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Research Article

Predictors of positive preoperative urine cultures in asymptomatic women undergoing urogynecologic surgery

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Abstract

Aim: To identify risk factors for positive preoperative urine cultures in asymptomatic women undergoing urogynecologic surgery. We also sought to identify risk factors for mixed flora clean catch urine cultures.

Methods: This is a cross-sectional study. Demographic data and screening preoperative urine cultures were extracted on all women who underwent urogynecologic surgery between 9/2011 and 9/2013. Urine culture results were defined as: negative (no growth), positive (≥100K organisms), and contaminated (mixed flora). Women with <100K colony-forming units of a single organism were excluded. Logistic regression models were constructed to evaluate for differences between groups.

Results: 490 women were included. When comparing positive to negative cultures, the positive culture group was more likely to have a history of recurrent urinary tract infections (UTIs) (20% vs. 5%, p=0.001). In a logistic regression model,a history of recurrent UTIs remained a risk factor for a positive preoperative urine culture (OR 6.9, 95% CI 2.3-20.8), whereas vaginal estrogen usage decreased the risk of a positive preoperative culture (OR 0.3, 95% CI 0.1-0.9). When comparing contaminated to negative cultures, the contaminated culture group was more likely to be obese (45% vs. 28%, p=0.001). In a logistic regression model, obesity remained a risk factor for contaminated preoperative urine cultures (OR 2.0, 95% CI 1.3-3.2).

Conclusion: A history of recurrent UTIs was a risk factor for a positive preoperative urine culture in asymptomatic women undergoing urogynecologic surgery. Vaginal estrogen therapy was associated with fewer positive preoperative urine cultures. Obesity was an independent risk factor for contaminated (mixed flora) clean catch urine culture results.

Introduction

Pelvic floor disorders are estimated to affect one in four women in the United States [1,2] and a woman's lifetime risk of having surgery for Pelvic Organ Prolapse (POP) or Urinary Incontinence (UI) is 20% [3]. Urinary tract infections (UTIs) are the second most common infection in older women, representing 25% of all clinically diagnosed infections in the US [4]. It is one of the most commonly reported complications of pelvic reconstructive surgery with an estimated incidence as high as 24% [5-8].

Ten percent of women undergoing surgery for POP or UI have positive preoperative catheterized urine cultures and a third of these women develop postoperative UTIs [9]. Risk based screening has the potential to identify these women and help prevent postoperative UTIs. Currently, there is no general consensus regarding the use of preoperative urine screening for patients undergoing surgery for POP or UI. Furthermore, there is a paucity of data to describe who may be at risk for having an asymptomatic positive urine culture prior to surgery for POP or UI.

The primary objective of the study was to identify risk factors for positive preoperative urine cultures in asymptomatic women undergoing surgery for POP or UI. Since mixed flora or contaminated cultures are common, inconclusive and limit the utility of preoperative screening, we also sought to identify risk factors for having contaminated clean catch urine cultures.

Materials and methods

This was a cross sectional study that included women who underwent surgery for POP or UI with the Division of Urogynecology at Duke University Medical Center between September 2011 and September 2013. After obtaining Institutional Review Board approval, electronic charts were examined to identify women undergoing surgery for POP or UI who were asymptomatic for UTI. Patients were categorized as "asymptomatic" if they denied the presence of acute irritative voiding symptoms. Urine cultures were obtained during the patient's preoperative clinic visit, which was within 30 days prior to the scheduled surgery. Patients were instructed to collect a midstream clean catch urine specimen after having wiped with a cleansing cloth three times.

Urine cultures were categorized as negative, positive, or contaminated. A negative urine culture was defined as no growth. A positive urine culture was defined as ≥100K colony forming units of a single organism. A contaminated urine culture was defined as mixed

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flora. Women with <100K colony forming units of a single organism were excluded.

Demographic data, medical history, and urine cultures were extracted through a retrospective review of the medical records. Information included: age, parity, race, Body Mass Index (BMI), menopausal state, usage and type of hormone replacement therapy, sexual activity, diagnosis of diabetes mellitus, current tobacco use, history of recurrent UTIs (defined as two positive cultures in the past 6 months or three positive cultures in the past year), diagnosis of overactive bladder, urgency UI symptoms, stress UI symptoms, history of hysterectomy, history of POP surgery, history of UI surgery, pelvic organ prolapse quantification (POP-Q) measurements, and preoperative urine culture results.

In order to identify risk factors for positive preoperative urine cultures, we compared characteristics of women with positive cultures to those with negative results. Similarly, in order to identify risk factors for contaminated preoperative urine cultures, characteristics of women with contaminated preoperative cultures were compared to those with negative cultures.

Demographic data were compared using chi-square and Student's *t*-test for categorical and continuous measures, respectively. Logistic regression models were constructed to evaluate for differences between groups. Statistical analyses were conducted using SPSS Statistics 22 (IBM, Armonk, NY, USA).

Results

Four hundred ninety six women were identified as meeting inclusion criteria. Of these, six were excluded due to culture results with <100K colony forming units. The remaining 490 women were included in the final analysis. One hundred thirty two (27%) had negative preoperative urine cultures and 69 (14%) had positive preoperative urine cultures. The majority, 289 (59%) had contaminated cultures. *Klebsiella, Enterococcus,* and *Escherichia coli* were the most common organisms isolated in the positive cultures.

The study population was predominately white (90%), had a mean age of 59 (±12) years, and was postmenopausal (76%). The median vaginal parity was 2 and the mean BMI was 28.7 (±5.4) kg/m^2. The surgical history of the women included 51% with a prior hysterectomy, 20% with previous surgery for POP, and 24% with previous surgery for stress UI. Other pertinent descriptions of the women included tobacco use in 8%, a diagnosis of diabetes mellitus in 13%, and 9% with a history of recurrent UTIs.

Women with positive preoperative clean catch urine cultures are compared to those with negative cultures in Table 1. The group with positive cultures was more likely to have a history of recurrent UTIs (20% *vs.* 5%, p = 0.001), otherwise there were no differences in baseline characteristics between the two groups. After controlling for age, vaginal parity, menopausal status, vaginal estrogen usage, sexual activity, diagnosis of diabetes mellitus, history of recurrent UTIs, and most distal POP-Q measurement (anterior wall or apex) in a logistic regression analysis, a history of recurrent UTIs (OR 6.9, 95% CI 2.3-20.8) remained a risk factor for positive preoperative urine cultures. In the same model, higher vaginal parity (OR 1.3, 95% CI 1.0-1.8) was also associated with more positive preoperative urine cultures, while vaginal estrogen usage (OR 0.3, 95% CI 0.1-0.9) was associated with fewer positive preoperative cultures (Table 2).

In order to investigate the common clinical practice of managing contaminated urine cultures as "clinically negative", we combined contaminated and negative cultures into one group. A comparison was then made between the positive to "clinically negative" preoperative

Table 1. Baseline characteristics of the positive and negative urine culture groups.

	Positive Urine Culture (N=69)	Negative Urine Culture (N=132)	*P* value
Age (in years)	62 ±14*	59 ± 12*	0.059
BMI	28 ± 6*	28 ± 5*	0.245
Parity	2 (1)†	2 (1)†	0.020
Number SVD	2 (1)†	2 (2)†	0.030
Number C/S	0 (0)†	0 (0)†	0.684
Race			
White	63‡ (92%)	118‡ (90%)	0.667
African American	3‡ (4%)	11‡ (8%)	0.292
Other	3‡ (4%)	3‡ (2%)	0.412
Menopausal Status			
Premenopausal	14‡	30‡	0.692
Postmenopausal (no HRT)	35‡	65‡	0.842
Postmenopausal (Vaginal ERT)	9‡	26‡	0.238
Postmenopausal (Oral ERT)	13‡	17‡	.260
Sexually Active	40‡ (58%)	81‡ (61%)	0.641
Diabetes Mellitus	11‡ (16%)	19‡ (14%)	0.770
Tobacco Use	5‡ (7%)	9‡ (7%)	0.910
Recurrent UTI	14‡ (20%)	7‡ (5%)	0.001
Overactive Bladder or Urgency Urinary Incontinence	29‡ (42%)	61‡ (46%)	0.571
Stress Urinary Incontinence	27‡ (39%)	61‡ (46%)	0.337
Prior Hysterectomy	32‡ (46%)	71‡ (54%)	0.318
Prior Prolapse Repair	10‡ (14%)	30‡ (23%)	0.165
Prior Surgery for Urinary Incontinence	15‡ (22%)	27‡ (20%)	0.832
Most Distal POP-Q Measurement (anterior or apical)	1.5 (6)†	1 (4)†	0.499

*mean ± standard deviation

†median (interquartile range)

‡number of women

Table 2. Logistic regression analysis comparing positive to negative urine cultures.

	Odds Ratio	95% CI		*P* value
		Lower	Upper	
Age	1.026	0.989	1.065	0.169
Number SVD	1.349	1.029	1.767	0.030
Premenopausal	1.449	0.527	3.983	0.472
Postmenopausal (Vaginal ERT)	0.309	0.112	0.850	0.023
Sexually Active	1.536	0.725	3.252	0.262
Diabetes Mellitus	1.178	0.473	2.932	0.725
Recurrent UTI	6.627	2.202	19.946	0.001
Most Distal POP-Q Measurement (anterior or apical)	1.034	0.926	1.154	0.555

Table 3. Baseline characteristics of the contaminated and negative urine culture groups.

	Contaminated Urine Culture (N=289)	Negative Urine Culture (N=132)	*P* value
Age (in years)	59 ± 12*	59 ± 12*	0.243
BMI	29 ± 6	28 ± 5*	0.045
Parity	2 (1)†	2 (1)†	0.134
Number SVD	2 (1)†	2 (2)†	0.045
Number C/S	0 (0)†	0 (0)†	0.613
Race			
White	259‡ (90%)	118‡ (90%)	0.944
African American	23‡ (8%)	11‡ (8%)	0.896
Other	7‡ (2%)	3‡ (2%)	0.926
Menopausal Status			
Premenopausal	75‡	30‡	0.478
Postmenopausal (no HRT)	135‡	65‡	0.630
Postmenopausal (Vaginal ERT)	54‡	26‡	0.806
Postmenopausal (Oral ERT)	36‡	17‡	0.904
Sexually Active	153‡ (53%)	81‡ (61%)	0.291
Diabetes Mellitus	35‡ (12%)	19‡ (14%)	0.516
Tobacco Use	24‡ (8%)	9‡ (7%)	0.599
Recurrent UTI	21‡ (7%)	7‡ (5%)	0.453
Overactive Bladder or Urgency Urinary Incontinence	151‡ (52%)	61‡ (46%)	0.250
Stress Urinary Incontinence	149‡ (52%)	61‡ (46%)	0.309
Prior Hysterectomy	149‡ (52%)	71‡ (54%)	0.671
Prior Prolapse Repair	57‡ (20%)	30‡ (23%)	0.480
Prior Surgery for Urinary Incontinence	74‡ (26%)	27‡ (20%)	0.251
Most Distal POP-Q Measurement (all compartments)	1 (5)†	1 (4)†	0.327

*mean ± standard deviation

†median (interquartile range)

‡number of women

clean catch urine cultures. A logistic regression model controlling for the same variables as described previously was constructed to compare these groups. Similar to that seen with the negative culture only comparison, a history of recurrent UTIs (OR 4.5, 95% CI 2.1-9.6) was a risk factor for a positive preoperative urine culture and vaginal estrogen usage decreased this risk (OR 0.4, 95% CI 0.19-0.99).

Finally, when comparing contaminated to negative culture results (Table 3), the contaminated culture group was more likely to be obese, as defined by BMI ≥ 30 kg/m^2 (45% *vs.* 28%, p=0.001). There were no other differences in baseline characteristics. Obesity (OR 2.0, 95% CI 1.3-3.2) remained a risk factor for contaminated preoperative urine cultures when controlling for age, vaginal parity, BMI, menopausal status, vaginal estrogen usage, and most distal POP-Q measurement (anterior wall, apex, or posterior wall) (Table 4).

Discussion

In our large preoperative cohort, a history of recurrent UTIs was the only significant clinical risk factor associated with a positive preoperative urine culture in asymptomatic women undergoing surgery for POP or UI. In addition, regular twice weekly use of vaginal estrogen therapy was associated with fewer positive preoperative urine cultures. Interestingly, obesity was the only risk factor associated with contaminated clean catch urine cultures.

In a study performed by Fok *et al.* [9], nearly 10% of urogynecologic patients had a positive catheterized urine culture on the day of surgery. Importantly, their study showed that those with positive preoperative urine cultures had a higher rate of postoperative UTI despite exposure to broad spectrum antibiotics at the time of surgery. This highlights the benefit of procuring preoperative urine cultures, as these patients may be treated prior to surgery to decrease the risk of postoperative UTI. The positive preoperative urine culture rate of 14% in our study was similar to that reported by Fok *et al.* [9]. Our study differed from theirs in that we were able to assess for a positive urine culture within the 30 days prior to surgery, and we assessed preoperative screening risks for positive culture results.

Perioperative UTIs were also evaluated by Nygaard *et al.* using data

Table 4. Logistic regression analysis comparing contaminated to negative urine cultures.

	Odds Ratio	95% CI		*P* value
		Lower	Upper	
Age	1.014	0.988	1.040	0.294
Number SVD	1.210	0.989	1.481	0.065
Obese (BMI ≥25)	1.981	1.261	3.112	0.003
Premenopausal	1.423	0.710	2.855	0.320
Postmenopausal (Vaginal ERT)	0.983	0.564	1.714	0.952
Most Distal POP-Q Measurement (all compartments)	0.958	0.885	1.036	0.281

from the SISTEr (Stress Incontinence Surgical Treatment Efficacy) and TOMUS (Trial of Mid-Urethral Slings) studies. This analysis found that a history of recurrent UTIs preoperatively was the strongest risk factor for postoperative UTI [8]. Our study confirmed a similar association between a history of recurrent UTIs and preoperative UTI.

Transvaginal estrogen therapy is known to prevent UTIs [10,11]. Our study findings describe an association between the use of transvaginal estrogen cream and fewer positive preoperative urine cultures, emphasizing the importance of vaginal estrogen use in UTI prevention. Interestingly, higher vaginal parity was identified as a risk factor for a positive preoperative culture. It is difficult to hypothesize the mechanism behind this finding as the most distal aspect of the vaginal prolapse measured by POP-Q did not differ between groups. A reasonable explanation may be that subtle changes in pelvic support with increased parity might increase UTI risk in ways not measured by POP-Q. Alternatively, it is possible that this is an association that was purely statistical in nature.

The large number of patients with comprehensive, uniform data strengthened the analysis so that it could include multiple variables to determine the potential risk factors for specific culture results. Limitations of the study include those inherent to a retrospective chart review. In light of the increasing investigation of the urinary microbiome, we recognize the growing controversy around current interpretations of urine culture results. Future studies investigating the urinary microbiome may redefine the definition of a "negative" urine culture. We attempted to address this by comparing positive cultures to both purely negative cultures as well as the combination of negative plus mixed flora cultures, and found similar results regardless of the groupings.

UTIs are a potentially preventable postoperative complication; therefore it will be important to have selective preoperative screening to help minimize these adverse events. This study identified a history of recurrent UTIs as a risk factor for positive preoperative urine cultures, while use of vaginal estrogen therapy was associated with fewer positive preoperative culture results. These findings, while perhaps recognized clinically for some time, have not, to our knowledge, been demonstrated in the scientific literature until now. Further studies will need to be directed at creating a risk model to determine which patients should be screened with preoperative urine cultures and which are sufficiently low risk as to not require screening. In addition, until there is a better understanding of how to interpret mixed flora culture results, effective collection techniques will need to be developed, specifically in the obese population.

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