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Universal Cystoscopy After Benign Hysterectomy: Examining the Effects of an Institutional Policy

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Abstract

Objective—To evaluate the association between a universal cystoscopy policy at the time of benign hysterectomy and the detection of urologic injuries.

Methods—This is a retrospective cohort study at a tertiary care academic center where a policy of universal cystoscopy at the time of benign hysterectomy was instituted on October 1, 2008. Benign hysterectomies performed from March 3, 2006 –September 25, 2013 were included and dichotomized into preuniversal and postuniversal cystoscopy groups. Medical records were reviewed for baseline and perioperative characteristics, cystoscopy use, and urologic injuries related to hysterectomy. Urologic injuries were identified by using a search engine and a departmental quality improvement database.

Results—Two thousand nine hundred eighteen hysterectomies were identified during the study time period, 96 of which were excluded for indications of abdomino-pelvic cancers and peripartum indications. Therefore, 973 women were in the preuniversal cystoscopy group and 1,849 were in the postuniversal cystoscopy group. Thirty-six percent (347/973, 95% CI 32.8 – 38.8%) and 86.1% (1,592/1,849, 95% CI 84.5 – 87.7%) of cases underwent cystoscopy prepolicy and postpolicy, respectively. The urologic injury rates were 2.6% (25/973, 95% CI 1.6 – 3.6%) and 1.8% (34/1,849, 95% CI 1.2 – 2.5%) in the prepolicy and postpolicy groups, respectively. Delayed urologic injuries decreased significantly (0.7% [7/973], 95% CI 0.3 – 1.2% vs. 0.1% [2/1,849], 95% CI 0.0 – 0.3%). Of the nine delayed injuries, four had normal intraoperative cystoscopy findings and five had no cystoscopy performed.

Conclusion—The practice of universal cystoscopy at the time of hysterectomy for benign indications is associated with decreased delayed postoperative urologic complications.

Introduction

Cystoscopy is a low-risk procedure that can improve detection of urologic injury at the time of gynecologic surgery and may decrease the rate of delayed ureteral complications.¹⁻³ In

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1995, Wiskind and Thompson suggested that gynecologists should perform routine cystoscopy at the time of hysterectomy to detect urologic injuries earlier.⁴

The pros of a universal cystoscopy policy at the time of hysterectomy include that it is a low cost tool with minimal risk to the patient. Cystoscopy leads to a higher detection rate of urologic injuries compared to visual inspection alone.⁵ Because up to 75% of urologic injuries are associated with uncomplicated hysterectomies,⁵ advocates for universal cystoscopy at the time of hysterectomy claim that this practice will help identify unsuspected injuries missed with selective cystoscopy and could help prevent delayed urologic complications⁵.

In contrast, proponents of selective cystoscopy at the time of hysterectomy argue that it should only be performed in cases where there is a high suspicion for urologic injury due to the overall low prevalence of urologic injuries and the added time and cost associated with cystoscopy. Additionally, some normal cystoscopy findings interpreted as “abnormal” may lead to unnecessary interventions. Finally, some urologic injuries, like those resulting from thermal damage, may not be immediately apparent at the time of cystoscopy and therefore it is not 100% sensitive in detecting all urologic injuries.

Clearly, the issue of whether or not cystoscopy should be performed universally after hysterectomy remains unresolved. The American Congress of Obstetricians and Gynecologists recommends that the general obstetrician-gynecologist perform cystoscopy for procedures with a high risk of urologic injury (such as those for pelvic organ prolapse or incontinence) but concludes that the routine use of cystoscopy at the time of hysterectomy requires further study.⁶

At our institution, after a hands-on educational program to credential attending physicians in the performance of cystoscopy, a policy of universal intraoperative cystoscopy at the time of benign hysterectomy was implemented in October 2008. The objectives of this study were to evaluate 1) the prevalence of urologic injury rates prepolicy and postpolicy; 2) the rate at which cystoscopy detected urologic injuries; and 3) the adherence rate to this policy.

Materials and Methods

We performed a retrospective cohort study of all hysterectomies performed for benign indications at the University of Michigan from March 3, 2006 through September 25, 2013. The start date was chosen as this is when a database tracking all hysterectomies performed at our institution was initiated. The end date reflects the time point at which our study began; however, data abstraction regarding urologic complications did not commence until December 2014. Approval for the study was granted by the Institutional Review Board (HUM00069383).

A policy requiring that cystoscopy be performed at the time of all hysterectomies for benign indications was implemented within the Gynecology Division at our institution on October 1, 2008. Prior to that time, cystoscopy was selectively performed at the time of hysterectomy based on surgeon discretion. Hysterectomies performed from March 3, 2006 to September 30, 2008 were categorized as the “preuniversal cystoscopy” group and those performed from

October 1, 2008 to September 25, 2013 were categorized as the “postuniversal cystoscopy” group.

Prior to implementation of the universal cystoscopy policy, a cystoscopy workshop was provided for all attending physicians who perform benign hysterectomy as part of their practice as well as fellows and residents. Attending physicians previously not trained in cystoscopy were also proctored in the operating room for a minimum of three sessions. Cystoscopy was performed using a 21 French rigid 70-degree cystoscope after the patient was given intravenous indigo carmine to aid in detecting ureteral patency. Indigo carmine was available at our institution for the entire duration of this study period. In order to become credentialed for cystoscopy privileges, providers had to demonstrate competency in performing a survey of the bladder mucosa, identifying and assessing patency of the ureteral orifices, and assessing urethral integrity.

A departmental database was used to identify benign hysterectomy cases, as well as to abstract demographic and perioperative data including: age, body mass index (BMI), race, indication for surgery (using International Classification of Diseases, 9th edition, codes), route of hysterectomy and concurrent procedures (using Current Procedural Terminology codes), utilization of cystoscopy, surgical time, and length of hospital stay. Route of hysterectomy included: abdominal, laparoscopic, robotic-assisted laparoscopic, and vaginal (which included laparoscopic-assisted vaginal hysterectomy).

Intraoperative urologic injuries included those identified during the hysterectomy and were categorized as bladder or ureteral (there were no urethral injuries identified). Delayed urologic injuries were defined as those injuries not detected until after the patient left the operating room after the hysterectomy.

Urologic injuries were identified using the Electronic Medical Record Search Engine,⁷ a specialized search engine designed to abstract information from medical documents. Search terms included: “bladder injury,” “cystotomy,” “ureteral injury,” “ureteral obstruction,” “ureteral kinking,” and “no efflux.” A departmental quality improvement database was also used to identify additional cases of urologic injury by querying cases of readmission or unplanned return to the operating room within 30 days, genitourinary fistula, and any surgical injury including the bladder or ureter. Chart review was performed by two authors (A.C. and C.S.) to verify cases of urologic injury and obtain data regarding their clinical outcomes. Follow-up times for the urologic injuries varied based on the date of the hysterectomy and ranged from 15 months to seven years and nine months.

In order to assess the increased cost associated with delayed urologic complications, available hospital charges and insurance payments were obtained for all of the delayed urologic injury cases and compared in a 1:2 fashion to hysterectomy cases in which no delayed urologic injury occurred. The two controls cases were chosen immediately before and after the case affected by a delayed urologic injury.

Demographics, perioperative variables, use of cystoscopy, and urologic injuries were then compared between the preuniversal and postuniversal cystoscopy groups. Normality of data was tested using the Kolmogorov-Smirnov and Shapiro-Wilk tests. Continuous variables

with a normal distribution were assessed using student's t test; Mann-Whitney U was used for those that were non-normally distributed. Categorical variables were analyzed using Chi-Square or Fisher's Exact. P values < .05 were considered significant. Statistical analyses were generated using IBM SPSS 20.0.

Due to the rarity of these injuries (<2%) and the higher (potentially protective) rates of intraoperative detection of injury, a post-hoc power analysis revealed the sample size required in each group for any urologic, intraoperative bladder, or intraoperative ureteral injury would be: 5,277, 24,923, and 6,083, respectively, assuming 80% power for a Chi-Square test.

Results

A total of 2,918 hysterectomies were performed for benign indications from March 3, 2006 to September 25, 2013. One thousand and four hysterectomies were performed prior to the universal cystoscopy policy and 1,914 hysterectomies were performed after the universal cystoscopy policy was implemented. Ninety-six hysterectomies were excluded for indications of abdomino-pelvic cancers (i.e. colon) and peripartum indications, 31 from the preuniversal cystoscopy group and 65 from the postuniversal cystoscopy group. Therefore, 2,822 hysterectomies were included in the final analysis: 973 in the preuniversal cystoscopy group and 1,849 in the postuniversal cystoscopy group.

Demographics, perioperative data, and urologic complications for hysterectomies done prior to and after implementation of the universal cystoscopy policy are shown in Table 1. Groups were similar in terms of age, BMI, race, and indication for hysterectomy. Utilization of abdominal hysterectomy decreased in the preuniversal compared with the postuniversal cystoscopy group, while robotic-assisted laparoscopic hysterectomies increased. Median surgical time was increased by 20 minutes in the post-universal cystoscopy group. Length of stay was significantly shorter in the post-universal cystoscopy group; however, the median difference was 4.8 hours. Performance of cystoscopy was documented for 86.1% of cases (1,592/1,849, 95% CI 84.5 – 87.7%) in the post-universal cystoscopy group, which is a significant increase compared to the preuniversal cystoscopy group (35.7%, [347/973], 95% CI 32.8 – 38.8%; $p < .001$, Table 1). There were no complications related to cystoscopy use identified in either group.

Overall, the rate of urologic injury was 2.1% (59/2,822, 95% CI 1.6 – 2.6%). Each urologic injury case corresponds to one patient with the exception of one woman in the post-universal cystoscopy group who had both an intraoperative bladder and ureteral injury. The preuniversal cystoscopy group had a urologic injury rate of 2.6% (25/973, 95% CI 1.6 – 3.6%) and the postuniversal cystoscopy group had a rate of 1.8% (34/1,849, 95% CI 1.2 – 2.5%), a difference that did not reach statistical difference. However, the power in our study to detect differences for any urologic, intraoperative bladder, or intraoperative ureteral injury given sample sizes of 973 for the preuniversal and 1,849 for the post-universal cystoscopy group was 30.4%, 8.8%, and 30.7%, respectively. Despite being underpowered to detect some differences, we did find significantly fewer delayed urologic complications in the

postuniversal compared with the preuniversal cystoscopy group (0.1% [2/1,849], 95% CI 0.0 – 0.3% vs. 0.7% [7/973], 95% CI 0.3 – 1.2%; $p = .01$).

Operative characteristics and urologic complications before and after implementation of the cystoscopy policy were compared for the 59 cases with bladder or ureteral injury (Table 2). Cystoscopy was performed significantly more frequently in the post-universal cystoscopy group. Although intraoperative bladder injury was the most common urologic injury in both groups, the frequency of bladder injuries was significantly higher in the postuniversal compared with the preuniversal cystoscopy group (85.3% [29/34], 95% CI 72.0 – 96.8% vs. 52.0% [13/25], 95% CI 31.6 – 72.2%; $p = .005$). Specifically, cystotomy rates were greater in the postuniversal compared with the preuniversal cystoscopy group (73.5% [25/34], 95% CI 57.9 – 87.1% vs. 48.0% [12/25], 95% CI 27.3 – 68.8%; $p = .045$). The prevalence of ureteral injuries, categorized as kinking, transection, ligation, and perforation, were similar in both groups. We were unable to identify any significant differences or clinically meaningful trends between the two groups in terms of route of hysterectomy, surgical time, and indication for hysterectomy (data not shown, lowest p -value = .12).

Because some urologic injuries, like cystotomy, may be detected prior to performing cystoscopy, we sought to determine the frequency with which cystoscopy actually detected urologic injuries. In the post-universal cystoscopy group, cystoscopy detected nearly twice as many urologic injuries compared to the preuniversal cystoscopy group (47% [16/34], 95% CI 32.4 – 64.7% vs. 24% [6/25], 95% CI 8.0 – 40.0%; $p = 0.04$). Table 3 details the nine cases of delayed urologic injury. Of the seven cases in the preuniversal cystoscopy group, two had intraoperative cystoscopy with normal findings and the other five cases had no cystoscopy performed. The two cases that occurred in the post-universal cystoscopy policy group both had normal intraoperative cystoscopy findings. Regarding complication type, four of the seven delayed injury cases in the preuniversal cystoscopy group were vesicovaginal fistulas, none of which had intraoperative cystoscopy documented. In contrast, there were no cases of vesicovaginal fistula after implementation of the universal cystoscopy policy. Time to detection of the delayed urologic injuries ranged from 3-40 days after the hysterectomy.

When we analyzed cost data from a sampling of our cases, hospital charges nearly doubled if a delayed urologic injury was present (\$13,098.50 vs. \$7,427.00, $p = .02$). However, insurance payments received by the hospital did not significantly change (\$4,221.68 in delayed urologic injury cases vs. \$2,477.10 in the controls, $p = .30$).

Discussion

At our institution, implementation of a universal cystoscopy policy at the time of benign hysterectomy was associated with a significant decrease in delayed postoperative urologic complications and an increase in cystoscopic detection of urologic injuries. These findings are consistent with published studies showing that universal cystoscopy increases intraoperative detection of unsuspected urologic injuries.^{5,8,9} However, as our data also show, the sensitivity of cystoscopy in detecting all urologic injuries is less than 100%. There were four cases in which a delayed urologic injury occurred despite intraoperative

cystoscopy. Nevertheless, it is important to recognize that a policy of universal cystoscopy at the time of benign hysterectomy at our institution appeared to be protective. When selective cystoscopy was used, as occurred in the preuniversal cystoscopy group, there were four vesicovaginal fistulas. In the postuniversal cystoscopy group, no vesicovaginal fistulas occurred. This is a notable finding, as benign gynecologic surgery is reported to be responsible for 90% of vesicovaginal fistulas.¹⁰

The overall prevalence of urologic injury at the time of benign hysterectomy in our study was 2.1%, with 2.6% in the pre-universal cystoscopy group and 1.8% in the post-universal cystoscopy group. Although these rates are consistent with the range of urologic injury at the time of hysterectomy in published literature^{5,9,11-13}, prior studies looking at selective cystoscopy use at the time of hysterectomy have reported urologic injury rates under 1%.¹¹⁻¹³ Low rates of cystoscopy utilization as well as a lack of, or poorly defined, postoperative follow-up has likely led to underestimation of the true prevalence of urologic injuries in these studies by failing to capture those that were unsuspected intraoperatively or arose after the immediate postoperative time period. Furthermore, published studies of universal cystoscopy at the time of benign hysterectomy are also limited by lack of long-term postoperative follow-up.^{5,9} Therefore, our study adds to the literature by reporting results specific to delayed urologic injury with up to nearly eight years of postoperative follow-up.

In addition to the clinical implications, urologic injuries may also have significant financial repercussions.¹⁴ Based on a sampling of our cost data, hospital charges nearly doubled if a delayed urologic injury occurred. Although a comprehensive cost-benefit analysis was beyond the scope of this paper, analyses evaluating the cost-effectiveness of cystoscopy have been previously reported. A hospital-based cost analysis by Visco et al determined that if a ureteral injury rate was greater than 1.5-2%, then universal cystoscopy would be cost saving.¹⁵ However, this study was limited to ureteral injuries only and did not account for costs associated with patient pain and suffering, time lost from work, and medical-legal payments. A cost-benefit analysis including all urologic injuries and the associated psychological and socioeconomic costs would be needed to more definitively answer the question of whether or not universal cystoscopy at the time of hysterectomy is a cost-effective intervention.

After implementation of the universal cystoscopy policy, utilization of cystoscopy at the time of benign hysterectomy significantly increased but was not 100%. Although this likely reflects the real-life challenges of implementing large-scale changes in clinical practice, we do show that it is feasible to train providers at a variety of skill levels to competently perform cystoscopy.

The main strength of our study is that we were able to compare urologic injury rates before and after implementation of a universal cystoscopy policy within a single institution. Our ability to follow patients postoperatively from 15 months to almost eight years increased our ability to detect delayed urologic injuries. We had a large sample size and performed a robust chart review, where urologic injuries were determined by two electronic methods and then verified by chart review.

Limitations of our study include its retrospective design and our ability to detect postoperative urologic injuries that were managed outside of our institution. Although postoperative follow-up varied between groups, the minimum follow-up time was 15 months and as all of the delayed urologic complications were identified within two months of the initial surgery, we do not think this variation impacts our results. Additionally, due to the low prevalence of urologic complications, we had limited power to be able to detect some differences between groups. A large, multicenter prospective trial is needed to validate the findings of this study.

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Table 1

Demographics, perioperative data, and urologic complications prior to and after implementing a policy for universal cystoscopy after hysterectomy

Variables	Pre-Universal Cystoscopy Policy (N=973)	Post-Universal Cystoscopy Policy (N=1849)	P value
Age, years	48.1 ± 10.9	49.5 ± 11.1	.07
Body Mass Index kg/m	29.1 ± 8.0	30.1 ± 11.9	.16
Caucasian	78.8 (767)	77.4 (1432)	.40
Cystoscopy Performed	35.7 (347)	86.1 (1592)	<.001
Any Urologic Injury	2.6 (25)	1.8 (34)	.20
Type of Urologic Injury:			
Intraoperative Bladder	1.3 (13)	1.6 (29)	.63
Intraoperative Ureteral	0.5 (5)	0.2 (4)	.29*
Delayed [†]	0.7 (7)	0.1 (2)	.01*
Indication for Hysterectomy:			
Endometriosis	9.4 (91)	9.7 (180)	.76
Fibroids	38.8 (378)	41.8 (773)	.14
Abnormal Uterine Bleeding or Dysmenorrhea	34.3 (334)	34.7 (642)	.87
Adnexal Mass	12.8 (125)	10.6 (196)	.07
Prolapse	22.9 (223)	25.7 (476)	.11
Cervical Dysplasia	4.0 (39)	3.4 (63)	.41
Endometrial Hyperplasia	6.1 (59)	6.8 (126)	.45
Risk-Reduction	2.5 (24)	2.4 (45)	.95
Pelvic or Tubo-ovarian abscess	0.8 (8)	0.4 (8)	.19
Pelvic Pain	3.6 (35)	2.7 (50)	.18
Other [‡]	0.8 (8)	0.6 (11)	.48
Route of Hysterectomy:			
Abdominal	38.2 (372)	26.9 (497)	<.001
Laparoscopic	14.4 (140)	16.9 (313)	.08
Robotic-assisted	13.7 (133)	22.0 (406)	<.001
Vaginal	33.7 (328)	34.2 (633)	.78
Surgical Time, minutes	152 (118, 192)	172 (135, 222)	<.001
Length of Stay, days	1.6 (1.3, 2.4)	1.4 (1.1, 2.3)	<.001

Data reported as mean ± SD, median (IQR), or % (n). P values determined using student's t test for parametric data and Mann-Whitney U for non-parametric data, Chi-Square or Fisher's Exact (*) for categorical variables.

[†] Refers to urologic complications (both bladder and ureteral) not recognized until after the patient left the operating room after the hysterectomy

[‡] All cases were gender reassignment surgeries

Table 2

Urologic injuries prior to and after implementing a policy for universal cystoscopy after hysterectomy

Variables	Urologic Injury		P value
	Pre-Universal Cystoscopy Policy (N=25)	Post-Universal Cystoscopy Policy (N=34)	
Cystoscopy Done	56.0 (14)	97.1 (33)	<.001
Intraoperative Bladder Injuries:	52.0 (13)	85.3 (29)	.005
Cystotomy	48.0 (12)	73.5 (25)	.045
Suture/Stitches in Bladder	4.0 (1)	11.8 (4)	.38*
Intraoperative Ureteral Injuries:	20.0 (5)	11.8 (4)	.47*
Kinking	8.0 (2)	5.9 (2)	1.00*
Transection	8.0 (2)	2.9 (1)	.57*
Ligation	0	2.9 (1)	1.00*
Perforation	4.0 (1)	0	.42*
Delayed Urologic Complications:	28.0 (7)	5.9 (2)	.03*
Vesicovaginal fistula	16.0 (4)	0	.03*
Ureterovaginal fistula	0	2.9 (1)	.58*
Ureteral Obstruction	12.0 (3)	0	.07*
Cystotomy	0	2.9 (1)	.58*
Injuries Detected with Cystoscopy	24.0 (6)	47.1 (16)	.04
Route of Hysterectomy:			
Abdominal	48.0 (12)	32.4 (11)	.22
Laparoscopic	12.0 (3)	14.7 (5)	1.00*
Robotic-Assisted	4.0 (1)	14.7 (5)	.23*
Vaginal [†]	34.6 (9)	38.2 (13)	.86
Surgical Time, minutes	171 (132, 275)	202 (165, 272)	.27

Data reported as median (IQR) or % (n). P values determined using Mann-Whitney U for continuous non-parametric data, Chi-Square or Fisher's Exact (*) for categorical variables.

[†] Includes laparoscopic-assisted vaginal hysterectomy

Table 3

Description of Delayed Urologic Injuries

Case	Universal Cystoscopy Policy		Intraoperative Cystoscopy Performed	Hysterectomy Route	Injury	Time to Injury Detection (Postoperative Day #)	Treatment
	Pre-	Post-					
1				TAH	Vesicovaginal fistula	3	Surgical repair
2				TAH	Vesicovaginal fistula	11	Surgical repair
3				TLH	Vesicovaginal fistula	30	Surgical repair
4				TAH	Vesicovaginal fistula	4	Surgical repair
5				TAH	Left ureteral obstruction	3	Balloon dilatation of ureteral obstruction by interventional radiology
6				TVH	Left ureteral obstruction	1	Ureteral stent placement and vaginal removal of uterosacral ligament suspension sutures
7				SAH	Left ureteral obstruction	12	Exploratory laparotomy and ureteral reimplantation
8				TAH	Delayed cystotomy	6	Exploratory laparotomy and cystotomy repair
9				RH	Left ureterovaginal fistula	40	Left percutaneous nephrostomy tube followed by exploratory laparotomy and ureteroneocystostomy

TAH – total abdominal hysterectomy; SAH – supracervical abdominal hysterectomy; TLH – total laparoscopic hysterectomy; RH – robotic-assisted total laparoscopic hysterectomy; TVH – total vaginal hysterectomy