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Retrospective Cohort Study

Urinary tract injury during hysterectomy: Does surgeon specialty and surgical volume matter?

Emilee Khair, Fareeza Afzal, Sanjana Kulkarni, Beaux Duhe', Karen Hagglund, Muhammad Faisal Aslam

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Ureteral injury is a known complication of hysterectomies. Recent studies have attempted to correlate surgeon volume and experience with incidence of urinary tract injuries during hysterectomies. Some studies have reported that as surgeon volume increases, urinary tract injury rates decrease. To our knowledge, no studies have assessed the relationship between surgeon subspecialty and the rate of urinary tract injury rates during minimally invasive hysterectomy.

AIM

To determine the incidence of urinary tract injury between urogynecologists, gynecologic oncologists, and general gynecologists.

METHODS

The study took place from January 1, 2016 to December 1, 2021 at a large community hospital in Detroit, Michigan. We conducted a retrospective chart review of adult patients who underwent minimally invasive hysterectomy. After we identified eligible patients, the surgeon subspecialty was identified and the surgeon's volume per year was calculated. Patient demographics, medical history, physician-dictated operative reports, and all hospital visits postoperatively were reviewed.

RESULTS

Urologic injury occurred in four patients (2%) in the general gynecologist group, in one patient (1%) in the gynecologic oncologist group, and in one patient (1%) in

the urogynecologist group. When comparing high and low-volume surgeons, there was no statistically significant difference in urinary tract injury (1% *vs* 2%) or bowel injury (1% *vs* 0%). There were more complications in the low-volume group *vs* the high-volume group excluding urinary tract, bowel, or major vessel injury. High-volume surgeons had four (1%) patients with a complication and low-volume surgeons had 12 (4%) patients with a complication ($P = 0.04$).

CONCLUSION

Our study demonstrated that there was no difference in the urinary tract injury rate in general gynecologists *vs* subspecialists, however our study was underpowered.

Key Words: Minimally invasive hysterectomy; Urinary tract injury; Surgeon volume; High volume gynecologist; Low volume gynecologist

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Core Tip: Surgeon volume and experience have been shown to play a role in decreasing the number of urinary tract injuries during minimally invasive hysterectomies. One may conclude that since urogynecologists and gynecologic oncologists had additional training years after residency, they also have more experience. This may result in a decreased incidence of urinary tract injury during minimally invasive hysterectomies. To our knowledge, no studies to date have been done to assess this correlation.

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INTRODUCTION

Hysterectomy is a common gynecologic surgery in the United States. It is estimated that there are over three hundred thousand hysterectomies performed each year[1]. Ureteral injury is a known complication of hysterectomies, and it is estimated that between 52 and 82 percent of all iatrogenic urinary tract injuries occur during gynecology surgeries[2]. Studies have reported iatrogenic ureteral injury incidence as low as 0.18%[3] and as high as 2.2%[4]. These injuries increase the rates of patient morbidity and mortality such as sepsis and fistula formation[5].

The method of hysterectomy has been examined to assess this risk of urinary tract injury. Janssen *et al* [4] found that those undergoing abdominal hysterectomy had an increased risk of ureteral injury when compared with vaginal hysterectomy. Another study found that the incidence of urinary tract injury was lowest in laparoscopic supracervical hysterectomy (LSH), compared to laparoscopic assisted vaginal hysterectomy (LAVH) and total laparoscopic hysterectomy (TLH)[6].

More recently, surgeon volume and experience have been studied when assessing risk factors for urinary tract injury during hysterectomies. Vree *et al*[7] reported that high-volume surgeons (those performing greater than 51 hysterectomies per year) had shorter operative time and less estimated blood loss, but no difference in the rate of urinary tract injury when compared with low-volume surgeons (those performing less than 11 hysterectomies per year). However, another study demonstrated that patients who underwent benign hysterectomy by a high-volume surgeon (greater than 14.1 hysterectomies per year), were less likely to have bladder, ureteral, and intestinal injury when compared with those surgeons who performed less than 5.88 hysterectomies per year[8]. Janssen *et al*[4] reported that as surgeon experience increased, defined by a threshold of greater than 30 hysterectomies performed, the risk of ureter injury decreased from 2.2% to 0.5%. To our knowledge no studies have been performed evaluating the effect of surgeon subspecialty on urinary tract injury rates during minimally invasive hysterectomy.

MATERIALS AND METHODS

We conducted a retrospective chart review of adult patients who underwent minimally invasive hysterectomy (including laparoscopic and robotic methods) with and without concomitant procedures from January 1, 2016 to December 1, 2021. All procedures and postoperative care were done at a large urban hospital by a fellowship trained board-certified female pelvic medicine and reproductive surgery

(FPMRS) surgeon (also known as a urogynecologist), fellowship trained board eligible or board-certified gynecologic oncology surgeons, and board-certified general gynecologists. All patients who underwent the following surgeries with or without concomitant procedures were included: LSH, LAVH, TLH, and robotic hysterectomy. After we identified eligible patients, the surgeon subspecialty was identified and the surgeon's volume per year was calculated. Patient demographics, medical history, physician-dictated operative reports, and all hospital visits postoperatively were reviewed. Our primary outcome was the incidence of urinary tract injury between fellowship trained board-certified FPMRS surgeon, fellowship trained board eligible or board-certified gynecologic oncology surgeons, and board-certified or board eligible general gynecologists. Our secondary outcome was the incidence of urinary tract injury between high (defined by 30 or more minimally invasive hysterectomies per year) and low-volume surgeons (defined by less than 30 hysterectomies per year). To calculate a power analysis for our study, we used data reported by Mäkinen *et al*[9], who cited the rate of urinary tract injury as 4.4% and 1.3% for low- (less than 30 hysterectomies per year) and high-volume (equal to or greater than 30 hysterectomies per year) surgeons respectively. To show such an effect, with 80% power and $\alpha = 0.05$, at least 452 patients were needed in each group, for a total of 904 patients. Descriptive statistics were generated to characterize the subjects. Continuous variables were described as the mean with standard deviation or median with 25th and 75th percentiles. Categorical variables were described as frequency distributions. Univariable analysis of factors associated with surgeon type and ureteral injury were assessed using Student's t-test, analysis of variance (ANOVA) followed by multiple pairwise comparisons using the Bonferroni correction of the *P* value, and the χ^2 analysis. Non-parametric tests were performed for data that were non-normally distributed, such as the Mann-Whitney U test and Kruskal-Wallis test. Analyses were conducted with SPSS version 25.0 and a *P* value less than 0.05 was considered to indicate statistical significance. All statistical analysis of this study were performed and/or reviewed by biomedical statisticians Karen Hagglund, MS and Susanna Szpunar, MPH, DrPH.

RESULTS

Primary outcome

In total 523 patients underwent minimally invasive hysterectomies performed during the study period. General gynecologists performed 255, the urogynecologist performed 196, and the gynecologic oncologists performed 102 procedures. Patient demographics are reported in [Table 1](#). Patients in the general gynecologist group were younger than those in the urogynecologist and gynecologic oncologist groups. Patient race differed between groups. Patient history of cardiovascular disease differed between groups with those in the general gynecologist group having lesser incidence of cardiovascular disease ($P < 0.0001$). The average body mass index (BMI) also varied between groups with those in the urogynecologist (29.2 ± 6.3) having a lower BMI than those in the general gynecologist (32.6 ± 7.7) and gynecologic oncology (34.4 ± 9.2) groups ($P < 0.0001$).

Operating time and estimated blood loss also differed between groups. Across all time parameters (total set-up time, total operating time, and total room time), the urogynecologist had the longest times, followed by the gynecologic oncologist and then the general gynecologists ($P < 0.0001$). The urogynecologist [25.0 (20, 50)] had the least blood loss, while the general gynecologists [100 (50, 200)] had the most ($P < 0.0001$). These results can be found in [Table 2](#). Length of stay did not differ between groups ($P = 0.93$) and can also be found in [Table 2](#). Surgery type and concomitant procedures are detailed in [Table 3](#). The urogynecologist performed more concomitant cystourethroscopies (100%) when compared to the general gynecologists (41%) and gynecologic oncologists (29%, $P < 0.0001$). The urogynecologist also performed more ureterolysis procedures (6%) than the general gynecologists (1%) and gynecologic oncologists (2%, $P = 0.01$). The general gynecologists performed less lysis of adhesions (22%) in comparison to the urogynecologist (35%) and gynecologic oncologist (34%, $P = 0.004$). Two percent of patients in both the general gynecologist and gynecologic oncologist groups underwent conversion to an open procedure. No procedures in the urogynecologist group underwent conversion to an open procedure.

Urologic injury occurred in four patients (2%) in the general gynecologist group, in one patient (1%) in the gynecologic oncologist group, and in one patient (1%) in the urogynecologist group. Bowel injury occurred in three (3%) of patients in the gynecologic oncologist group and there were none in the general gynecologist and urogynecologist groups. There were no cases of major vessel injury.

Secondary outcomes

A total of 42 surgeons performed minimally invasive hysterectomies at our institution during the specified time frame and were included in our study. Three of these surgeons performed 30 or more minimally invasive hysterectomies per year and qualified to be placed in the high-volume surgeon category. There were 280 patients in the high-volume group and 273 patients in the low-volume group. Patient demographics can be found in [Table 4](#). Patient age and race differed between groups. Patient history of cardiovascular disease, hypertension, diabetes mellitus, and BMI also differed between groups. Total set up time, total operating time, and total room time all were significantly longer for

Table 1 Patient demographics-subspecialty, n (%)

	General gynecologist, n = 255; mean ± SD	Urogynecologist, n = 196; mean ± SD	Gynecologic oncologist, n = 102; mean ± SD	P value
Age (yr)	45.4 ± 8.3	58.9 ± 12.5	55.9 ± 11.3	< 0.0001
Race				0.001
Black	94 (37)	42 (21)	19 (18)	
White	146 (57)	139 (71)	73 (72)	
Other/Unknown	15 (6)	15 (8)	10 (10)	
BMI	32.6 ± 7.7	29.2 ± 6.3	34.4 ± 9.2	< 0.0001 ^a
Cardiovascular disease	41 (16)	70 (36)	27 (27)	< 0.0001
Hypertension	83 (33)	86 (44)	48 (47)	0.01
Diabetes mellitus	25 (10)	24 (12)	18 (18)	0.12
Chronic lung disease	44 (17)	27 (14)	16 (16)	0.62
History of abdominal surgery	160 (63)	109 (56)	55 (54)	0.18

^aUrogynecologist *vs* general gynecologist and gynecologic oncologist, *P* < 0.0001, general gynecologist *vs* gynecological oncologist, *P* = 0.12. BMI: Body mass index.

Table 2 Surgery characteristics and length of stay-subspecialty

	General gynecologist, n = 255; mean ± SD or median (25 th %ile, 75 th %ile)	Urogynecologist, n = 196; mean ± SD or median (25 th %ile, 75 th %ile)	Gynecologic oncologist, n = 102; mean ± SD median (25 th %ile, 75 th %ile)	P value
Total set-up time (minutes)	34.3 ± 8.2	51.1 ± 7.7	40.7 ± 9.8	< 0.0001 ^a
Total operating time (minutes)	133.1 ± 57.8	257.8 ± 48.9	162.4 ± 69.2	< 0.0001 ^a
Total room time (minutes)	192.1 ± 61.5	343.0 ± 51.9	231.1 ± 74.5	< 0.0001 ^a
Uterine weight (grams)	181.2 ± 131.1	104.1 ± 72.7	150.9 ± 104.3	< 0.0001 ^b
Estimated blood loss (mL)	100.0 (50, 200)	25.0 (20, 50)	50.0 (50, 100)	< 0.0001
Length of stay (d)	1.0 ± 0.7	1.1 ± 0.2	1.0 ± 0.5	0.93

^aAll comparisons, *P* < 0.0001.

^bGeneral gynecologist *vs* urogynecologist, *P* < 0.0001; general gynecologist *vs* gynecological oncologist, *P* = 0.06; urogynecologist *vs* gynecological oncologist, *P* = 0.002.

high-volume surgeons compared to low-volume surgeons. These comparisons can be found in Table 5. Uterine weight was higher in the low-volume surgeon group (179.0 0 ± 129.6) when compared to the high-volume surgeon group (117.50 ± 85.4, *P* < 0.0001). Low-volume surgeons also had an increased estimated blood loss when compared to high-volume surgeons [100.0 mL (50, 200) and 50.0 mL (20, 50) respectively, *P* < 0.0001]. The length of stay did not differ between groups. Patients in the high-volume group stayed 1.0 d ± 0.4 and those in the low-volume surgeon group stayed on average 1.0 d 0 ± 0.7 (*P* = 0.98).

High-volume surgeons performed mostly robotic hysterectomies (86%), while low-volume surgeons performed mostly LAVH (53%). While high-volume surgeons did perform ureterolysis more often than low-volume surgeons (5% *vs* 1%, *P* = 0.01), there was no significant difference in lysis of adhesions (31% *vs* 26%, *P* = 0.17). High-volume surgeons performed cystourethroscopy more often than low-volume surgeons (74% *vs* 44%, *P* < 0.0001). Two (1%) patients in the high-volume group were converted to open,

Table 3 Surgery type and concomitant procedures-subspecialty, n (%)

	General gynecologist, n = 255	Urogynecologist, n = 196	Gynecologic oncologist, n = 102	P value
Surgery				--
LAVH	144 (57)	0 (0)	25 (24)	
LSH	13 (5)	0 (0)	1 (1)	
TLH	47 (18)	0 (0)	13 (13)	
RATLH	50 (20)	196 (100)	63 (62)	
Concomitant procedures				--
None	19 (8)	0 (0)	1 (1)	
BS	168 (66)	13 (7)	13 (13)	
BSO	66 (26)	2 (10)	88 (86)	
BS+SC	0 (0)	34 (17)	0 (0)	
BSO+SC	0 (0)	116 (59)	0 (0)	
SC	0 (0)	3 (2)	0 (0)	
BS+USLS	1 (0)	18 (9)	0 (0)	
BSO+USLS	1 (0)	7 (3)	0 (0)	
USLS	0 (0)	3 (2)	0 (0)	
Rectopexy	2 (1)	31 (16)	0 (0)	--
Cystourethroscopy	105 (41)	194 (99)	30 (29)	< 0.0001
Lysis of adhesions	55 (22)	68 (35)	34 (34)	0.004
Uterolysis	2 (1)	11 (6)	2 (2)	0.01
Conversion to open	5 (2)	0 (0)	2 (2)	--

BS: Bilateral salpingectomy; BSO: Bilateral salpingo-oophorectomy; SC: Sacrocolpopexy; LAVH: Laparoscopic assisted vaginal hysterectomy; LSH: Laparoscopic supracervical hysterectomy; RATLH: Robotic-assisted laparoscopic hysterectomy; TLH: Total laparoscopic hysterectomy; USLS: Uterosacral ligament suspension.

compared to five (2%) patients in the low-volume group were. When comparing high and low-volume surgeons, there was no statistically significant difference in urinary tract injury (1% *vs* 2%) or bowel injury (1% *vs* 0%). There were more complications in the low-volume group *vs* the high-volume group when looking at complications aside from urinary tract, bowel, or major vessel injury. High-volume surgeons had four (1%) patients with a complication and low-volume surgeons had 12 (4%) patients with a complication (*P* = 0.04). For high-volume surgeons, three patients had a postoperative wound infection or pelvic abscess, and one had a small bowel obstruction. For low-volume surgeons, four patients had vaginal cuff dehiscence, one patient had a small bowel obstruction, three patients required a blood transfusion postoperatively, one patient returned to the hospital with vaginal bleeding, and three patients had a postoperative wound infection or pelvic abscess.

DISCUSSION

We found no difference in the incidence of urinary tract injury when comparing subspecialists to general gynecologists or between high and low-volume surgeons. However, it is important to note that our study was underpowered, and therefore, a conclusion cannot be drawn. To our knowledge, this is the first study to look at differences in urinary tract injury rates in general gynecologists *vs* subspecialists. We plan to continue collecting data to gain a larger sample size to reach appropriate statistical power.

When comparing high and low-volume surgeons, low-volume surgeons had an increased rate of complications (excluding urinary tract injury and bowel injury) when compared to high-volume surgeons. This aligns with the findings of Rogo-Gupta *et al*[10], who reported that high-volume surgeons were less likely to have perioperative complications than low-volume surgeons. All high-volume surgeons in our study were subspecialists. As such, the increased incidence of complications

Table 4 Patient demographics of high vs low-volume surgeons, *n* (%)

	High-volume, <i>n</i> = 280, mean ± SD	Low-volume, <i>n</i> = 273, mean ± SD	<i>P</i> value
Age (yr)	58.1 ± 12.3	46.0 ± 8.8	< 0.0001
Race			
Black	60 (21)	93 (35)	0.002
White	197 (70)	161 (59)	
Other/Unknown	23 (8)	17 (6)	
BMI	30.9 ± 7.8	32.6 ± 7.8	0.01
Cardiovascular disease	92 (33)	46 (17)	< 0.0001
Hypertension	127 (45)	90 (33)	0.003
Diabetes mellitus	42 (15)	25 (9)	0.04
Chronic lung disease	41 (15)	46 (17)	0.49
History of abdominal surgery	153 (55)	171 (63)	0.06

BMI: Body mass index.

Table 5 Operating time of high vs low-volume surgeons

	High-volume, <i>n</i> = 280, mean ± SD	Low-volume, <i>n</i> = 273, mean ± SD	<i>P</i> value
Total set-up time (min)	47.5 ± 9.6	35.2 ± 9.3	< 0.0001
Total operating time (min)	224.4 ± 73.8	140.0 ± 62.7	< 0.0001
Total room time (min)	303.9 ± 82.1	200.3 ± 68.1	< 0.0001

seen in low-volume surgeons could be attributed to decreased surgical volume or lack of subspecialty training.

Limitations of this study include the inherent nature of a retrospective study and differences in surgical technique. This institution has only one urogynecologist and therefore these results cannot be generalized to results of all urogynecologists. There are also many physicians at this hospital that perform hysterectomies at multiple hospitals and, therefore, these procedures were not accounted for in this study. If the surgeries performed at other institutions were accounted for, there is a possibility that some of the generalists would qualify as high-volume surgeons.

Strengths of this study include a wide variety of general gynecologists and gynecologic oncologists to account for varied surgical technique and increased generalizability. All methods of minimally invasive hysterectomies are performed at this institution and therefore represented in this study. This study was also performed at a large institution in an urban city further increasing the generalizability. To our knowledge, this was the first study to look at differences in urinary tract injury rates in general gynecologists *vs* subspecialists. This study provides a guide for further and more widespread studies to be performed to investigate if a difference truly exists.

CONCLUSION

Surgeon volume has previously been shown to play a role in rate of urinary tract injury during minimally invasive hysterectomies. Although it has not been studied previously, it is reasonable to assume that this may also hold true for subspecialists *vs* general gynecologists, as subspecialists are usually high-volume surgeons. Our study demonstrated that there was no difference in the urinary tract injury rate in general gynecologists *vs* subspecialists, however our study was underpowered. We recommend a multicenter study to better analyze the potential differences.

ARTICLE HIGHLIGHTS

Research background

It is well known that urinary tract injury is a complication of hysterectomies. There have been many studies that aim to determine if surgeon volume has an impact on the incidence urinary tract injury during hysterectomies. However, no studies have compared subspecialists to general gynecologists when assessing the incidence of urinary tract injury.

Research motivation

Urinary tract injury increases morbidity for patients who undergo hysterectomy. Subspecialty training and surgeon volume are factors that should be assessed when determining the incidence of urinary tract injury in an effort to decrease patient morbidity.

Research objectives

Our primary outcome was the incidence of urinary tract injury between fellowship trained board-certified female pelvic medicine and reproductive surgery surgeon, fellowship trained board eligible or board-certified gynecologic oncology surgeons, and board-certified or board eligible general gynecologists. Our secondary outcome was the incidence of urinary tract injury between high (defined by 30 or more minimally invasive hysterectomies per year) and low-volume surgeons (defined by less than 30 hysterectomies per year).

Research methods

We conducted a retrospective chart review of adult patients who underwent minimally invasive hysterectomy. All patients who underwent the following surgeries with or without concomitant procedures were included: Laparoscopic supracervical hysterectomy, laparoscopic assisted vaginal hysterectomy, total laparoscopic hysterectomy, and robotic hysterectomy. After we identified eligible patients, the surgeon subspecialty was identified and the surgeon's volume per year was calculated. Univariable analysis of factors associated with surgeon type and ureteral injury were assessed using Student's *t*-test, ANOVA followed by multiple pairwise comparisons using the Bonferroni correction of the *P* value, and the χ^2 analysis. Non-parametric tests were performed for data that were non-normally distributed, such as the Mann-Whitney U test and Kruskal-Wallis test.

Research results

Urologic injury occurred in four patients (2%) in the general gynecologist group, in one patient (1%) in the gynecologic oncologist group, and in one patient (1%) in the urogynecologist group. Bowel injury occurred in three (3%) of patients in the gynecologic oncologist group and there were none in the general gynecologist and urogynecologist groups. There were no cases of major vessel injury.

Research conclusions

When comparing high and low-volume surgeons, there was no statistically significant difference in urinary tract injury (1% *vs* 2%) or bowel injury (1% *vs* 0%). There were more complications in the low-volume group *vs* the high-volume group when looking at complications aside from urinary tract, bowel, or major vessel injury.

Research perspectives

To our knowledge, this was the first study to look at differences in urinary tract injury rates in general gynecologists *vs* subspecialists. This study provides a guide for further and more widespread studies to be performed to investigate if a difference truly exists.

FOOTNOTES

Author contributions: Khair EL designed the study, collected data, and wrote and edited the manuscript; Afzal F, Kulkarni SP, and Duhe' BJ collected data for the manuscript; Haggglund K analyzed the data for the manuscript; Aslam MF edited the manuscript and assisted in study design; All authors have read and approved the final manuscript.

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