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Routine Cystoscopy After Robotic Gynecologic Oncology Surgery

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ABSTRACT

Background and Objectives: Our aim was to determine whether the use of routine cystoscopy increases lower urinary tract injury detection (bladder and/or ureter) after robotic surgery performed by gynecologic oncologists.

Methods: A retrospective chart review of patients who presented for robotic hysterectomy from 2009–2012 was performed at 2 separate academic medical centers, one that performed routine cystoscopy and one that did not. Statistical analysis was performed with *t* tests and χ^2 tests.

Results: We identified 140 cases without cystoscopy and 109 cases with routine cystoscopy. There were no intraoperative or postoperative urinary injuries detected in either group. There were no significant differences in age and body mass index. In the non-cystoscopy group, a larger specimen size ($P < .001$), less blood loss ($P = .013$), and a longer mean operative time were observed ($P < .0001$). In the routine cystoscopy group, more lymphadenectomies were performed with hysterectomy ($P = .007$) and more patients underwent hysterectomy for ovarian cancer ($P = .0192$). There were no differences in surgical indications or secondary procedures including bilateral salpingo-oophorectomy, radical hysterectomy, ureterolysis, and pelvic organ prolapse–related procedures. The minimum follow-up period was 30 days in both groups.

Conclusion: Routine use of cystoscopy did not appear to affect the detection rate of intraoperative lower urinary tract injury during robotic gynecologic surgery because this rate was zero in both groups. However, cystoscopy is relatively simple to perform and can be efficiently incorporated into robotic surgery to avoid the severe morbidity and possible litigation surrounding a urinary tract injury.

Key Words: daVinci Robot, Hysterectomy, Urinary tract injury, Routine cystoscopy.

INTRODUCTION

Injury to the lower urinary tract (LUT) is a potential risk associated with major gynecologic surgery, particularly hysterectomy, regardless of route or mode of access. Recent studies have reported an overall incidence of LUT injury ranging from 0.32% to 12.1% during hysterectomy.[1–5] The data describing the incidence of LUT injuries for each mode of surgery are variable. Some authors report a lower incidence of injury with laparoscopy,[1] whereas other authors believe that the incidence is lower when performed through an open approach.[3–5] In addition, studies have shown a higher rate of LUT injury in more complicated procedures such as hysterectomy for pelvic organ prolapse, incontinence, or tumor debulking.[3]

Despite the relatively low incidence of LUT injuries during hysterectomy, the morbidity from such complications can be severe. Patients with unrecognized intraoperative LUT injuries may present with fever, flank pain, urinary peritonitis, pyelonephritis, and even anuria.[6] Injuries to the bladder and/or ureters can potentially result in vesicovaginal fistulae, ureteral strictures, and other urinary complaints that may adversely affect quality of life.[6,7] Injuries may require extensive workup, additional radiologic studies, hospitalizations, and possible surgical intervention including but not limited to ureteral stents, nephrostomy, or corrective surgery.[8,9] Surgeons may also be more prone to medical-legal ramifications when an LUT injury occurs.[10] Considering the detrimental outcomes of an LUT injury, some practitioners have suggested performing routine intraoperative cystoscopy after hysterectomy to detect urinary tract injuries.

Most studies examining the overall incidence of LUT injuries at hysterectomy have largely been performed for benign indications only or for combined gynecologic,

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urogynecologic, and gynecologic oncology cases. Other studies have suggested that routine cystoscopy is most useful by helping surgeons detect unsuspected LUT injuries and may prevent sequelae from the injuries detected.[3] To our knowledge, however, there have been no reports on the utility of routine cystoscopy in hysterectomies performed specifically with the da Vinci robot (Intuitive Surgical, Sunnyvale, California).

The da Vinci robotic platform for gynecologic procedures has assisted surgeons with wristed instrumentation and 3-dimensional visualization at the robotic console. Gynecologic oncologists have adapted this platform for various procedures such as endometrial cancer staging, management of early-stage cervical cancer, and complicated benign gynecologic cases such as endometriosis. The robotic platform has also allowed surgeons to perform complex gynecologic surgery through a minimally invasive approach for obese patients.[11] The rate of LUT injury has not been determined for patients undergoing major gynecologic surgery with the robotic platform alone.

In this retrospective study of robotic surgery performed by gynecologic oncologists, we attempted to determine whether the routine use of cystoscopy in robotic surgery increases the detection rate of LUT injury as compared with nonroutine use of cystoscopy.

METHODS

An institution review board–approved retrospective chart review of patients who presented to the division of gynecologic oncology for surgery with the da Vinci robotic system from 2009–2012 was performed at 2 separate teaching institutions (a tertiary referral center with 2 gynecologic oncologists who performed routine cystoscopy after surgery and a community hospital with a gynecologic oncologist who did not perform routine cystoscopy). All surgeons had similar levels of expertise. Patient demographic data such as age, body mass index, primary surgical indication, surgical procedures, hysterectomy specimen size, blood loss, and urinary complications were analyzed.

Patients included in the study had to have undergone surgery on the robotic platform and had to have undergone a hysterectomy, at a minimum. Exclusions included conversions from robotic surgery to laparotomy and the omission of cystoscopy in the routine cystoscopy group. The primary outcome was urinary injury detection rate by cystoscopy. Indicated cystoscopies were defined as a cystoscopy performed because of an intraoperative concern for an LUT injury such as extensive ureterolysis or difficulty in mobilizing and dissecting the bladder from the lower uterine segment and the cervix. Indicated cystoscopies were excluded from the routine cystoscopy cohort.

All statistical analyses were performed by use of SPSS statistical software, version 20.0 (SPSS, Chicago, Illinois). Measurement data were expressed as mean ± SD or as a percentage of total patients. The Student t test and Pearson χ^2 test were used for the analysis of statistical significance for parametric and nonparametric data, respectively, with Bonferroni adjustments for multiple comparisons. The significance of all tests was set at $P < .05$.

RESULTS

We identified 109 cases with routine cystoscopy and 140 cases without routine cystoscopy (**Table 1**). There were no indicated cystoscopies in the nonroutine cystoscopy group, and none of the patients in the routine cystoscopy group went without a cystoscopy. No intraoperative or postoperative urinary injuries were detected in either study group with a minimum follow-up time of 30 days. Although conversions to laparotomy for reasons other than LUT injury were excluded, conversions were performed because of dense adhesions, equipment failure, or inability of the patient to tolerate Trendelenburg positioning on the operating table. Three patients from the routine cystoscopy group were excluded because of conversions. Despite this exclusion, the patients from the converted cases still underwent a cystoscopy at the end of the procedure; none showed evidence of an LUT injury. As shown in **Table 1**, there were no statistically significant differences between the non-cystoscopy and cystoscopy groups with respect to age (59.4 ± 12.3 years vs 57.0 ± 11.9 years, $P = .12$) or body mass index (33 ± 8 vs 33 ± 8, $P = .82$). Box-whisker plots (**Figure 1**) further show the comparison between the non-cystoscopy and routine cystoscopy groups. The amount of estimated blood loss was significantly greater in the routine group (101.6 ± 124.4 mL vs 68.3 ± 44.1 mL, $P = .013$). In addition, in the routine group, specimen size (132.6 ± 86.2 g vs 218.6 ± 239.5 g, $P = .001$) and mean operative time were significantly less (180 minutes vs 360 minutes, $P < .0001$).

Overall, there were no differences in surgical indications except that more patients underwent hysterectomy for ovarian cancer (including borderline tumors) in the routine cystoscopy group (2 vs 11, $P = .0192$). As shown in **Table 2**, when we compared the specific procedures

Table 1.
Baseline Characteristics of Patients Undergoing Robotic Gynecologic Surgery

	Nonroutine (Control)	Routine Cystoscopy	*P* Value
No. of patients	140	109	
Age (y)	59.4 ± 12.3	57.0 ± 11.9	.125
Body mass index	33 ± 8.1	33 ± 8.3	.819
Hysterectomy with lymphadenectomy	47	57	.0007
Hysterectomy for ovarian cancer	2	11	.0192
Estimated blood loss (mL)	68.3 ± 44.1	101.6 ± 124	.013
Specimen size (g)	218.6 ± 239.5	132.6 ± 86.2	.001
Operating time (range) (min)	360 (120–730)	180 (51–340)	.0001
Ureteral or bladder injury	0	0	NS[a]

[a]NS = not significant.

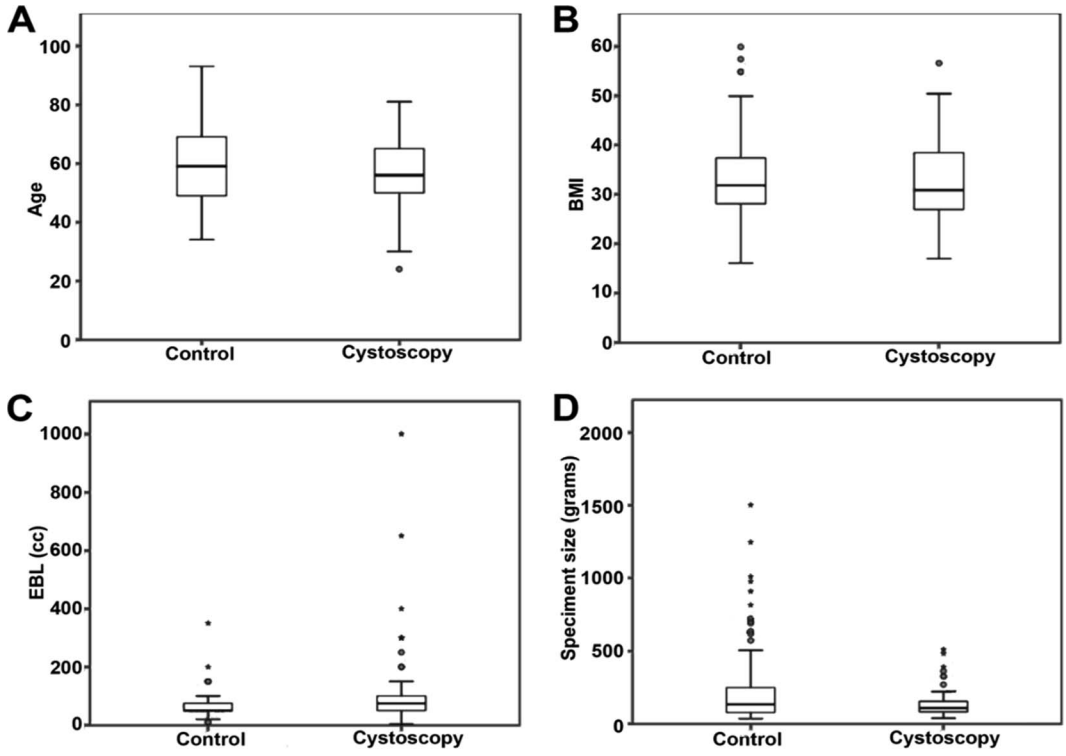

Figure 1. Box-whisker plots comparing patients undergoing nonroutine (control) and routine cystoscopy after robotic gynecologic surgery. No significant difference in age (A) or body mass index (BMI) (B) was observed between the groups. A significant difference in estimated blood loss (EBL) (C) and specimen size (D) was observed between the groups.

performed, there was a significantly higher number of robotic hysterectomies without lymphadenectomy in the non-cystoscopy group (85 vs 40, $P = .05$) and a greater number of robotic hysterectomies with pelvic and/or para-aortic lymphadenectomy in the cystoscopy group (47 vs 57, $P = .05$). There were no differences in other primary and secondary procedures including bilateral salpingo-oophorectomy, radical hysterectomy, ureterolysis, and pelvic organ prolapse–related procedures performed by gynecologic oncologists.

DISCUSSION

This study is the first to examine the role of routine cystoscopy in robotic surgery performed by gynecologic oncologists. Theoretically, an increased risk of ureteral injury would be present in gynecologic oncology cases because of the complexity entailed. Gynecologic oncologists often perform radical dissections with a higher risk of bladder and ureteral injury—for example, procedures such as radical hysterectomy for cervical cancer, pelvic and para-aortic lymphadenectomy with dissection near the ureter, severe endometriosis resection involving extensive ureterolysis, and debulking surgeries in which the tumor may encase the ureter or coat the serosa of the bladder. If we extrapolate from total laparoscopic hysterectomy data alone, there may be an increased risk of LUT injury with the minimally invasive approach.[3–5] Among our 140 cases of no cystoscopy versus 109 cases of routine cystoscopy, we did not detect a single LUT injury with the robotic platform, either intraoperatively or postoperatively.

Table 2.
Comparison of Primary Indications for Robotic Surgery and Type of Robotic Surgery

	Nonroutine (n = 140)	Routine Cystoscopy (n = 109)	*P* Value
Primary indication			
Endometrial carcinoma	54	53	NS[a]
Ovarian carcinoma/ borderline	2	11	NS
Fibroids	23	10	NS
Pelvic/adnexal mass	28	17	NS
Prolapse/incontinence	2	4	NS
Endometriosis	2	1	NS
Preinvasive disease	19	7	NS
Cervical cancer	8	2	NS
Primary procedure			
Robotic TLH[a]	85	40	.05
Robotic TLH with nodes	47	57	.05
Radical or modified radical hysterectomy	5	2	NS
Oophorectomy or cystectomy	2	5	NS
Other	1	5	.05

[a]NS = not significant; TLH = total laparoscopic hysterectomy.

The debate over selective (or indicated) versus routine cystoscopy has been ongoing in the gynecologic literature. Several large studies have reported the incidence of LUT injury at the time of laparoscopic gynecologic surgery, along with the detection rate of these injuries by routine cystoscopy (**Table 3**). Ibeanu et al[14] performed routine cystoscopy in 839 patients including patients who underwent minimally invasive surgery with laparoscopic-assisted vaginal hysterectomy (n = 61) for benign disease. Their overall incidence of urinary tract injury was 4.3% (2.9% with bladder injury, 1.8% with ureteral injury), with the highest rates occurring during vaginal hysterectomy when performed concomitantly for pelvic organ prolapse. They assert that the true incidence of asymptomatic injury after minimally invasive gynecologic surgery is difficult to determine whereas cystoscopy is relatively simple to perform and therefore recommend the universal adoption of routine cystoscopy after minimally invasive gynecologic surgery.

Table 3.
Studies Examining Urinary Tract Injury in Gynecologic Surgery

Year	Author	Bladder Injury	Detection of Bladder Injury by Cystoscopy	Ureteral Injury	Detection of Ureteral Injury by Cystoscopy	Detection of LUT Injury by Cystoscopy	Indication for Surgery	Routine Cystoscopy
1999	Gilmour[12]	20/1928 (10.3%)	17/20 (85%)	20/3235 (0.61%)	19/20 (95%)	36/40 (90%)	Benign	Yes
1999	Ribiero[13]			4/118 (3.4%)	4/4 (100%)		Benign	Yes
2005	Vakili et al[2]	17/471 (3.6%)	11/17 (65%)	8/471 (1.7%)	7/8 (87.5%)	18/25 (72%)	Benign	Yes
2006	Gilmour et al[3]	62/3670 (1.7%)	59/62 (95%)	53/5755 (10.4%)	47/53 (88.6%)	106/115 (92.1%)	Benign	Yes
2009	Ibeanu et al[14]	24/839 (2.9%)		15/839 (1.8%)		35/36 (97.2%)	Benign	Yes
2012	Sandberg et al[15]	14/251 (5.5%)	0/14 (0%)	5/251 (2.0%)	0/5 (0%)	0/19 (0%)	Mixed	Yes

On the other hand, Sandberg et al[15] recently looked at the utility of cystoscopy in a retrospective cohort of 1982 patients undergoing any type of hysterectomy by gynecologists or subspecialists. They found that low-volume surgeons and laparoscopic and/or robotic platforms were both significantly associated with ureteral injury. Interestingly, they noted that gynecologic oncologists were less likely to perform a cystoscopy. At their institution, on the basis of the low absolute risk of LUT injury during hysterectomy, as well as the low incidence of detecting an LUT injury with cystoscopy, they argue against routine cystoscopy and further recommend the use of selective or indicated cystoscopy.

One of the strengths of this study is that we included surgeons of a single specialty (gynecologic oncology) using only the robotic approach for surgery. We attempted to control for operator variability by including surgeons at similar experience levels and similar surgical volumes. Unlike this study, prior studies have incorporated various routes of surgery (transvaginal, laparoscopic, and abdominal) and have combined results of surgeons with variable expertise (general gynecologists and subspecialists who possess different levels of training and/or surgical skill).

A weakness of our study is that our data are from a retrospective analysis with relatively small numbers. We examined the surgical practices of only 3 surgeons (1 from an institution that did not perform routine cystoscopy and 2 from a second institution that performed cystoscopy routinely). Furthermore, we may have underestimated the rate of ureteral injury just as in other studies, in which patients may have been diagnosed with an LUT injury postoperatively at another institution. Finally, we did not examine the additional cost of diagnostic cystoscopy with intravenous administration of indigo carmine. Visco et al[6] performed a decision analysis in which they concluded that there would be cost savings for routine cystoscopy if the rate of ureteral injury is >1.5% for total abdominal and >2.0% for total vaginal hysterectomy considering the cost of reoperation to repair an LUT injury. There has been controversy regarding the cost-effectiveness of robotic surgery, and with routine cystoscopy, this extra procedure may have additional costs.[16] However, the expense of a reoperation for an unrecognized injury, as well as the possibility of litigation, may justify the use of routine cystoscopy at procedure end. In addition, it has been reported that up to 32% of ureteral injuries are caused by surgeons neglecting to dissect out the ureter for identification.[8] Recognition of such injuries by use of routine cystoscopy may therefore prevent malpractice.

As other studies have suggested, LUT injuries can still go undetected even with the use of routine cystoscopy. In one of the largest meta-analyses on the topic, Gilmour et al[3] found that there were a greater number of both ureteral and bladder injuries detected in studies that used routine cystoscopy after hysterectomy compared with those that did not. This discrepancy is likely explained by the ability of routine intraoperative cystoscopy to better detect and therefore catch any intraoperative injuries. Patients whose injuries were missed became symptomatic later or presented to another institution for workup. When routine cystoscopy was not performed, surgeons were only able to detect <50% of ureteral injuries and <25% of bladder injuries. When routine cystoscopy was performed, however, 100% of ureteral injuries and 80% of bladder injuries were detected intraoperatively. Partial ureteral transection, for example, may not be immediately apparent. Furthermore, with electrosurgical devices (eg, monopolar shears or fenestrated bipolar graspers), thermal injury necrosis may not manifest until days later and the initial cystoscopic findings may be normal.

Operative time is still an issue with robotic surgery as compared with laparoscopy. When we investigated the utility of cystoscopy, the mean operative time for the non-cystoscopy group was longer than that for the routine cystoscopy group, perhaps because of a larger mean specimen size. The shorter operative time in the routine cystoscopy group suggests that it is possible to efficiently incorporate cystoscopy into robotic surgery without significantly lengthening the operative time.

Laparoscopic injuries to the LUT were less commonly recognized by direct visualization intraoperatively in one study,[17] suggesting that there is a role for routine cystoscopy, especially for low-volume gynecologic surgeons. In addition, with training of residents, fellows, and novice surgeons on the robotic platform, increased risks of damage to the LUT exist for surgeons who are developing and surpassing their learning curve. We believe that resident training in cystoscopy is essential because of the increased risks of iatrogenic LUT injury during gynecologic surgery. One small study suggested that although most obstetrics and gynecology residents in training are familiar with cystoscopy, many only use this skill when a urinary tract injury is suspected.[18]

CONCLUSION

As gynecologic surgeons perform more complex robotic procedures and as the utility of robotic surgery in gynecology increases, the risk of LUT injury may increase over

time. However, as evidenced by our study of solely gynecologic oncologists, there may be a low absolute risk of both encountering an LUT injury and detecting an LUT injury through the use of routine cystoscopy for experienced robotic surgeons. Given the devastating sequelae of an unrecognized LUT injury, routine cystoscopy may be a worthy safeguard against potential litigation, as well as improving care from a patient safety standpoint, even in experienced hands. The risk of complications from an undetected LUT injury makes a compelling case for the continued use of routine cystoscopy in robotic gynecologic surgery.

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