Best practices in minimally invasive gynecology: making sense of the evidence

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Chapter 5

Utility of cystoscopy during hysterectomy

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Abstract

Objective: To estimate the incidence of cystoscopy use at time of hysterectomy and its use to detect urinary tract injury.

Methods: This was a retrospective cohort study in a tertiary care academic center of 1982 patients who underwent a hysterectomy for any indication (excluding obstetric) between January 2009 and December 2010. Medical records were reviewed for baseline and perioperative characteristics, cystoscopy use, and information about bladder or ureteral injury related to hysterectomy.

Results: Two hundred fifty-one women (12.66%, 95% confidence interval [CI] 11.23–14.21%) underwent a cystoscopy at the time of hysterectomy with no reported complications resulting from the cystoscopy procedure. Cystoscopy was most frequently used by low-volume surgeons and in cases involving prolapse or vaginal mode of access. Fourteen patients (0.71%, 95% CI 0.39–1.19%) experienced bladder injury and five patients (0.25%, 95% CI 0.08–0.58%) sustained ureteral injury. None of these complications were detected by cystoscopy; cystoscopy was either normal at the time of hysterectomy or was omitted. The presence of adhesions was significantly associated with bladder injury at the time of hysterectomy (p=.006). Low-volume surgeon and laparoscopic or robotic mode of access were both significantly associated with ureteral injury (p=.023 and p=.042, respectively).

Conclusions: Our data support selective rather than universal cystoscopy at the time of hysterectomy.

Introduction

Hysterectomy is the most common major gynecologic surgical procedure performed worldwide.[1] Regardless of the route of hysterectomy, potential for injury to the urinary tract remains a major concern. Injuries not identified at the time of surgery can have serious postoperative consequences; therefore, it is of utmost importance to recognize and repair injuries intraoperatively if possible.[2] According to a review by Gilmour and a large retrospective study performed in Finland by Brummer, the incidence of urinary tract injuries during hysterectomy ranges from 0.2 to 12.1 per 1,000 for bladder injury[3;4] and from 0.2 to 13.9 per 1,000 for ureteral injury.[4]

Historically, surgeons relied on clinical suspicion alone to diagnose intraoperative injury to the ureters or bladder.[5] The first cystoscopy was described by German urologist M.C.F. Nitze in 1879; however, it was not until later that gynecologic surgeons began to perform cystoscopy concomitantly with their primary procedure.[6] As surgeons strive to lower the risk of complications related to gynecologic surgery, it has been debated whether cystoscopy should routinely be performed at the time of hysterectomy. Many authors advocate that cystoscopy should be a universal screening tool, because its relatively low cost is accompanied by a high injury detection rate superior to simple visual inspection.[7] The use of cystoscopy can help detect injuries that might otherwise have been unidentified, thus decreasing morbidity and potentially avoiding further complications.[2] Advocates of universal, rather than selective, cystoscopy point to the fact that using cystoscopy only with complicated cases may lead to underdiagnosis; it has been reported that up to 75% of urinary tract injuries are associated with uncomplicated hysterectomies.[8] Additionally, serious complications related to cystoscopy are rare.[9]

However, one should also take into account the potential disadvantages of performing universal cystoscopy at the time of hysterectomy, including increased operative time, procedure cost, and incidence of minor complications such as bladder trauma or urinary tract infection. Although extremely rare, severe complications associated with intravenous dye use during cystoscopy have also been reported.[5] Although cystoscopy has a high sensitivity and specificity, it will not detect all injuries, particularly those caused by thermal damage, which may take several weeks to develop.[8;10] It has also been suggested that some urinary tract injuries are asymptomatic and resolve spontaneously, meaning that universal cystoscopy could lead to overdiagnosis and unnecessary intervention in some cases.[3] As a result of these considerations, many surgeons perform selective cystoscopy in more complex cases, basing their decisions on training, surgical experience, and individual rate of injuries.[11]

To minimize hysterectomy-associated urinary tract complications, it is important to carefully evaluate the use of cystoscopy. The aim of this study is to estimate the incidence of cystoscopy use at the time of hysterectomy and its use to detect urinary tract injury at a large academic tertiary-care hospital in the northeastern United States. In our hospital, there is no specific protocol in place across specialties regarding the use of cystoscopy, and the vast majority of health care providers practice selective cystoscopy.

Material and methods

This retrospective study was approved by Partner's Research Management Institutional Review Board, our local institutional review board. The study cohort included the 1,982 patients who underwent a hysterectomy for any nonobstetric indication from January 2009 through December 2010 at Brigham and Women's Hospital. All modes of hysterectomy (abdominal, vaginal, laparoscopic, robotic) and each subtype (total, subtotal, radical) were included. Patients who underwent a gravid or postpartum hysterectomy were excluded; however, oncologic hysterectomy cases were included.

The following data were abstracted from the medical record: age, parity, race, body mass index (calculated as weight (kg)/[height (m)]^2), indication for surgery, history of prior surgeries, annual hysterectomy volume of operating surgeon (low volume defined as less than 10 hysterectomies per year, medium volume as 11–50 hysterectomies per year, high volume as greater than 51 hysterectomies per year), operative findings, intraoperative complications, postoperative complications, readmission, reoperation, presence of urinary tract injury, operative time (listed as time in and out of the operating room), length of hospital stay (same day discharges coded as 0 days), estimated blood loss, total hospital cost and operative cost (as reported by hospital accounting ledgers), performance of cystoscopy, and complications related to cystoscopy. Intraoperative complications included injuries to the urinary tract, nerves, vessels, or bowel as well as estimated blood loss of more than 1,000 mL or major anesthesia-related issues. The postoperative complications were divided into major and minor complications based on previously described criteria;[12] major complications included injuries to the urinary tract, nerves, vessels, or bowel, which were diagnosed postoperatively, as well as hemorrhage requiring transfusion, hematoma requiring drainage, pulmonary embolus, or wound dehiscence; minor postoperative complications included hemorrhage not requiring transfusion, infection or fever, spontaneously resolving hematoma, deep vein thrombosis, minor anesthesia issues, or other mild complications requiring treatment.

Statistical analyses were performed using SAS 9.2 software. Data were summarized and extreme values were verified to be correct. Comparisons of the patients who

underwent cystoscopy at the time of hysterectomy, compared with those who did not, were performed using the Wilcoxon rank-sum test for continuous and ordered variables because distributional normality could not be assumed according to results of standard tests of normality (SAS implementation of Shapiro-Wilk). The X^2 was used for nonordered categorical variables. P-values were not adjusted for multiple testing in this exploratory data analysis context.

Results

Of the 1,982 patients included in this study, 251 women (12.66%, 95% confidence interval [CI] 11.23–14.21%) underwent a cystoscopy at the time of their hysterectomy with no reported complications resulting from the cystoscopy procedure. Baseline and operative characteristics are displayed in Table 5.1. Patients who underwent a cystoscopy were found to be younger on average compared with patients who did not undergo cystoscopy. Discrepancies were also found with regard to race, lower body mass index, and higher parity in the group who underwent cystoscopy. No significant difference was found between the two groups in terms of history of laparotomy or laparoscopy.

Concerning the indication for hysterectomy, there were 775 oncologic and 1,207 benign cases. Cystoscopy was performed less frequently in the oncologic cases (frequency 1.68%, 95% CI 0.90–2.85%) in oncologic cases compared with (19.72%, 95% CI 17.51–22.08%) in benign cases ($p<.001$). There were 216 prolapse and 1,766 nonprolapse cases; cystoscopy was performed more frequently in cases involving prolapse (frequency 38.89%, 95% CI 32.35–45.74% compared with 9.46%, 95% CI 10.74–13.85%; $p<.001$). No significant difference was found with regard to cystoscopy use in cases involving leiomyomata or endometriosis.

Perioperative outcomes and complications were also examined (Table 5.1). Estimated blood loss was lower in the cystoscopy group, although there was no statistically significant difference seen with regard to uterine weight between the groups. Operative time was longer in the cystoscopy group with a corresponding higher operative cost as well. Length of stay was found to be shorter in the cystoscopy group; this may reflect the preponderance of oncologic cases in the noncystoscopy group, which are associated with more complex medical issues and comorbidities that result in longer hospitalization. Intraoperative complications, major postoperative complications, readmissions, and reoperations were not significantly different between the two groups. However, when analyzing subcategories of intraoperative or major postoperative complications, the cystoscopy group was found to have a significantly lower incidence of estimate blood

Table 5.1: Baseline characteristics, perioperative outcomes and complications of hysterectomy cohort

	Cystoscopy n=251	No cystoscopy n=1,731	p-value
Age (y)	49.7±11.5 (48 [19.4–87])	53.4±11.9 (51 [18–92])	<.001
BMI (kg/m^2)	28.0±6.0 (27 [18.1–52.7])	29.9±8.3 (27.9 [15.8–69.4])	.02
Race			.05
White	179 (73)	1332 (79)	
Black	34 (14)	194 (12)	
Other§	33 (13)	155 (9)	
Parity	2.1±1.6 (2 [0–11])	1.83±1.5 (2 [0–12])	.009
Prior laparoscopy	71 (29.8)	400 (24.3)	.07
Prior laparotomy	91 (38.1)	654 (39.6)	.65
Indication/findings*			
Cancer	13 (5.2)	762 (44.0)	<.001
Prolapse	84 (33.5)	132 (7.6)	<.001
Leiomyomata	134 (53.4)	886 (51.2)	.51
Endometriosis	16 (6.4)	117 (6.8)	.82
Adhesive Disease	50 (19.9)	451 (26.1)	<.001
OR time (min)	206.7±78.3 (195 [79–692])	191.4±67.5 (180 [29–618])	.004
Estimated blood loss (mL)	150.5±196.6 (100 [0–1800])	205.6±327.0 (100 [0–4800])	.03
Uterine weight (grams)	247±269.5 (141 [24–17775])	280.3±462.4 (139 [20–8000])	.93
Length of Stay (d)	1.5±4.2 (1 [0–65])	2.0±2.2 (1 [0–34])	<.001
Total OR cost (USD)	14,170.3±9,834.1 (9927.5 [3252–54999])	11,136.0±7,434.8 (9322 [1498–88453])	<.001
Total cost (USD)	24,854.2±33,224.4 (19968.1 [964.1–496237])	23,876.4±13,940.7 (23532.51 [2254.4–125603.5])	.36
Intra-operative complication*	13 (5.2)	53 (3.1)	.08
Readmission	18 (7.2)	87 (5.1)	.16
Reoperation	6 (2.4)	41 (2.4)	.99
Major postoperative complication	15 (6)	84 (4.9)	.45
Minor postoperative complication	93 (38.8)	318 (19.1)	<.001

BMI, body mass index; Data are mean + standard deviation or number (%).
* Each was compared with all others combined; § Includes 102 Hispanics, 77 Asians and 9 others.

loss greater than 1,000 mL (0.8% compared with 3%; p=.045) but a higher incidence of bladder injury (2% compared with 0.3%; p<.001) and bowel injury (1.6% compared with 0.5%; p=.049). The minor postoperative complications were more common in the cystoscopy group, perhaps reflecting associated urinary tract symptoms in the patients who underwent cystoscopy.

Table 5.2 outlines the frequency of cystoscopy listed by procedure and surgeon characteristics. Cystoscopy was performed most often in vaginal hysterectomies followed by laparoscopic and robotic. Of note, there was no significant difference found between frequency of cystoscopy in the laparoscopic and robotic subgroups (p=.19). It also was seen that cystoscopy was performed less frequently if the hysterectomy was completed by a higher-volume surgeon. However, when surgeons were further categorized into generalists or specialists (defined as having completed fellowship training in urogynecology, gynecologic oncology, reproductive endocrinology and infertility, or minimally invasive surgery), no significant difference was found with regard to cystoscopy use.

Nineteen patients experienced a urinary tract injury; 14 patients (0.71%, 95% CI 0.39–1.19%) incurred bladder injuries and five patients (0.25%, 95% CI 0.08–0.58%) sustained ureteral injuries. The bladder injury cases are outlined in Table 5.3 separated into the 10 cases that were identified intraoperatively and the four that were discovered postoperatively (Table 5.3). Cystoscopy did not aid in the intraoperative detection of any bladder injuries.

Table 5.2: Proportion who underwent cystoscopy according to procedure and surgeon characteristics in 1,982 hysterectomy patients

	n	Cystoscopy n (%)	p-value
Mode of hysterectomy			<.001
Abdominal	644	12 (1.9)	
Vaginal	250	69 (27.6)	
Laparoscopic	1,011	162 (16.0)	
Robotic	77	8 (10.4)	
Subtype of hysterectomy			<.001
Supracervical	391	74 (18.9)	
Total	1,511	177 (11.7)	
Radical	79	0 (0.0)	
Surgeon type			.91
Generalist	297	37 (12.5)	
Specialist	1,685	214 (12.7)	
Surgeon volume*			<.001
Low	196	51 (26.0)	
Medium	518	110 (21.2)	
High	1,268	90 (7.1)	

* Low volume > 10; medium 21–50; high 51–80 cases/year.

Table 5.3: Description of bladder injuries

Case	Type of hysterectomy	Low-volume surgeon	Cancer	Adhesions	Endometriosis	Uterine weight (g)	Prior surgery	Cystoscopy use	Comments
Identified intraoperatively n=10									
1	TAH		x	x		122	x	No	**Cystotomy** visualized & repaired
2	SAH	x		x		495	x	No	**Cystotomy** visualized & repaired
3	TLH			x		167	x	No	Blood-tinged urine noted, bladder back-filled and **cystotomy** identified & repaired
4	TLH converted to TAH			x	x	833		No	**Cystotomy** visualized & repaired
5	TAH					1,144		No	Blood-tinged urine noted, bladder back-filled and **cystotomy** identified & repaired
6	TAH		x	x		406	x	No	**Cystotomy** visualized & repaired
7	TVH	x				129	x	After repair of injury	Fluid leakage into field, bladder back-filled and **cystotomy** identified & repaired
8	TLH			x		155	x	After repair of injury	**Cystotomy** visualized & repaired
9	TVH					114		After repair of injury	Fluid leakage into field, **cystotomy** identified & repaired
10	TLH			x		746	x	After repair of injury	**Cystotomy** visualized & repaired

Case	Type of hysterectomy	Low-volume surgeon	Cancer	Adhesions	Endometriosis	Uterine weight (g)	Prior surgery	Cystoscopy use	Comments
Identified postoperatively n=4									
11	TAH		x			84		No	Tumor plaque dissected off surface of bladder. 1 week postoperatively developed ascites, when drained found to be urine. **Vesicovaginal fistula** identified, prolonged bladder drainage and interval transperitoneal fistula repair performed
12	TLH		x			164	x	No	4 days postoperatively developed pain, ascites. CT cystogram demonstrated **cystotomy**, repaired via laparotomy
13	TLH					387		Normal at time of hysterectomy	Intraoperatively backfilled bladder to confirm location during dissection. 1 week postoperatively fluid leakage per vagina. CT urogram confirmed **vesicovaginal fistula**, repaired via laparotomy
14	TLH	x		x		168	x	Normal at time of hysterectomy	Intraoperatively backfilled bladder to confirm location during dissection. 10 days postoperatively developed vaginal leakage. CT urogram confirmed **vesicovaginal fistula**, repaired via laparotomy

TAH, total abdominal hysterectomy; SAH, supracervical abdominal hysterectomy; TLH, total laparoscopic hysterectomy; TVH, total vaginal hysterectomy; CT, computed tomography.

Table 5.4: Description of ureter injuries

Case	Type of hysterectomy	Low-volume surgeon	Cancer	Adhesions	Endometriosis	Uterine weight (g)	Prior surgery	Cystoscopy use	Comments
	Identified intraoperatively n=0								
	Identified postoperatively n=5								
1	RRH		x			81		No	Developed urine leakage postoperatively, cystoscopy normal. Continued leakage led to CT urogram and retrograde pyelogram, left ureteral injury diagnosed and stented. Continued leakage led to repeat CT urogram and laparotomy to reimplant left ureter. Faiulre to improve led to third CT urogram which diagnosed right ureteral injury, reimplanted via laparotomy.
2	TLH	x				442		No	Left ureter noted to be in close proximity to coagulated edges of vaginal cuff. Postoperative urine leak into abdomen led to diagnosis of ureteral stricture which was stented. Required laparotomy and reimplantation.
3	TLH	x		x		221	x	No	2 weeks postoperatively developed vaginal leakage. Cystogram normal, CT urogram showed ureteral obstruction, stented.
4	TLH					303		No	2 days postoperatively developed vaginal leakage. Cystogram normal, CT urogram showed ureteral leakage and kinking, stented.
5	TLH		x	x	x	250	x	No	2 days postoperatively developed vaginal leakage. CT urogram showed ureteral injury, unable to stent. Nephrostomy placed, interval re-implantation with psoas hitch.

RRH, robotic radical hysterectomy; TLH, total laparoscopic hysterectomy; CT, computed tomography.

Instead, surgeons recognized the injuries by direct visualization of a cystotomy or presence or blood-tinged urine and fluid leakage into the field. In the four intraoperatively detected injuries wherein cystoscopy was used, it was solely used as a postrepair check. In two of the four cases of bladder injury identified postoperatively, a cystoscopy had been performed at the time of the hysterectomy without any abnormal findings. Table 5.4 outlines the five ureteral injuries that occurred. In all five cases, intraoperative cystoscopy was not performed and the ureteral injury was detected postoperatively.

Regarding risk factors for genitourinary injury at the time of hysterectomy, the following variables were investigated: low-volume surgeon, laparoscopic or robotic mode of access, total hysterectomy, oncologic indication, presence of adhesions, and history of laparotomy or laparoscopy. Of these factors, only the presence of adhesions was significantly associated with bladder injury at the time of hysterectomy (p=.006). Low-volume surgeon and laparoscopic or robotic mode of access were both significantly associated with ureteral injury at the time of hysterectomy (p=.023 and .042, respectively).

Discussion

Cystoscopy has been described as a useful tool in the detection of urinary tract injuries, which may occur during hysterectomy. Evaluation of the patients undergoing hysterectomy from our institution over a two-year study period found that gynecologic surgeons performed selective (rather than universal) cystoscopy at the time of hysterectomy. Surprisingly, cystoscopy was performed more commonly in subtotal hysterectomy than it was in total or radical types. This may in part reflect the performance of a joint procedure of supracervical hysterectomy and sacrocervicopexy, which is commonly used for treatment of apical prolapse and is often accompanied by a cystoscopy. Additionally, the gynecologic oncology surgeons were less likely to perform cystoscopy and almost exclusively perform total or radical hysterectomies. This difference among specialists is interesting and demonstrates that there are wide variations in philosophy regarding its cystoscopy use.

The absolute rate of hysterectomy-associated urinary tract injury was low. Although there is no substitute for prevention of injury with meticulous surgical technique and thorough knowledge of anatomy, timely detection of injury is also essential. In examination of the cases of bladder injury in our cohort, cystoscopy did not help detect any injuries intraoperatively. Furthermore, three of the four delayed recognition bladder injuries involved fistula formation. The tissue necrosis that leads to fistula development is typically the result of thermal or other mode of injury, which may not be visible on intraoperative cystoscopy.[13] Given these considerations and the low baseline incidence of bladder injury,

it is not clear that a strategy of universal cystoscopy would have substantially improved outcomes for these patients. Rather, these findings reinforce that, whether performing cystoscopy or not, it is not always possible to identify damage that occurs at the time of surgery.

Inferences regarding ureteral injury are more complex, because all five ureteral injuries in the cohort were identified postoperatively and not associated with cystoscopy screening at the time of hysterectomy. It is open to speculation whether or not universal cystoscopy would have identified any or all of these ureteral injuries earlier, allowing for more timely intervention and repair. However, it is interesting to note that in one of the ureteral injury cases (case 1 from Table 5.4), persistent vaginal drainage led to a cystoscopy two weeks after surgery that did not reveal any urinary tract defects. At the time of postoperative cystoscopy, indigo carmine was administered intravenously and bilateral ureteral jets seen. Failure to improve led to further urologic work-up and the patient was subsequently diagnosed with bilateral ureteral injuries. This case exemplifies the imperfect sensitivity of cystoscopy for injury detection and highlights the difficulty that may be encountered in diagnosis of ureteral injury. Even with the use of cystoscopy, one may fail to identify ureteral injury, particularly in cases of partial obstruction or thermal injury.[10] Visco et al. evaluated the cost-effectiveness of cystoscopy for detection of ureteral injury and concluded that universal cystoscopy is cost-effective when the incidence of ureteral injury at the time of hysterectomy exceeds 1.5–2%.[14] These recommendations should be interpreted with caution as a result of evolving techniques and changes in practice patterns in the intervening decade since the study was published; however, it is notable that the ureteral injury incidence in our study population was well below the cost-effectiveness threshold.

Although this study was not designed to analyze the predictive ability of risk factors for hysterectomy related urinary tract injury, it is interesting to examine these results in light of what has previously been reported in the literature. The rate of urinary tract injury in our cohort was 9.6 per 1,000 cases overall (9.3 per 1,000 for abdominal, 10.1 per 1,000 cases for laparoscopic or robotic, and eight per 1,000 for vaginal mode of access), which is comparable to reported incidence in the literature.[1] The increased risk of ureteral injury with the laparoscopic or robotic approach is consistent with previous findings, although must be interpreted with caution in a noncontrolled study because confounding factors may be present, which influence both choice of mode and risk of injury.[15;16] Surgical volume has been reported to be an important predictor of perioperative outcomes and was associated with ureteral injury occurrence in our cohort as well.[17] Additionally, the presence of adhesions was associated with incidence of bladder injury in this study, as has been reported previously.[4;18] As a result of the low baseline incidence of urinary tract

injury in our patient population, it is not possible to confirm the noted associations as definitive risk factors; a larger study design targeting this issue is needed to confirm these findings. Despite this caveat, surgeons who are prospectively assessing particular patient cases may find it useful to reflect on the presence of these factors (low-volume surgeon, laparoscopic or robotic access, adhesions) and further individualize decisions regarding urinary tract evaluation.

Limitations to this study include its retrospective nature. The rate of urinary tract injury may have been underestimated if patients presented to outside institutions for treatment or remained asymptomatic during the follow-up period that was observed (range 2–3 years). Strengths of this work include the large number of patients and surgeons present. Because this study was performed at an academic institution, health care providers represent a variety of surgical experience ranging from trainees to fellowship-trained attending surgeons. Additionally, both benign and oncologic hysterectomy cases were included. This patient and health care provider diversity lends generalizability to our findings, although it may also introduce confounding variables that are not fully accounted for by the study design.

Based on the low absolute risk of urinary tract injury, selective cystoscopy at the time of hysterectomy appears to be acceptable as currently practiced at Brigham and Women's Hospital. It may well be that outcomes regarding cystoscopy use and its use may vary in different populations or hospital settings. Although our data support selective rather than universal cystoscopy at the time of hysterectomy, the authors maintain that the threshold to perform a cystoscopy should be low, and in cases involving low-volume surgeons, significant pelvic pathology, or both, cystoscopy should be performed liberally. Surgeons should also be aware that a normal cystoscopy does not negate the possibility of urinary tract injury and maintain vigilance during the postoperative period. Additionally, it is important for gynecologic surgeons who perform advanced pelvic surgery to be trained and have privileges for performance of diagnostic cystoscopy. A Canadian study found that the most common reason for omitting cystoscopy at the time of laparoscopic hysterectomy was lack of training.[19] Although continually striving to improve early detection of bladder and ureteral injury at time of hysterectomy, there is no substitute for primary prevention through surgeon experience and comfort with pelvic anatomy.

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