <sup>2</sup> )	27.4 (23.7–32.3)
History	
No previous surgeries	828 (35.3)
Previous laparoscopy	847 (36.1)
Previous laparotomy	990 (42.2)
Nulliparous	566 (24.1)
Indication for surgery	
Myomas	1119 (47.7)
Pelvic pain/endometriosis	862 (36.8)
Abnormal bleeding	824 (35.1)
Other	251 (10.7)
Procedural outcomes	
Uterine weight (g)	201.5 (108.0–451.8)
Operative time (min)	102 (69–144)
Estimated blood loss (mL)	50 (30–100)
Same-day discharge	1521 (64.9)
Postoperative complications*	
No complications	1498 (63.9)
Grade 1: Any deviation from the normal postoperative course without the need for pharmacological treatment or surgical, endoscopic, and radiological interventions. Allowed therapeutic regimens are drugs as antiemetics, antipyretics, analgesics, diuretics, and electrolytes and physiotherapy. This grade also includes wound infections opened at the bedside.	107 (4.6)
Grade 2: Requiring pharmacological treatment with drugs other than such allowed for grade 1 complications. Blood transfusions and total parenteral nutrition are also included.	246 (10.5)
Grade 3a: Requiring surgical, endoscopic, or radiological intervention without general anesthesia	8 (0.3)
Grade 3b: Requiring surgical, endoscopic, or radiological intervention under general anesthesia	19 (0.8)
Grade 4: Life-threatening complications requiring intermediate care or intensive care unit management	0
Grade 5: Death of a patient	0
BMI = body mass index.	
Data reported as median (interquartile range Q1–Q3) or number (%).	
* Clavien-Dindo classification.	

## Discussion

In this retrospective study, we noted a low rate of ureteral injury at the time of laparoscopic hysterectomy despite many highly complex surgeries as evidenced by patients with previous surgeries, endometriosis, and significantly enlarged uteri at our tertiary referral center. The single reported ureteral injury occurred in a case that was notable for severe abdominopelvic adhesions in the setting of multiple previous laparotomies and laparoscopies (514 g). Extensive adhesiolysis was performed with assistance from a second fellowship-trained MIGS surgeon, before exposing the pelvic organs and allowing for commencement of the hysterectomy. The ureteral injury was identified intraoperatively during the hysterectomy portion

of the procedure. The patient had an intraoperative urology consultation, at which time the procedure was converted to laparotomy for ureteral stent placement and primary ureteroureterostomy. The patient was discharged on postoperative day 2 with an indwelling ureteral double-J stent and intraperitoneal Jackson Pratt drain. After 2 weeks, she had a computed tomography of the abdomen/pelvis with no concern for retroperitoneal fluid collection or anastomotic leak. After 4 weeks, cystoscopy was performed and the stents were removed. Two weeks after stent removal, she underwent a renal ultrasound with no concern for hydronephrosis.

In our review, we reported a same-day discharge rate of 64.9% for laparoscopic hysterectomy cases performed by MIGS-trained surgeons between 2009 and 2019. At the same

institution, we evaluated these data in 2019 alone and noted the same-day discharge rate for laparoscopic hysterectomy to be 80.2%. This reflects surgical practice changes over the last decade and a shift toward laparoscopic hysterectomy as a fairly routine outpatient procedure in the present.

This study highlights the benefits of fellowship training and high-volume practice on patient outcomes and public health measures. Our reported laparoscopic ureteral injury rate is significantly lower than that reported in the literature as a national average rate for hysterectomy in general. This may be related to additional fellowship training with a strong focus on retroperitoneal dissection and maintenance of high-volume surgical practices. Putting this into context, given that approximately 450 000 hysterectomies are performed annually in the United States [1], the literature-reported ureteral injury rate for laparoscopic hysterectomy would result in approximately 360 to 8100 injuries and for all hysterectomy approximately 3500 injuries vs an estimated 180 injuries if surgeons were fellowship trained and maintained a high-volume practice. Assuming a projected cost of \$10 000 per ureteral injury, the cost savings per year nationally could approach up to \$80 million even without taking into account the effects on patients measured by pain and suffering, delayed return to daily activities and work, and potential liability costs [13]. Extrapolating these values to open procedures requiring hospital admission, the cost savings could be even higher.

High-volume surgeons have superior outcomes for the same procedures compared with lower-volume surgeons. This fact is true for hysterectomy procedures, performed through all routes [14,15]. A comprehensive, population-based review of all hysterectomies performed in New York state between 2000 and 2014 reported that very-low-volume surgeons (those with average annualized volume of 1 hysterectomy or less per month) comprised up to 41% of operating gynecologic surgeons. These very-low-volume surgeons had significantly higher overall complication rates including higher intraoperative, surgical site, and medical complications and higher rates of transfusion, longer length of stay, excessive hospital charges, and higher mortality rates than higher-volume surgeons [16].

Fellowship training, although increasing surgical volume, also exposes surgeons to more challenging cases prioritizing dissection and entry into the retroperitoneal space and isolation of the ureter from injury even in the context of complex anatomy. It is a difficult task statistically to isolate and analyze the 2 factors of volume and training/experience, given that fellowship-trained surgeons will likely have higher volume. Even so, these data suggest that some component of enhanced training and assurance of volume for gynecologic surgeons will result in much improved outcomes for our patients.

Another option to achieve improved surgical outcomes could include higher training standards in residency. More explicitly, familiarity with exploration of retroperitoneal spaces and ureterolysis combined with higher-volume

requirements for these skills may be beneficial [17]. One proposed method would be tracking in residency [18]. This could enable earlier exposure for those interested in gynecologic surgery and more time spent training alongside surgical mentors with advanced laparoscopic skills. Fellowship training would be another option to increase volume and provide mastery of retroperitoneal dissection and ureterolysis, techniques necessary for safely performing gynecologic procedures in patients with complex pathologies or multiple previous surgeries. Maintaining these skill sets would require practice models that prioritize higher-volume surgical practice (rather than an obstetrics-predominant model). This would in turn require national policies to increase reimbursement and support for gynecologic-only practices [19–21].

The limitations of our study include its single institution, retrospective nature. A prospective, randomized controlled trial across multiple institutions would be needed to examine the true causative effect of training and volume on patient outcomes. Evaluation of outcomes among high-volume surgeons without additional fellowship training could help elucidate the impact and benefit of additional training vs surgical volume as independent factors. Unfortunately, a review of this magnitude would be difficult to design, given that there does not exist a state of clinical equipoise necessary to justify such a study. Stated another way, a randomized study with enough power to distinguish training from volume in terms of causation for better surgical outcomes would be difficult or impossible to achieve and not to mention expensive. As a control, we would need to include low-volume surgeons and, if available, low-volume fellowship-trained surgeons. The scientific literature is strong enough in favor of higher volume such that randomization of patients between these groups is likely unethical. Instead, we have the opportunity and a path forward to decrease complication rates through the methods described here. Our ethics demand that we incentivize and prioritize these possibilities.

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