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Routine Cystoscopy during Robotic Hysterectomy for Endometrial Cancer

*Diana El-neemany[1], Nicole Pursell[1], Erin Curcio[1], Alexandra Giglio[1], Yu Chen[1], Patricia Greenberg[2], Verda J Hicks[3] and Karim Elsahwi[3]**

[1]*Department of Obstetrics and Gynecology, Jersey Shore University Medical Center, USA*

[2]*Office of Research Administration, Jersey Shore University Medical Center, USA*

[3]*Division of Gynecologic Oncology, Jersey Shore University Medical Center, USA*

Abstract

Background: The use of routine cystoscopy after hysterectomy is controversial.

Objective: To evaluate the role of routine cystoscopy in the detection of urinary tract injuries in robotic total laparoscopic hysterectomies performed for endometrial cancer staging.

Study design: This was a retrospective chart review of patients undergoing robotic-assisted laparoscopic hysterectomy for endometrial cancer staging by a single gynecologic oncologist between January 2012 and December 2015. Routine cystoscopy was performed in all cases.

Results: A total of 157 cases met inclusion criteria and among those, five cases of urinary tract injury were identified (3.2%). Among the patients with urinary tract injury, average age was 66 [range 47, 90] years old, the average BMI was 34 [range 25, 34], and all patients had Stage I of endometrial cancer. Three patient injuries were detected intraoperatively, and 2 injuries were diagnosed postoperatively. Two of the intraoperative injuries were caused by dissection of the bladder from the lower uterine segment and detected prior to performing the cystoscopy. Another intraoperative injury was detected immediately after performing a mini-laparotomy to extract a larger uterus. The 2 urinary tract injury cases detected postoperatively were both ureteral injuries. The visual detection rate of the urinary tract injuries was 60% (3/5), while the cystoscopy detection rate was 0%. There were no significant differences detected in risk factors between the injury cases and the whole cohort.

Conclusion: In this study, the incidence of urinary tract injury in robotic hysterectomy performed for endometrial cancer staging was 3.2%. Performing routine cystoscopy did not improve detection of urinary tract injuries in these cases.

Keywords

Cystoscopy, Endometrial cancer, Hysterectomy, Laparoscopy, Robot, Urinary tract injury

Introduction

Gynecologic surgery is associated with an increased risk of injury to the lower urinary tract. The overall estimated incidence of urinary tract injury when performing a hysterectomy ranges from 0.2 to 15 per 1000 cases [1]. More specifically, laparoscopic hysterectomy has higher rates of urinary tract injuries compared to other surgical routes, with an incidence of bladder injuries ranging between 8.9-12.1 per 1000 cases and an incidence of ureteral injuries between 7.3-13.9 per 1000 cases [2-4]. Though hysterectomy related urinary tract injuries are rare, the morbidity associated with delayed detection can be devastating, incurring emotional and financial cost to both the patient and the health care system [5]. Several studies have shown that routine cystoscopy can help increase detection rates of urinary tract injuries. Teeluckdharry and colleagues noted a 95% increase in detection of ureteric or bladder injuries intraoperatively when using cystoscopy [6]. Another study by Chi and colleagues showed there were significantly fewer delayed urologic complications after a policy of universal cystoscopy

***Corresponding author:** Karim Elsahwi, MD, FACOG, FACS, Division of Gynecologic Oncology, Hackensack Meridian Health, Jersey Shore University Medical Center, 1945 Corlies Avenue, Neptune, NJ, USA, Tel: 732-776-3790, Fax: 732-922-8264

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was instituted [7]. However, controversy still exists regarding the adoption of a universal cystoscopy policy as other studies have shown them to have no benefit in detecting urinary tract injury [8,9].

Robotic laparoscopic methods are growing in popularity in the field of gynecology [10]. Robotic-assisted surgery has also been shown to be a feasible method for complicated gynecological cases and is receiving more attention for use in different gynecologic malignancies due to its promising results [10-14]. Few studies have addressed the benefit of universal cystoscopy associated with robotic laparoscopic surgery in endometrial cancer staging [9,11]. The objective of this study was to evaluate the role of routine cystoscopy in the detection of urinary tract injuries in robotic total laparoscopic hysterectomies for endometrial cancer staging. The secondary objective was to evaluate potential risk factors that may increase the risk of urinary tract injury during those operations.

Materials and Methods

A retrospective chart review of patients who underwent robotic-assisted staging for endometrial cancer by one gynecologic oncologist in one healthcare system between January 2012 and December 2015 was performed. Patient inclusion into the study required that a total laparoscopic hysterectomy be performed for an endometrial malignancy. The da Vinci Si® robot was used as the platform for performing all the surgeries and routine cystoscopy was performed at the conclusion of each case. Even if an injury to the urinary tract was detected intraoperatively, a cystoscopy was still performed at the end of the procedure to confirm the integrity of the bladder repair and exclude any further ureter injury. Data collection included: demographic information such as age, Body Mass Index (BMI), past medical history related to cardiovascular or pulmonary systems, and any previous abdominal surgery. Pulmonary disease was defined as grade 2 or above restrictive or obstructive pulmonary disease based on the National Institutes of Health (NIH) Common Terminology Criteria for Adverse Events (CTACE 4.03). Cardiac morbidity was defined as grade 2 or above (CTACE 4.03) ischemic or valvular disease, heart failure or arrhythmia. Operative data abstracted included: Preoperative and postoperative diagnoses, length of surgery, intraoperative complications, total estimated blood loss, postoperative complications, readmissions and final pathology. Length of surgery was defined as the time from the initial incision to skin closure. This included docking of the robot, time spent on the robotic console, and cystoscopy. Cystoscopy was performed using a diagnostic 70-degree lens through a 17-French sheath in a systematic 360-degree exploration of the bladder including the dome, the trigone, and both ureteric orifices. Saline was used as a distending medium. Due to a national shortage of blue dye (indigo carmine), this was not consistently used across all cases. Cystoscopy was continued until efflux of urine from the ureteric orifices was confirmed bilaterally by the surgeon, both assistants and in most of the cases the scrub technician. Descriptive statistics, Fisher Exact tests, and Wilcoxon rank sum tests were used to draw conclusions in this study. All p-values reported are two-sided and any p-value less than 0.05 was considered statistically significant. Institutional review board approval for this study was obtained through the Jersey Shore University Medical Center IRB in Neptune, New Jersey.

Results

A total of 220 robotic cases were reviewed; However, 63 cases where the patient did not have a total laparoscopic hysterectomy, or the post-operative findings revealed no endometrial malignancy were excluded, leaving 157 patients in the analytic data set. Average age at the time of surgery was 66 years old and the average BMI was 34 kg/m^2. Most patients (72.6%) had stage-1 endometrial cancer. A full list of patient demographics is shown in Table 1 and

Table 1: Full sample patient characteristics (n = 157).

Patient characteristic	
	Median [IQR]
Age at surgery (years)	66.1 [57.2, 74.3]
Body mass index (kg/m^2)	33 [28, 40]
	Frequency (%)
History of CVD	119 (75.8)
History of COPD	42 (26.8)
Prior abdominal surgery	76 (48.4)
EAC stage	
Stage 1	114 (72.6)
Stage 2	17 (10.8)
Stage 3	17 (10.8)
Stage 4	7 (4.5)
Unknown	2 (1.3)
Histopathology	
Type 1	140 (89.2)
Type 2	17 (10.8)
Urinary tract injury type	
Bladder injury	3 (1.9)
Ureter injury	2 (1.3)

IQR = Interquartile range; CVD = Cardiovascular disease; COPD = Chronic obstructive pulmonary disease; EAC = Endometrial adenocarcinoma.

Table 2: Full sample operative data (n = 157).

Primary procedure performed:	**Frequency (%)**
Total laparoscopic hysterectomy	151 (96.2)
Radical laparoscopic hysterectomy	6 (3.8)
Additional procedural steps†:	
Bilateral salpingectomy	2 (1.3)
Bilateral salpingo-oophorectomy	155 (98.7)
Omentectomy	29 (18.5)
Lysis of adhesions	90 (57.3)
Pelvic lymph node dissection	128 (81.5)*
Para-aortic lymph node dissection	94 (59.9)*
Procedure measures:	**Median [IQR]**
Uterine weight (g)	140 [96, 188]*
Length of surgery (min)	200 [158, 233]*
Estimated total blood loss (mL)	100 [100, 150]*

*Indicates missing data (less than 5% of sample size).

†While the above procedures are listed as independent frequencies, many overlap.

further operative details are listed in Table 2. Most patients underwent a total laparoscopic hysterectomy with bilateral salpingo-oopherectomy (98.7%) and lymph node dissection (82.8%). Other than cystotomy repair, no additional urinary or gastrointestinal procedures were planned or performed. Four cases (2.5%) were converted to laparotomy. One case was due to large uterine size, another required radical debulking due to preliminary diagnosis of uterine sarcoma, another due to large vessel injury requiring immediate intervention, and the last due to poor access and visualization limiting completion of surgery laparoscopically. None of these cases included our patients sustaining a bladder or ureteral injury. The total urinary tract injury rate was 3.2%, where 3 patients (1.9%) sustained a bladder injury and 2 patients (1.3%) sustained a ureter injury. The visual detection rate of the urinary tract injuries was 60% (3/5), while the cystoscopy detection rate was 0%. More specifically, the visual detection rate of bladder injury was 100% (3/3).

Table 3 outlines the main characteristics of the 5 cases of urinary tract injury, along with the details of their diagnosis and management. In summary, Case 1 was a 61-year-old patient with a 14 cm size uterus who underwent surgical staging followed by a lower transverse incision for extraction of a large specimen that was complicated by a bladder dome cystotomy, which was immediately recognized and repaired in a standard 2-layer fashion. Cystoscopy confirmed the integrity of the bladder and ureters. Case 2 was an 89-year-old patient with a BMI of 32 who underwent surgical staging for grade-1 adenocarcinoma of the endometrium, which was complicated by dense peritoneal adhesions and retroperitoneal fibrosis. A cystotomy was sustained during bladder dissection. It was immediately recognized and repaired in a standard two-layer fashion. Cystoscopy confirmed the integrity of the bladder and ureters. Case 3 was a 57-year-old patient with postmenopausal bleeding with endometrial biopsy showing complex atypical hyperplasia of the endometrium. She had a past surgical history of 2 cesarean sections. Her BMI was 34 kg/m^2, and her uterus was 14 cm in size. Adhesions were pervasive throughout the pelvis causing a frozen pelvis. A 1 cm cystotomy was noted during bladder dissection. This was repaired in two layers. A cystoscopy was performed to ensure the integrity of the ureters and the bladder. Case 4 was an 84-year-old patient with a BMI of 42 and a history of ruptured appendicitis who during surgical staging underwent extensive lysis of intraperitoneal adhesions as well as ureterolysis for dense retroperitoneal fibrosis. Cystoscopy at the conclusion confirmed bladder integrity and bilateral ureteral jets. At her 2-week postoperative check, she complained of leakage of clear fluid from the vagina. A CT urogram was performed noting left sided urinoma and left hydroureter. The patient proceeded for urologic evaluation and treatment, however she did not follow up with the surgeon. Finally, Case 5 was a 47-year-old patient with a BMI of 21 kg/m^2, who underwent an uneventful surgical staging procedure followed by cystoscopy to confirm the integrity of the bladder and ureters. She presented at her 2-week postoperative visit with complaints

Table 3: Urinary tract injury patient details, diagnoses, and management.

	Case 1	**Case 2**	**Case 3**	**Case 4**	**Case 5**
Type of injury	Bladder	Bladder	Bladder	Ureteral	Ureteral
Age	61	89	57	84	47
BMI	25	32	34	42	21
Prior surgery	+	-	-	+	-
Preoperative diagnosis	High grade endometrial stromal sarcoma	Grade 1 EAC	Complex atypical hyperplasia	Grade 2 EAC	Grade 1 EAC
Procedure	TLHBSO	TLHBSO	RRHBSO	TLHBSO	TLHBSO
LND	PPALND	PPALND	-	PPALND	PPALND
Adhesiolysis	-	+	+	+	-
Ureterolysis	+	-	+	+	+
Other procedures	Mini-laparotomy, cystotomy repair	Cystotomy repair	Proctosigmoidoscopy, cystotomy repair	-	-
Uterine size (g)	158	70	225	82	222
Pathology	Stage 1B, Grade 2 EAC	Stage 1B, Grade 1 EAC	Stage 1A, Grade 1 EAC	Stage 1B, Grade 2 EAC	Stage 1A, Grade 1 EAC
Blood loss (mL)	150	250	250	50	150
Surgical time (min)	250	256	215	209	204
Complications	Cystotomy during mini-laparotomy	Cystotomy incurred during dissection of bladder from cervix	Cystotomy incurred during dissection of bladder from cervix	Left ureteral injury detected 2 weeks after surgery	Left ureteral injury detected 2 weeks after surgery
Management	Repaired intraoperatively-confirmed bladder integrity with cystoscopy	Repaired intraoperatively-confirmed bladder integrity with cystoscopy	Repaired intraoperatively-confirmed bladder integrity with cystoscopy	Patient was treated extramurally	Patient had outpatient placement of left ureteral stent

EAC = Endometrial adenocarcinoma; TLH = Total laparoscopic hysterectomy; RRH = Robotic radical hysterectomy; BSO = Bilateral salpingo-oophorectomy; PPALND = Pelvic and para-aortic lymph node dissection.

Table 4: Comparison of data by urinary tract (UT) injury status.

	Patients w/o UT injury (n = 152)	Patients w/UT injury (n = 5)	P-Value
Patient demographics:	**Median [IQR] or Frequency (%)**		
Age at surgery (years)	66.1 [57.1, 74.3]	61.9 [57.2, 84.5]	0.92
Body mass index (kg/m^2)	33 [28, 40]	32 [25, 34]	0.40
History of CVD	116 (76.3)	3 (60.0)	0.60
History of COPD	40 (26.3)	2 (40.0)	0.61
Prior abdominal surgery	74 (48.7)	2 (40.0)	1.0
EAC stage 1	109 (71.7)	5 (100.0)	0.33
Histopathology type 1	136 (89.5)	4 (80.0)	0.44
Primary procedure performed:	**Frequency (%)**		
Total laparoscopic hysterectomy	147 (96.7)	4 (80.0)	0.18
Radical laparoscopic hysterectomy	5 (3.3)	1 (20.0)	
Additional procedural steps†:	**Frequency (%)**		
Bilateral salpingectomy	2 (1.3)	0 (0.0)	1.0
Bilateral salpingo-oophorectomy	150 (98.7)	5 (100.0)	1.0
Omentectomy	29 (19.1)	0 (0.0)	0.59
Lysis of adhesions	87 (57.2)	3 (60.0)	1.0
Pelvic lymph node dissection	124 (81.6)*	4 (80.0)	1.0
Para-aortic lymph node dissection	90 (59.2)*	4 (80.0)	0.65
Procedural/outcome measures:	**Median [IQR]**		
Uterine weight (g)	140 [96, 188]*	158 [82, 222]	0.98
Length of surgery (min)	196 [158, 231.5]*	215 [209, 250]	0.13
Estimated total blood loss (mL)	100 [100, 150]*	150 [150, 250]	0.09
Total length of hospital stay (days)	1 [1, 1]	1 [1, 1]	1.0

*Indicates missing data (less than 5% of sample size).

†While the above procedures are listed as independent frequencies, many overlap.

of vaginal discharge. A CT urogram was performed and noted a left ureteral injury. She proceeded for urologic evaluation and placement of left stent. Her symptoms resolved without further complications. The stent was removed in 6 weeks.

A comparison of operative data between the patients with urinary tract injury versus those without is summarized in Table 4. There were no statistical differences found between the two groups in terms of median age (p = 0.92) and BMI (p = 0.40), or existing comorbidities at the time of surgery (CVD: p = 0.60; COPD: p = 0.61; Prior abdominal surgery: p = 1.0). Additionally, there were no statistical differences between the groups for stage (p = 0.33) and histopathology of cancer (p = 0.44), the type of surgery performed (p = 0.18), surgical time (p = 0.13), median uterine weight (p = 0.98), length of hospital stay (p = 1.0), or the frequency of any additional procedures performed such as pelvic lymph node dissection (p = 1.0), omentectomy (p = 0.59), or lysis of adhesions (p = 1.0). Additionally, the total estimated blood loss was not found to be statistically different (p = 0.09) between the patients with a urinary tract injury (Median [Interquartile Range]: 150 ml [150, 250]) compared to those without injury (100 ml [100, 150]).

Comment

The overall incidence rate of urinary tract injury during robotic staging for endometrial cancer in this study was 3.2%, with 3 intraoperative bladder injuries and 2 postoperative ureter injuries occurring. Routine cystoscopy did not alter the detection rate of any of these injuries.

In a retrospective chart review of robotic surgery performed for malignant pathology at two different institutions, Nguyen, et al. reported no urinary tract injuries and hence did not find cystoscopy to be of benefit in detecting injuries in the routine cystoscopy group [9]. In the Gynecologic Oncology Group LAP2 study, one of the largest prospective studies of laparoscopic staging for endometrial cancer, the reported urinary tract injury rate was 2-3% [15]. In another prospective study of 471 hysterectomy cases for benign disease reported by Vakili, et al. (10% laparoscopic hysterectomy), the total urinary tract injury rate was 4.8% (1.7% ureter injury, 3.6% bladder injury) [16]. The authors argued that the incidence of urinary tract injury with hysterectomy might be underestimated since most of the literature comprises retrospective studies that may have been limited by the underreporting of cases that presented in the postoperative period. All but one patient in our study continue to be followed in our practice as part of cancer surveillance up to the date of writing of this manuscript.

In two studies by Sandberg and Nguyen, the incidence of urinary tract injury was 0% and up to 0.7%, respectively [8,9]. Cystoscopy was not found to increase the detection rate of these injuries in either of these studies. The former recommended selective rather than universal cystoscopy, while the latter argued the importance of training physicians on the efficient use of cystoscopy in order to avoid potentially morbid and costly injuries as well as litigation [8,9]. In a large systematic review of the literature [3], Gilmour, et al. found a 5-fold increase in injury rates when routine intraoperative cystoscopy was performed during laparoscopic hysterectomy

with or without other gynecologic or other urogynecologic procedures. The authors reported that 89% of ureteric injuries and 95% of bladder injuries were detected when cystoscopy was routinely performed (*vs.* 7% and 43%, respectively); However, the number of injuries detected with cystoscopy was unclear. In a follow up review [6], the authors maintained a 5-fold increase in injury detection rates when cystoscopy was used intraoperatively, but found no evidence that cystoscopy provided any meaningful reduction in the number of postoperatively detected injuries. Additionally, in a recent systematic review of urinary tract injury in gynecologic laparoscopy for benign indications, bladder injuries were more commonly recognized intraoperatively and attributed to lysis of adhesions while ureter injuries- much like our observations- were more commonly recognized postoperatively and attributed to thermal injury [17].

Although we cannot definitively determine the cause of the delayed ureter injuries observed in our study, possible explanations include devascularization and thermal damage, especially since 100% of those injuries were detected postoperatively. It has been observed that thermal injuries often present between 2-14 days postoperatively, and that the diagnosis is often illusive due to the difficulty in differentiating thermal coagulative necrosis from longstanding inflammation and secondary infection [18]. Various mechanisms of laparoscopic energy source-related injuries have been described. Monopolar electrocautery-related injuries are associated with capacitive coupling, insulation failure, or direct coupling, which occurs when current from the active electrode passes to another instrument that is in contact with tissues away from the active electrode. Capacitive coupling can be induced in a conductor adjacent to the insulation surrounding the active electrode and can be generated along the insulation shaft of the active electrode with biologic fluid acting as a conductor, especially at high electrosurgical generator settings [18]. Monopolar and bipolar electrosurgical devices can also cause tissue damage through thermal spread. While bipolar electrosurgical spread is not well assessed, it is believed to range from 2 mm to 22 mm. Interestingly, thermal effect as far as 1 cm away has been documented when the monopolar electrode tip was activated for greater than 10 seconds with a power setting of 40 W [18]. The power setting for both monopolar and bipolar electrocautery used in this study was arbitrarily set at 45 W. While we cannot definitively prove causation between our injuries and electrosurgery unit settings, we certainly view our findings as an eye opener that are worth heeding and have since decreased our power settings especially when performing adhesiolysis and ureterolysis.

We do not believe that the lack of use of indigo carmine dye during cystoscopy has led to a decrease in our detection rate for a couple of reasons. First, cystoscopy was not terminated in any of the cases before the surgeon and his assistants confirmed satisfactory bilateral ureter jet streams. Second, the use of saline is certainly acceptable by gynecologists and urologists and has served as the control arm in published clinical trials aiming to find alternatives to indigo carmine [19,20].

Risk factors associated with increased rates of urinary tract injury in previous studies included: The addition of prolapse procedures, the use of laparoscopic or robotic surgery, the presence of adhesions, and low volume surgeons [8,16]. We were unable to identify statistically significant risk factors that predict urinary tract injury in our study (Table 4), most likely due to the small number of injury cases. A descriptive synopsis of those cases is provided in the text (Table 3).

As with any retrospective study, there are limitations to our study. A small number of patients (5% or less) had missing data (noted in Table 1, Table 2 and Table 4). However, we note that all 5 cases with urinary tract injury had complete data available. Another limitation is that the results of this study reflect only a single gynecologic oncology surgeon's practice, hence generalization of the results should be made with caution. Additionally, given the low rate of urinary tract injury in the patient sample, few inferential statistical analyses could be done to correlate patient demographic, disease specific, and operative characteristics with the occurrence of urinary tract injury.

In conclusion, routine cystoscopy during robotic hysterectomy for endometrial cancer staging did not alter the detection rate of urinary tract injury in this study. Based on this study, the pertinence of cystoscopy in the case of bladder injury is restricted to evaluating the lower urinary tract after bladder repair. However, this finding cannot be extrapolated to hysterectomy for other indications such as pelvic reconstructive surgery. The potential net positive impact of performing cystoscopy vis a vis resident physician training should be considered.

Disclosure

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