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A randomized Control Trial of a Controlled Aseptic Protocol for Catheter Insertion to Reduce Urinary Tract Infection Rates after Gynecologic Oncology Surgery

Robyn Shaffer[2], Alyse Brennecke[1], Kian Behbakht[1], Anna Tayebnejad[1], Christopher A. Breed[1], Lisa Marie Babayan[1], Amin A. Ramzan[1], Lindsay J. Wheeler[1], Bradley R. Corr[1], Carolyn Lefkowits[1], Jaime Arruda[1], Aaron Smoroda[2], Dina Flink[1] and Saketh R. Guntupalli[1]*

[1]Division of Gynecologic Oncology, Department of Obstetrics and Gynecology University of Colorado School of Medicine at Denver, Aurora CO, USA
[2]Department of Obstetrics & Gynecology, University of Colorado School of Medicine, Aurora CO, USA

***Corresponding author: Saketh R. Guntupalli,**
Email: saketh.guntupalli@cuanschutz.edu .

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Abstract

Background: Catheter-associated urinary tract infections (CAUTI) are the most common healthcare-associated infection in the United States. Efforts to reduce CAUTI include implementation of aseptic protocols. Studies in gynecologic surgery are limited.

Aim: To determine if use of a betadine-treated aseptic catheter will reduce the rate of CAUTI in gynecologic surgical patients.

Methods: A single-site randomized controlled trial enrolled women undergoing surgery within the gynecologic oncology department requiring urinary catheter placement. Ninety enrolled patients were randomized 1:1 to a betadine-treated aseptic catheter placement versus standard of care (SOC) and followed with urinalysis and urine culture (if indicated) at 24-hour and 14 days post-operatively.

Findings: There was no difference in CAUTI between the two randomized groups. Six (13.3%) patients in the aseptic protocol versus six (13.3%) patients in the SOC group were diagnosed with UTI at 14 days post-operatively (p=1.000). The study population included a majority of oncology cases (85.4%). None of the following was associated with risk of CAUTI: age, length of stay, catheter discontinuation ≤24hrs, break in closed drainage system or training level of placing provider. Patient satisfaction was high and did not differ significantly (mean 8.17 (SD 2.39) in the SOC arm versus. 8.6 (SD 2.04) in the aseptic arm, scale 1-10, p=0.388). The study was closed early when interim analysis showed lower than expected CAUTI rates.

Conclusion: Utilization of betadine-treated aseptic catheter placement did not reduce the rate of CAUTI in patients undergoing gynecologic surgery. Further studies are needed to help reduce CAUTI in populations requiring intraoperative catheterization.

Keywords: Urinary Tract Infections; Bacteriuria; Catheter-associated Urinary Tract Infections; Randomized Controlled Trial; Hysterectomy

Introduction

Catheter-associated urinary tract infections (CAUTI) are the most common healthcare-associated infections in the United States, accounting for an estimated 40% of nosocomial infections and with associated cost estimates up to $1.8 billion annually [1,2].

CAUTI are particularly common in gynecologic surgery, where catheterization is often required for bladder decompression and reduction of bladder injury as well as to assess accurate output in the setting of significant intra-operative or post-operative fluid shifts. In a study of 82,000 women undergoing surgery for gynecologic malignancy, CAUTI were the most common healthcare infections (35% of all hospital-acquired conditions), particularly in women >60 years or undergoing open surgery [3]. Although catheterization in gynecologic surgery is often short-term, even a single exposure to catheterization may increase the risk of urinary tract infection [4].

CAUTI confer both clinical and healthcare systems burdens. Catheter-associated infections cause up to 13,000 deaths yearly in the US [5]. Up to 70% of CAUTI may be "reasonably preventable," with significant impact on patient morbidity, mortality and healthcare costs and quality [6,7].

Efforts to reduce CAUTI have included reduced catheter use as well as change in catheter maintenance and materials [8-10]. Recently, aseptic protocols have been investigated and implemented in countries worldwide [11-13]. Aseptic protocols are appealing due to wide availability and low cost of topical antiseptics such as betadine.

At our institute, pre-study internal data identified elevated departmental rates of CAUTI as a target for quality improvement. We hypothesized that implementation of a controlled antiseptic urinary catheter insertion protocol compared to standard of care (SOC) insertion would reduce CAUTI rates in patients undergoing open gynecologic oncology and general gynecologic surgery.

Methods

Study Design and Intervention

The trial was a single-site randomized control study conducted at the University of Colorado Hospital under a quality improvement protocol. Patients were identified, screened, and provided written informed consent up to 30 days prior to their procedure. They were appropriately consented with IRB approval from the institution (COMIRB 16-1096). On the day of surgery, enrolled patients were randomized via REDCap randomization module to either 1) a control group of SOC catheter placement in which catheter was inserted directly from standard packaging or 2) an intervention group of aseptic insertion protocol that used a 7.5% betadine-treated catheter with the plastic sleeve maintained on the catheter during insertion.

An attending or fellow trained in proper use of the aseptic intervention protocol conducted the catheter insertion in the operating room prior to surgery. Pre-operative antibiotics were given according to standard American College of Obstetrics and Gynecology (ACOG) guidelines for antibiotic prophylaxis [14]. Foley catheters used were standard BARD 3-way latex catheters pre-packaged in a plastic sleeve, stocked throughout our inpatient operating rooms.

Patient Enrollment

Enrollment began in October 2017 and ended in February 2019. Women were eligible for enrollment if they met the following criteria: undergoing open surgery by a gynecologic oncologist or gynecologic surgeon lasting greater than one hour and requiring urinary catheter placement; age 18-89 years; normal urinalysis within 24 hours pre-surgery. Women with chronic urinary tract infection, current urinary tract infection defined by positive urinalysis 0-24 hours prior to surgery, or current dialysis were not eligible for enrollment. Minimally invasive cases and open diagnostic cases lasting less than one hour were excluded.

Outcome Measurements

Urinalysis and urine culture were collected 0-24 hour prior to surgery, 24 hours post-operatively, and two weeks post-operatively (14 +/- 2 days) at the patient's routine post-operative visit. Study urinalyses were done with rapid urine analysis (UA) test. Urinary tract infection was defined as >10^5 bacterial colony forming units per ML on urine culture regardless of symptoms. Asymptomatic bacteriuria cases were counted as urinary tract infection cases. The primary outcome was defined as urinary tract infection at the two-week post-operative visit.

Secondary outcome information included need for catheter replacement, length of hospital stay, occurrence of Emergency Department (ED) visit or hospital readmission, disruption of closed drainage system, method of catheter discontinuation and patient satisfaction. This data was collected during study visits and through medical chart review. Patient satisfaction was assessed using a Likert scale questionnaire.

Statistical Methods

The primary outcome of UTI diagnosis at two weeks post-operatively was assessed by Fisher's exact test with Bonferroni adjustment for multiple comparisons. Differences between continuous variables were assessed by Students t-test and differences between categorical variables were assessed by chi-square test. Univariate logistic regression was used to assess independent predictors associated with CAUTI; due to null univariate analysis, multivariate analysis was not performed. P value of <0.005 was used for statistical significance. Analysis was conducted using STATA statistical software Version 15.1 (College Station, TX).

Power Calculations and Early Discontinuation

Based on a prior internal quality improvement study at our department, we estimated a 40% risk of urinary tract infection after catheter placement. We calculated that 200 patients (100 per arm) would need to be enrolled to detect a 50% reduction in UTI rates in the intervention group, with alpha of 0.05 and power of 0.84. Based on the prevalence of the primary outcome at interim analysis, post-hoc power calculation showed that an enrollment of 656 total patients would be needed to detect a 50% reduction in primary outcome. As such, the study was discontinued early due to futility.

Results

109 patients were evaluated and consented (Figure 1). Ten were excluded due to failure of randomization, positive or inadequate

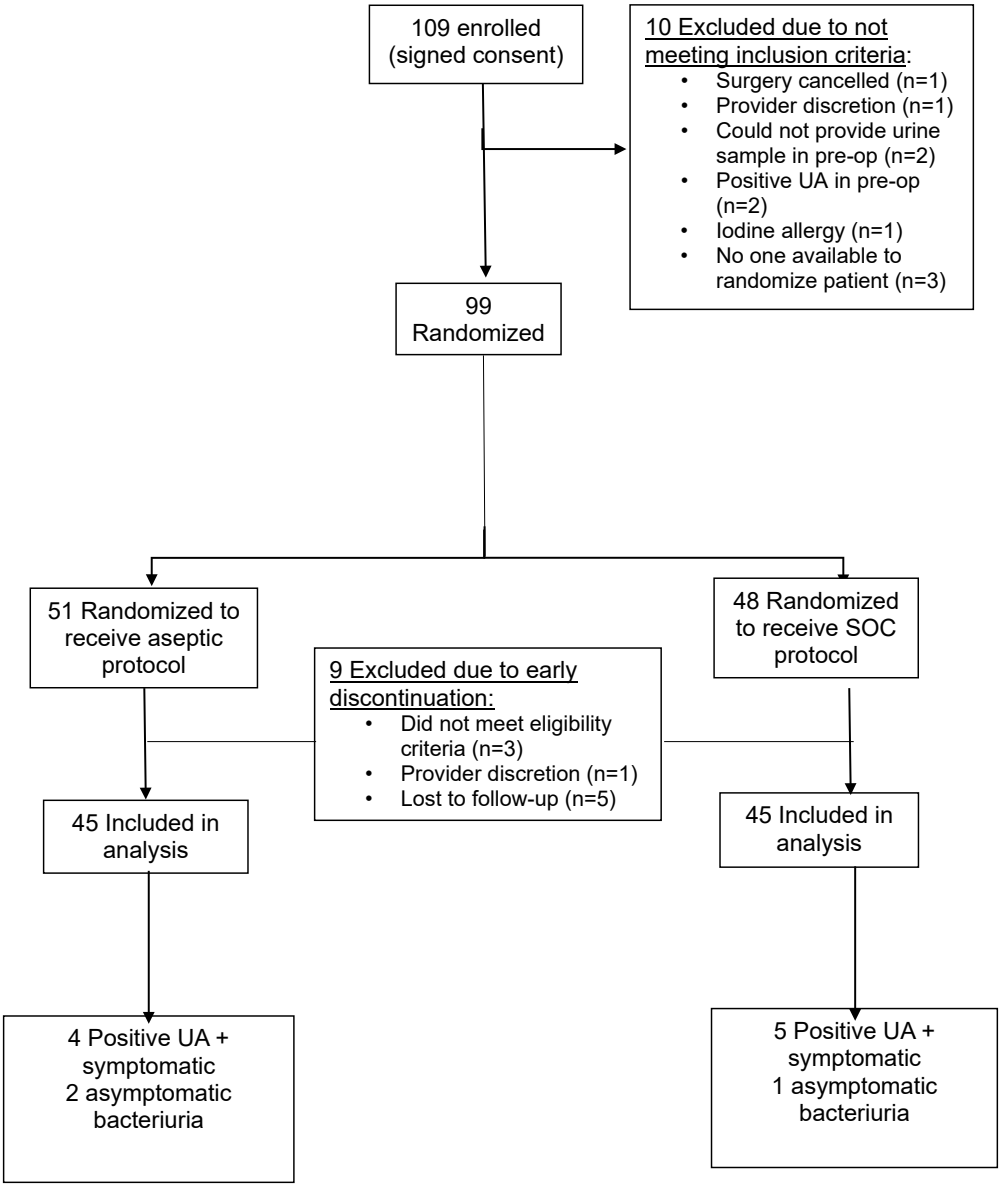

Figure 1: Enrollment, Randomization, and Follow-up.

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Table 1: Demographic Characteristics of Participants..

	Standard of Care n=45	Aseptic Protocol n=45	Total n=90	*p* value[1]
Age - years	56.0 (13.37)	56.5 (14.27)	56.2 (13.75)	0.873
Body-mass index (kg/m2)	25.9 (7.76)	29.5 (7.12)	27.7 (7.62)	0.028
Race or ethnic group				0.471
White	40 (89.0%)	36 (80.0 %)	76 (84.4%)	
Hispanic	2 (4.4%)	6 (13.3%)	8 (8.9%)	
American Indian or Alaskan Native	1 (2.2%)	0 (0%)	1 (1.1%)	
African American	1 (2.2%)	1 (2.2%)	2 (2.2%)	
Asian	1 (2.2%)	2 (4.4%)	3 (3.3%)	
Menopause status				1.000
Pre-menopausal	15 (33.3%)	15 (33.3%)	30 (66.7%)	
Post-menopausal	30 (66.7%)	30 (66.7%)	60 (66.7%)	
Smoking status				0.433
Current	5 (11.1%)	6 (13.3%)	11 (12.2%)	
Former	12 (26.7%)	17 (37.8%)	29 (32.2%)	
Never	28 (62.2%)	22 (48.9%)	50 (55.6%)	
Diabetes	4 (8.9%)	6 (13.3%)	10 (11.1%)	0.502
Hypertension	16 (35.6%)	18 (40.0%)	34 (37.8%)	0.664
Diagnosis				0.887
Uterine cancer	10 (22.2%)	10 (22.2%)	20 (22.2%)	
Ovarian cancer	26 (57.8%)	24 (54.6%)	50 (56.18%)	
Cervical cancer	2 (4.4%)	2 (4.6%)	4 (4.49%)	
Benign	5 (11.1%)	8 (19.2%)	13 (14.61%)	
Other	2 (4.4%)	1 (2.3%)	3 (3.37%)	
Primary Surgery				0.537
TAH +/- BSO/USO	23 (51.1%)	28 (62.2%)	51	
Radical Hysterectomy	2 (4.4%)	0	2	
Bowel resection	4 (8.8%)	2 (4.4%)	6	
Omentectomy	6 (13.3%)	4 (8.8%)	10	
BSO/USO	3 (6.6%)	5 (11.1%)	8	
Lymph Node Dissection	1 (2.2%)	0	1	
Other	6 (13.3%)	6 (13.3%)	12	

Values are listed n (%) or mean (standard deviation). [1]P value compares the SOC versus aseptic protocol groups using student's t-test or chi-square tests.

Table 2: Primary Outcome.

	Standard of Care n (%)	Aseptic Protocol n (%)	*p* value[1]
UTI at 14 +/- 2 days	6 (13.3%)	6 (13.3%)	1.00

[1]p value represents Fisher's exact test of SOC versus aseptic protocol

urinalysis pre-operatively, iodine allergy, cancelled surgery, or provider discretion. Screened participants with UTI on pre-operative urine culture were excluded and not randomized. Of the 99 randomized patients, nine were excluded from analysis (N=3 from SOC protocol, N=6 from aseptic protocol) due to secondary discovery of failure to meet eligibility criteria, provider discretion, and lost to follow-up. A total of N=90 patients completed the study and were included for study analysis.

Many of the patients were oncology cases (85.4%) as the population was enrolled from the gynecologic oncology department clinic. Body-mass index (BMI) varied significantly between the two arms, with mean BMI 25.9 (SD 7.76) in the SOC arm versus 29.5 (SD 7.12) in the aseptic protocol arm (p=0.028). Randomized arms did not differ with respect to age, race, menopause status, smoking or other co-morbidities, underlying diagnosis, or primary surgery type (Table 1).

There was no difference in the rate of post-operative UTI between the randomized arms (Table 2). The prevalence of CAUTI at two weeks post-operatively in the entire study population was 13.3%. Positive cases were split equally between aseptic protocol (N=6) and SOC (N=6) (p=1.000). There was one diagnosed UTI in the SOC arm at the 24 hours post-operative assessment who had a negative urinalysis at two weeks. Organisms isolated from urine culture in patients in the SOC arm were E Coli (N=3), Klebsiella sp (N=1), Enterococcus sp (N=1), and mixed organisms (N=1); Organisms isolated from the aseptic arm were E Coli (N=2), Pseudomonas sp (N=1), Citrobacter sp (N=1), and mixed and/or unavailable (N=2).

20 patients required catheter replacement (N=11 in the SOC arm, N=9 in the aseptic arm) between the immediate post-operative period and their hospital discharge. Two of the patients requiring catheter replacement developed UTI by two weeks, both in the SOC arm. There was no significant difference in the rate of UTI at two weeks in patients requiring catheter replacement compared to patients who did not have their catheters replaced (10% versus 11%, p=0.891).

Adverse events from the SOC and aseptic catheter placements were rare (Table 3) and did not differ significantly between the randomized arms (p=1.000). The most commonly reported adverse event was catheter discomfort, reported in both arms. There were no Grade 3 or higher adverse events reported.

Given negative findings between the two randomized arms,

Table 3: Documented Adverse Events.

	Standard of Care n (%)	Aseptic Protocol n (%)	*p* value[1]
# adverse events reported	2 (4.4%)	3 (6.6%)	1
Adverse event type			
Catheter discomfort	1	1	-
Neutropenic fever	-	1	-
Hematuria	1	-	-
Constipation	-	1	-

[1]p value represents Fisher's exact test of SOC versus aseptic protocol

Table 4: Univariate Analysis of Risk Factors for UTI at 14 days Post-op.

	Odds Ratio	*p* value	95% Confidence Interval
Randomized Aseptic Protocol (ref: SOC)	1.00	1.00	0.30, 3.37
Co-morbidity Confounders			
Smoking (ref: never)			
current	0.61	0.665	0.07, 5.57
former	0.98	0.980	0.26, 3.69
Age	1.01	0.453	0.97, 1.07
BMI	0.99	0.918	0.92, 1.07
Diabetes	1.75	0.515	0.32, 9.44
Post-menopausal (ref: pre-menopausal)	1.00	1.00	0.28, 3.63
Hospital / Operative Confounders			
Catheter discontinued by 24h post-op	1.49	0.544	0.41, 5.38
Catheter discontinued after backfill (ref: no backfill)	0.95	0.962	0.09, 9.37
Catheter replaced during hospitalization	1.04	0.966	0.19, 5.60
Intraoperative Cystoscopy Done	0.62	0.661	0.07, 5.32
Hospital Length of Stay	1.02	0.870	0.84, 1.23
Insertion by fellow physician (ref: attending physician)	1.58	0.483	0.44, 5.70

independent risk factors were assessed for prevalence of post-operative UTI in the total study population (Table 4). There were no demographic or operative confounders associated with increased risk of catheter associated UTI, including age, length of hospital stay, catheter discontinuation ≤ 24h, break in closed drainage system or training level of placing provider.

Patient satisfaction was assessed from 90% of protocol patients. Average patient satisfaction was high and did not differ significantly between the two arms (mean 8.17 (SD 2.39) in the SOC arm versus 8.6 (SD 2.04) in the aseptic arm, scale 1-10, p=0.388).

Discussion

This study demonstrated no significant difference between a betadine-treated aseptic protocol for urinary catheter placement and standard of care catheter placement in gynecologic oncologic and benign gynecologic surgeries.

Prior randomized studies' interventions to reduce catheter associated UTI in gynecologic surgery have also had limited success. Two randomized trials of antibiotic prophylaxis have not shown to reduce culture proven UTI in patients catheterized for urinary retention after pelvic reconstructive surgery [15,16]. Self-discontinuation of catheters has been shown to improve patient satisfaction and pain related to catheter use, however did not impact rates of CAUTI [17].

There is limited data on CAUTI in gynecology or gynecologic oncology specific populations. Studies have suggested an incidence of approximately 11% after radical hysterectomy or 15% after uncomplicated total abdominal hysterectomy, though other studies have reported rates as low as 2-4% [18-21]. The prevalence in this study population was consistent with established data, though considerably lower than the preliminary estimate of 40%. Factors contributing to this distinct difference may include fewer trainees placing catheters or heightened awareness and focus on quality improvement and post-surgical recovery pathways. Post-hoc power analysis shows this study had an 80% power to assess a 25% difference in the odds of our primary outcome, a difference that was not reached between the two study arms.

A recent study associated post-operative UTI with placement by a junior trainee [22]. ACOG recommends only placing a urinary catheter in the setting of appropriate trained personnel and resources, and to formulate alternate management plans not requiring catheterization depending on available safe resources [23]. In this study, placement by an attending or fellow physician may have ensured consistent sterile technique regardless of protocol arm.

Prior studies have additionally linked CAUTI risk to older age, increased hospital duration, catheter duration >4 days, and placement outside the operating room [12]. In our study population, age and hospital length of stay were not independently associated with CAUTI events, possibly due to limited number of events and/or limited study power to evaluate these associations in secondary analysis.

This study is limited by several factors. The study was underpowered as specified above; in addition, secondary to its low power, this study was discontinued due to futility based on the interim analysis finding an inability to reach its designated endpoints. This study is strengthened by its randomized controlled design, low attrition in both investigational arms, and detailed patient-level and operation-level data on confounding events including cystoscopy and method of discontinuation.

Conclusion

Reduction of CAUTI remains a priority in targeting healthcare-associated complications particularly in gynecologic surgical populations. This randomized assessment of an aseptic insertion technique did not reduce post-operative UTI in this gynecologic surgery

population. Limiting catheter use remains a standby of prevention, however, in this surgical population where intraoperative catheterization is often required and catheter-related complications may lead to longer length of hospitalization, increased cost, and possibly life-threatening infectious morbidity, future research should continue to investigate new aseptic protocols, catheter maintenance or antimicrobial catheters in order to reduce catheter associated UTI.

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Author Contributions

SG, CB and DF conceived the study and contributed to study design and literature search. RS wrote the manuscript draft and adjusted the manuscript after critical review. SG, RS, and AB contributed to data collection, data analysis, data interpretation, figures, tables, writing, and editing. KB, AT, CB, LM, AR, LW, BC, CL, JA, DF, and AS contributed to data collection and critical review of the manuscript. All authors agreed with the decision to submit for publication.

References

1. Umscheid CA, Mitchell MD, Doshi JA, Agarwal R, Williams K, Brennan PJ. Estimating the proportion of healthcare-associated infections that are reasonably preventable and the related mortality and costs. Infection Control & Hospital Epidemiology. 2011; 32:101-14.
2. Peasah SK, McKay NL, Harman JS, Al-Amin M, Cook RL. Medicare non-payment of hospital-acquired infections: infection rates three years post implementation. Medicare & Medicaid Research Review. 2013; 3.
3. Chan JK, Gardner AB, Mann AK, Kapp DS. Hospital-acquired conditions after surgery for gynecologic cancer—An analysis of 82,304 patients. Gynecologic Oncology. 2018; 150:515-20.
4. Healy EF, Walsh CA, Cotter AM, Walsh SR. Suprapubic compared with transurethral bladder catheterization for gynecologic surgery: a systematic review and meta-analysis. Obstet Gynecol. 2012; 120:678-87.
5. Klevens RM, Edwards JR, Richards Jr CL, Horan TC, Gaynes RP, Pollock DA, et al. Estimating health care-associated infections and deaths in US hospitals, 2002. Public Health Reports. 2007; 122:160-6.
6. Wald HL, Kramer AM. Nonpayment for harms resulting from medical care: catheter-associated urinary tract infections. JAMA. 2007; 298:2782-4.
7. Umscheid CA, Mitchell MD, Doshi JA, Agarwal R, Williams K, Brennan PJ. Estimating the proportion of healthcare-associated infections that are reasonably preventable and the related mortality and costs. Infection Control & Hospital Epidemiology. 2011; 32:101-14.
8. Warren JW. Catheter-associated urinary tract infections. International Journal of Antimicrobial Agents. 2001; 17:299-303.
9. Trinkaus D. Reduction of ICU Nosocomial Catheter-Associated Urinary Tract Infections. American Journal of Infection Control. 2004; 32:E105.
10. Majeed A, Sagar F, Latif A, Hassan H, Iftikhar A, Darouiche RO et al. Does antimicrobial coating and impregnation of urinary catheters prevent catheter-associated urinary tract infection? A review of clinical and preclinical studies. Expert Review of Medical Devices. 2019; 16:809-20.
11. Stéphan F, Sax H, Wachsmuth M, Hoffmeyer P, Clergue F, Pittet D. Reduction of urinary tract infection and antibiotic use after surgery: a controlled, prospective, before-after intervention study. Clinical Infectious Diseases. 2006; 42:1544-51.
12. Barbadoro P, Labricciosa FM, Recanatini C, Gori G, Tirabassi F, Martini E et al. Catheter-associated urinary tract infection: Role of the setting of catheter insertion. American Journal of Infection Control. 2015; 43:707-10.
13. Amine AE, Helal MO, Bakr WM. Evaluation of an intervention program to prevent hospital-acquired catheter-associated urinary tract infections in an ICU in a rural Egypt hospital. GMS Hygiene and Infection Control. 2014; 9: Doc 15.
14. American College of Obstetricians and Gynecologists. ACOG Practice Bulletin No. 195: Prevention of infection after gynecologic procedures. Obstet Gynecol. 2018; 131:e172-89.
15. Dieter AA, Amundsen CL, Edenfield AL, Kawasaki A, Levin PJ, Visco AG, et al. Oral antibiotics to prevent postoperative urinary tract infection: a randomized controlled trial. Obstet Gynecol. 2014; 123:96-103.
16. Lavelle ES, Alam P, Meister M, Florian-Rodriguez M, Elmer-Lyon C, Kowalski J et al. Antibiotic prophylaxis during catheter-managed postoperative urinary retention after pelvic reconstructive surgery: a randomized controlled trial. Obstet Gynecol. 2019; 134:727-35.
17. Shatkin-Margolis A, Yook E, Hill AM, Crisp CC, Yeung J, Kleeman S et al. Self-Removal of a Urinary Catheter After Urogynecologic Surgery: A Randomized Controlled Trial. Obstet Gynecol. 2019; 134:1027-36.
18. Szender JB, Frederick PJ, Eng KH, Akers SN, Lele SB, Odunsi K. Evaluation of the national surgical quality improvement program universal surgical risk calculator for a gynecologic oncology service. International Journal of Gynecologic Cancer. 2015; 25:512-20.
19. Cardenas-Goicoechea J, Adams S, Bhat SB, Randall TC. Surgical outcomes of robotic-assisted surgical staging for endometrial cancer are equivalent to traditional laparoscopic staging at a minimally invasive surgical center. Gynecologic Oncology. 2010; 117:224-8.
20. Cardosi RJ, Cardosi RP, Grendys Jr EC, Fiorica JV, Hoffman MS. Infectious urinary tract morbidity with prolonged bladder catheterization after radical hysterectomy. American Journal of Obstetrics and Gynecology. 2003; 189:380-3.
21. Ahmed MR, Ahmed WA, Atwa KA, Metwally L. Timing of urinary catheter removal after uncomplicated total abdominal hysterectomy: a prospective randomized trial. European Journal of Obstetrics & Gynecology and Reproductive Biology. 2014; 176:60-3.
22. Sultan I, Kilic A, Arnaoutakis G, Kilic A. Impact of Foley Catheter Placement by Medical Students on Rates of Postoperative Urinary Tract Infection. Journal of the American College of Surgeons. 2018; 227:496-501.
23. American College of Obstetricians and Gynecologists. Ethical considerations for performing gynecologic surgery in low-resource settings abroad. Committee Opinion No. 466. Obstet Gynecol. 2010; 116:793-9.