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Urinary Symptoms and their Associations With Urinary Tract Infections in Urogynecologic Patients

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Abstract

OBJECTIVE—To assess urinary symptoms associated with urinary tract infection (UTI) in a urogynecologic population of women.

METHODS—In this cohort study, we enrolled 150 urogynecologic patients, who completed the validated UTI Symptom Assessment questionnaire and contributed transurethral catheterized urine samples. The primary measure (UTI diagnosis) was defined in three ways. Self-report (a non-culture-based UTI diagnosis) was defined by the Yes/No response to the query “Do you think you have a UTI?” Two culture-based UTI diagnoses also were analyzed: Standard Urine Culture (10^4 CFU/mL) and Enhanced Quantitative Urine Culture (10 CFU/mL) of any uropathogen. Statistical analyses were performed on patient demographics and urinary symptom prevalence among patient groups.

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RESULTS—Although the presence of the urinary symptoms of frequency and urgency (respectively) differ somewhat between UTI-positive and UTI-negative women (self-report ($p=0.005$ and $p<0.001$), Standard Urine Culture ($p=0.038$ and $p=0.044$), or Enhanced Quantitative Urine Culture ($p=0.059$ and $p=0.098$), the presence of dysuria (pain or burning) during urination was significantly more prevalent in UTI-positive women for all UTI definitions (self-report $p<0.001$, Standard Urine Culture $p<0.001$ and Enhanced Quantitative Urine Culture $p=0.010$). Furthermore, women reporting dysuria had higher severity and bother scores for all other urinary symptoms assessed by the UTI Symptom Assessment questionnaire, compared to women not reporting dysuria (frequency $p=0.001$, urgency $p=0.006$, dysuria $p<0.001$).

CONCLUSION—Our findings show that, in women seeking urogynecologic care, the presence of frequency and urgency of urination do not confirm a culture-based UTI diagnosis. Instead, clinicians can more readily detect UTI using the presence of dysuria, which more effectively discriminates UTI-positive and UTI-negative individuals, regardless of the culture-based method used to diagnose UTI.

INTRODUCTION

Clinicians typically rely on patient-reported symptoms to diagnose urinary tract infection (UTI) in ambulatory adult women. Seven classic UTI symptoms, including frequency and urgency of urination are included in the only validated UTI symptom survey (1). Yet many clinicians accept that frequency and urgency are non-specific for a culture-based UTI diagnosis and frequency and urgency may add little or nothing to a UTI diagnosis in a urogynecologic population.

Clinicians face a dilemma when assessing UTI in urogynecologic patients with chronic frequency or urgency. In this population, Fitzgerald et al. found that chronic frequency and incontinence of urine were unlikely to be symptoms reliably associated with UTI (2). Thus, despite scant evidence, patients and clinicians may rely on changes in baseline symptoms to detect UTI (e.g., worsened urgency or frequency, dysuria). In the urogynecologic population, clinicians typically assume a non-bacteriologic etiology for urgency or frequency when standard UTI testing is negative. However, recent advances in understanding the female urinary microbiota (3–11) demonstrate that most women have detectable bacteria present using an Enhanced Quantitative Urine Culture protocol despite a negative Standard Urine Culture (10–11). This new knowledge complicates our understanding of bladder health and disease, including UTIs.

We determined the proportion of patients with symptoms using three different definitions of UTI (self-report, Standard Urine Culture, and Enhanced Quantitative Urine Culture). Our goal was to determine if urinary symptoms differ among the diagnosis methods, as well as to identify symptoms that are the strongest indicators of UTI regardless of diagnosis method.

MATERIALS AND METHODS

The *a priori* sample size for this cohort of 150 urogynecologic patients. Participants were enrolled following approval by Loyola University Chicago Health Sciences' Institutional Review Board (IRB). Participants were volunteers from consecutively approached adult

women seeking clinical urogynecologic care at Loyola University Medical Center's Female Pelvic Medicine and Reconstructive Surgery unit between June 2014 and August 2015. Exclusion criteria included age <18, pregnancy, catheterization (indwelling or intermittent) or insufficient English skills to complete study measures. Participants contributed demographic and questionnaire data, as well as a single transurethral catheterized urine sample. Two cohorts, each with 75 women, were formed based on their self-report of UTI presence using the query: "Do you feel you have a UTI?" (Yes/No). All participants completed the validated UTI Symptom Assessment questionnaire (1), in which the participant rates the severity and bother for seven common UTI symptoms (frequency and urgency of urination, dysuria (pain or burning), difficulty urinating, lower abdominal/pelvic pain or pressure, low back pain, blood in urine). Scores for each symptom range from 0 (no symptom) to 3 (highest severity or bother). The UTI Symptom Assessment questionnaire further groups the 7 symptoms into four domains (Appendix 1, available online at <http://links.lww.com/xxx>). Participants who reported UTI symptoms (Yes cohort) were also asked to qualitatively document any UTI-related symptoms.

Participants were clinically characterized using standard urogynecologic history and physical assessments. Consistent with Loyola's urogynecological clinical care protocol for all patients, each patient-participant's urine was collected aseptically through transurethral catheterization and placed into BD Vacutainer Plus C&S preservative tubes. Each specimen was processed by two clinical laboratory methods: the Standard Urine Culture method and the Expanded Spectrum version of the Enhanced Quantitative Urine Culture method (11). Table 1 displays the parameters of these two culture-based methods. The Standard Urine Culture protocol used 1μL of urine, spread quantitatively (i.e., pinwheel streak) onto 5% sheep blood (BAP) and MacConkey agars (BD BBL™ Prepared Plated Media, Cockeysville, MD) and incubated aerobically at 35°C for 24 hours. The limit of microbial detection for Standard Urine Culture is 10³ CFU/mL. The Standard Urine Culture UTI diagnosis definition was 10⁴ CFU/mL of a uropathogen. The Expanded Spectrum Enhanced Quantitative Urine Culture protocol used 1, 10, and 100μL of urine, spread quantitatively (i.e., pinwheel streak) onto 5% sheep blood (BAP), MacConkey, Chocolate, CNA, and CDC Anaerobic BAP (BD BBL™ Prepared Plated Media, Cockeysville, MD) and incubated aerobically, in 5% CO₂, anaerobically, or in microaerophilic conditions at 35°C for 48 hours, although some plates were documented for growth earlier, at 24 hours. The limit of microbial detection for the enhanced quantitative urine culture is 10 CFU/mL. The UTI diagnosis definition for Enhanced Quantitative Urine Culture was 10 CFU/mL of a uropathogen.

Continuous variables were reported as means with standard deviations (SD) or medians with ranges; categorical variables were reported as frequencies and percentages. Pearson Chi-square tests (or Fisher's Exact Tests, when necessary) and 2-sample t-tests (or Wilcoxon Rank Sum tests, when appropriate) were used to compare demographics and culture results (e.g., abundance and diversity) between cohorts. All statistical analyses were conducted using SAS software v9.4 (SAS Institute, Cary, NC) or SYSTAT software version 13.1 (SYSTAT Software Inc., Chicago, IL).

RESULTS

Table 2 shows the demographics of the 150 participants in this study population (150 participants); their average age was 62.3 years $\pm$ 14.9 years; most were Caucasian (81%) and overweight (mean body mass index 29.3 kg/m² $\pm$ 6.3 kg/m²). Nearly all participants [92% (138/150)] endorsed symptoms on the UTI Symptom Assessment questionnaire. Additional patient and clinical demographics were previously published (11).

Using the Standard Urine Culture protocol, only 38% (57/150) of samples grew bacterial colonies (11 different species from 10 different genera, median number of 1 microbial species per urine sample). In contrast, using the Expanded Spectrum Enhanced Quantitative Urine Culture, nearly all samples [139/150 (93%)] grew microbial colonies (98 different species from 36 different genera, median number of 2 microbial species per urine sample). Table 3 is a list of uropathogens that is consistent with the current clinical uropathogen literature. All 11 species detected by Standard Urine Culture and 23 of the species detected by the Expanded Spectrum Enhanced Quantitative Urine Culture are considered to be uropathogens.

Table 2 also displays the study population dichotomized by self-report. Of the 150 participants, by our *a priori* study design, 75 were in each self-reported cohort (Yes/No); these two groups were similar demographically (Table 2). We did not detect significant differences in the proportions of urine samples with detected bacteria [No self-reported UTI=89% (67/75) vs. self-reported UTI=96% (72/75); $p=0.12$] or total unique species per urine sample (75 vs. 66; $p=0.31$). Although the no self-reported UTI cohort had a larger median number of detected species per urine sample when compared to the self-reported UTI group, the difference was not statistically significant [3 (IQR=1–5) vs. 2 (IQR=1–4); $p=0.12$].

Table 2 also displays the percentage of patients reporting each UTI symptom. Symptoms were endorsed by all women who self-reported UTI (100%, 75/75) and most women in the no self-reported UTI population (84%; 63/75). However, women who self-reported UTI had higher average scores (severity and bother scores combined) for the seven symptoms of the UTI Symptom Assessment questionnaire. In addition to the UTI Symptom Assessment questionnaire-measured symptoms, 64/75 women in the self-reported UTI population qualitatively reported their UTI symptoms and 19% (12/64) indicated the presence of malodorous urine. Although the presence of frequency and urgency of urination differed between the cohorts ($p=0.038$ and $p=0.044$, respectively); dysuria (pain or burning) was significantly more prevalent in the self-reported UTI population ($p<0.001$).

Table 4 displays the study population dichotomized by culture-based UTI diagnoses. Fifty-seven individuals (38%) met the criterion for UTI using Standard Urine Culture, most (91%) of whom also self-reported UTI. Except for age, the Standard Urine Culture defined UTI-positive population did not differ demographically from the UTI-negative population.

Nearly all (98%) of the Standard Urine Culture defined UTI-positive and a majority [88% (82/93)] of the UTI-negative population endorsed symptoms on the UTI Symptom Assessment questionnaire. Similar to results by self-reported UTI (Table 2), the presence of

frequency ($p=0.038$) and urgency ($p=0.044$) of urination differed between the Standard Urine Culture defined cohorts UTI-positive population, but dysuria was even more prevalent ($p<0.001$) in the UTI positive cohort and did a better job of distinguishing the UTI positive and negative cohorts. Twenty percent (9/44) of women who were both Standard Urine Culture defined UTI-positive and self-reported UTI reported malodorous urine.

One hundred-ten (73%) women met the criterion for UTI as defined by the Enhanced Quantitative Urine Culture; most also self-reported UTI (63%, 69/110). The Enhanced Quantitative Urine Culture defined UTI-positive population did not differ demographically from the UTI-negative population. Most of the Enhanced Quantitative Urine Culture defined UTI-positive and UTI-negative women endorsed symptoms on the UTI Symptom Assessment questionnaire [92% (101/110) and 93% (37/40), respectively]. The presence of frequency ($p=0.059$) and urgency ($p=0.098$) of urination did not differ between the cohorts, while dysuria was significantly more prevalent in the Enhanced Quantitative Urine Culture defined UTI-positive population ($p=0.01$). Nineteen percent (11/57) of women who were both Enhanced Quantitative Urine Culture defined UTI-positive and self-reported UTI reported malodorous urine.

DISCUSSION

Our findings suggest that, in urogynecologic patients, dysuria is a better clinical clue to UTI than urinary frequency or urgency or both. While clinicians and validated UTI measures that include urinary urgency and frequency have utilized the Standard Urine Culture as the current standard for UTI diagnosis, this approach has not been evaluated in urogynecologic patients. In our participants, urgency and frequency correlated poorly with culture-based UTI diagnostic tests and did not contribute to a correct UTI diagnosis. Dysuria, however, appeared relevant and more specific; therefore, the use of dysuria as a key UTI symptom warrants further assessment.

Abnormal urinary odor is not included in the currently validated UTI assessment tool, yet participants often reported this symptom as a sign of UTI; this correlates with our clinical experience. We suggest that odor be included in a modified tool, at least for urogynecologic populations. Conversely, hematuria was rarely reported and may have less importance as a UTI-related symptom in this population.

It is critical that we improve current UTI detection methods. In response to patient-reported symptoms, clinicians consider it proper to empirically treat acute uncomplicated UTIs in pre-menopausal women who experience infrequent episodes of UTI with typical symptoms, e.g. urgency and frequency (12–14). In urogynecologic populations, however, the chronic presence of these symptoms complicates UTI diagnosis. Clinicians often rely on Standard Urine Culture, which requires growth of at least one uropathogen above a certain threshold (15). However, our group has found that this method misses most non-*E. coli* uropathogens (11). This and other emerging knowledge about urinary microbiota may provide information about the absence of good bacteria, as well as the presence (or overabundance) of bad bacteria. In a companion to this study (11), we reported that urine samples from women who did not self-report UTI were likely to be predominated by *Lactobacillus*, *Streptococcus*, and

Gardnerella, an observation that is consistent with previous reports (8,9,16). In contrast, the urine of women with UTI were more likely to contain traditional uropathogens at the expense of *Gardnerella*, *Streptococcus* and *Lactobacillus* (11), which may be a clue to the composition of healthy microbiota, consistent in part with previous observations (9,16). Given its beneficial role in the genito-urinary tract (17–20), *Lactobacillus* in the bladder may prevent UTI or facilitate microbial restoration following UTI treatment. Thus, clinicians must balance appropriate, selective UTI testing with the risk of antibiotic overuse. Given the beneficial protective role of certain bacteria in the bladder (6,8), improved UTI testing and treatment algorithms in urogynecologic patients may improve patient care.

The colony count threshold has been debated extensively. In this study, we tested a traditional threshold with the standard method, as well as a lower threshold with an enhanced culture protocol. The former was chosen because it is the most widely used threshold and method for UTI diagnosis in this patient population. We chose the latter to detect as many potential pathogens as possible.

Strengths of our study include various definitions of UTI, including simple self-report, two different thresholds for culture methods and the Enhanced Quantitative Urine Culture technique. Our study also benefits from an enhanced means of describing patient symptoms through the validated UTI Symptom Assessment questionnaire. Finally, we reduced vulvo-vaginal contamination through standardized urethral catheterization collection techniques.

Limitations of this study include a lack of ethnic diversity of the study population. We recommend caution in generalizing our findings beyond this subspecialty population. In addition, we did not complete an *a priori* power calculation due to a lack of effect size estimates in the literature. We hope our findings will inform these aspects of future studies.

Clinicians may wish to include microbial assessment using the streamlined version of the Enhanced Quantitative Urine Culture, which we recently recommended for patients with negative Standard Urine Culture results and persistent or refractory urinary symptoms (11). Good antibiotic stewardship in this population may need to incorporate a more personalized approach to antibiotics use that aligns more closely with specific symptoms. Such techniques will help clinicians and patients move away from the simplistic approach of kill the uropathogen and better understand the role of good and bad bacteria that inhabit the female bladder. Also, certain women may benefit from an approach that ensures restoration of a healthy urinary microbiota following UTI treatment. Further research into these compelling areas of women's urinary health may reduce the morbidity and costs associated with poorly controlled bladder symptoms and improve diagnostic precision and treatment.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Table 1

Summary of Urine Cultivation Protocols and UTI Diagnosis Definitions

Protocol	Description of Protocol				UTI Diagnosis Definition
	Volume of Urine	Media	Conditions	Microbial Identification	
Standard Urine Culture	1µL	BAP, MacConkey	Aerobic 35°C	24hr	10 ⁴ CFU/mL uropathogen
Expanded Spectrum Enhanced Quantitative Urine Culture	1µL, 10µL, and 100µL	BAP, MacConkey	Aerobic 35°C	24hr, 48hr	10 CFU/mL uropathogen
		BAP, Chocolate, CNA	5% CO ₂ 35°C	24hr, 48hr	
		CDC Anaerobic BAP	Anaerobic 35°C	48hr	
		CDC Anaerobic BAP	Microaerophilic gas mixture (5% O ₂ , 10% CO ₂ , 85% N) 35°C	48hr	

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BAP = Blood Agar Plate; CNA = Columbia Naladixic Acid Agar; CDC = Centers for Disease Control; CFU = Colony Forming Units; UTI = Urinary Tract Infection

Table 2

Patient Demographics and Symptoms by Self-Report or Dysuria

Patient and Clinical Variables	Total Cohort (N = 150)	No Self-Reported Cohort (N = 75)	Self-Reported Cohort (N = 75)	p-value	No “Dysuria” (N = 92)	Yes “Dysuria” (N = 58)	p-value
Age (years)	62.3 (14.9)	60.6 (12.3)	64.0 (17.1)	0.162 ^a	62.9 (13.1)	61.4 (17.5)	0.551 ^a
Race/Ethnicity				0.905 ^b			0.595 ^b
-White	121 (81%)	59 (79%)	62 (83%)		73 (79%)	48 (83%)	
-Hispanic	15 (10%)	9 (12%)	6 (8%)		10 (11%)	5 (9%)	
-Black	9 (6%)	5 (7%)	4 (5%)		7 (8%)	2 (3%)	
-Asian	4 (3%)	2 (3%)	2 (3%)		2 (2%)	2 (3%)	
-Other	1 (1%)	0 (0%)	1 (1%)		0 (0%)	1 (2%)	
BMI (kg/m ²)	29.3 (6.3)	28.8 (5.9)	29.9 (6.6)	0.272 ^a	29.1 (6.0)	29.6 (6.8)	0.642 ^a
Number of Vaginal Deliveries, (N=148)	2.0 (1.0–3.0)	2.0 (2.0–3.0) (N=75)	2.0 (1.0–4.0) (N=73)	0.803 ^c	3.0 (2.0–3.0) (N=91)	2.0 (1.0–3.0) (N=57)	0.499 ^c
Sexually Active (N=146)	58 (39%)	37 (49%) (N=75)	21 (28%) (N=71)	0.003	37 (41%) (N=90)	21 (38%) (N=56)	0.664
Previous Antibiotics Treatment	45 (30%)	20 (27%)	25 (33%)	0.373	27 (29%)	18 (31%)	0.826
Current Anticholinergic Treatment	26 (17%)	9 (12%)	17 (23%)	0.084	13 (14%)	13 (22%)	0.192
Type of Anticholinergic Used				0.749 ^b			0.676 ^b
-Oxybutynin	9 (6%)	3 (4%)	6 (8%)		4 (4%)	5 (9%)	
-Solifenacin	8 (5%)	3 (4%)	5 (7%)		4 (4%)	4 (7%)	
-Fesoterodine	4 (3%)	2 (3%)	2 (3%)		2 (2%)	2 (3%)	
-Tolterodine	2 (1%)	1 (1%)	1 (1%)		1 (1%)	1 (2%)	
-Oxybutynin Patch	1 (1%)	0 (0%)	1 (%)		1 (1%)	0 (0%)	
-Trospium Chloride	1 (1%)	0 (0%)	1 (1%)		0 (0%)	1 (2%)	
-Myrbetriq	1 (1%)	0 (0%)	1 (1%)		0 (0%)	0 (0%)	
Previous Vaginal Estrogen Use	32 (21%)	11 (15%)	21 (28%)	0.046	19 (21%)	13 (22%)	0.798

Patient and Clinical Variables	Total Cohort (N = 150)	No Self-Reported Cohort (N = 75)	Self-Reported Cohort (N = 75)	p-value	No "Dysuria" (N = 92)	Yes "Dysuria" (N = 58)	p-value
Current Vaginal Estrogen Use	29 (19%)	10 (13%)	19 (25%)	0.063	16 (17%)	13 (22%)	0.448
Prior Urogynecologic Surgery	40 (27%)	13 (17%)	27 (36%)	0.01	21 (23%)	19 (33%)	0.180
Symptoms of Incontinence:							
- Stress Urinary Incontinence	16 (11%)	9 (12%)	7 (9%)	0.597	11 (12%)	5 (9%)	0.519
- Urgency Urinary Incontinence	26 (17%)	11 (15%)	15 (20%)	0.388	14 (15%)	12 (21%)	0.389
- Mixed Urinary Incontinence	40 (27%)	26 (35%)	14 (19%)	0.027	25 (27%)	13 (22%)	0.514
Urgency-Frequency Syndrome	19 (13%)	9 (12%)	10 (13%)	0.806	16 (17%)	4 (7%)	0.066
Myofascial Pain	55 (37%)	20 (27%)	35 (47%)	0.011	23 (25%)	32 (55%)	<0.001
Painful Bladder Syndrome, Pelvic Pain and Dyspareunia	52 (35%)	20 (27%)	32 (43%)	0.039	22 (24%)	30 (52%)	<0.001
Pelvic Organ Prolapse Quantification Stage (N=127)	1.5 (1.0)	1.7 (1.0) (N=69)	1.3 (1.0) (N=58)	0.059 ^a	1.7 (1.0) (N=80)	1.3 (1.1) (N=47)	0.073 ^a
Urinary Distress Inventory Scores (N=116)	48 (27)	48 (27) (N=58)	48 (27) (N=58)	0.907 ^a	46.6 (26.6) (N=71)	49.9 (28.3) (N=45)	0.534 ^a
Total Pelvic Floor Distress Inventory Scores (N=116)	103 (59)	107 (61) (N=58)	98 (56) (N=58)	0.424 ^a	101.7 (59.9) (N=71)	105.3 (57.8) (N=45)	0.749 ^a
UTI Symptom Assessment (UTISA) Score							
-Urinary Frequency	4.0 (1.0-6.0)	2.0 (0.0-4.0)	5.0 (2.0-6.0)	0.005 ^c	3.0 (0.0-5.0)	5.0 (2.0-6.0)	0.001 ^c
-Urinary Urgency	4.0 (1.0-6.0)	2.0 (0.0-4.0)	4.0 (2.0-6.0)	<0.001 ^c	3.5 (0.0-5.0)	4.0 (2.0-6.0)	0.006 ^c
-Dysuria	0.0 (0.0-4.0)	0.0 (0.0-0.0)	4.0 (0.0-5.0)	<0.001 ^c	0.0 (0.0-0.0)	5.0 (3.0-6.0)	<0.001 ^c
-Difficulty Emptying	1.0 (0.0-4.0)	0.0 (0.0-3.0)	2.0 (0.0-5.0)	0.057 ^c	0.0 (0.0-3.5)	2.0 (0.0-5.0)	0.022 ^c
-Pressure	0.0 (0.0-4.0)	0.0 (0.0-2.0)	2.0 (0.0-5.0)	<0.001 ^c	0.0 (0.0-2.0)	2.0 (0.0-5.0)	<0.001 ^c
-Low Back Pain	0.0 (0.0-3.0)	0.0 (0.0-2.0)	0.0 (0.0-4.0)	0.012 ^c	0.0 (0.0-2.0)	2.0 (0.0-4.0)	0.007 ^c
-Blood	0.0 (0.0-0.0)	0.0 (0.0-0.0)	0.0 (0.0-0.0)	0.227 ^c	0.0 (0.0-0.0)	0.0 (0.0-0.0)	0.032 ^c

Chi-Square Test used unless otherwise indicated.

Normally Distributed Data are presented as Mean (Standard Deviation). Non-normally Distributed Data are presented as Median (Interquartile Range), *p* 0.05.

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^a - Independent T test,
^b - Fisher's exact test,
^c - Wilcoxon Rank Sum test
Bold indicates statistical significance

Table 3

List of Uropathogens

Uropathogen	Number Detected by Standard Urine Culture	Number Detected by Expanded Spectrum Enhanced Quantitative Urine Culture
<i>Actinotignum schaalii</i>	0	6
<i>Aerococcus sanguincola</i>	0	1
<i>Aerococcus urinae</i>	1	15
<i>Alloscardovia omnicolens</i>	0	8
<i>Candida albicans</i>	0	2
<i>Candida parapsilosis</i>	0	4
<i>Citrobacter freundii</i>	1	1
<i>Citrobacter koseri</i>	0	1
<i>Corynebacterium riegelii</i>	0	4
<i>Corynebacterium urealyticum</i>	0	2
<i>Enterobacter aerogenes</i>	1	3
<i>Enterococcus faecalis</i>	1	16
<i>Escherichia coli</i>	44	50
<i>Klebsiella pneumoniae</i>	4	10
<i>Morganella morganii</i>	0	1
<i>Oligella urethralis</i>	0	1
<i>Proteus mirabilis</i>	2	4
<i>Pseudomonas aeruginosa</i>	1	1
<i>Serratia marcescens</i>	0	1
<i>Staphylococcus aureus</i>	3	7
<i>Staphylococcus lugdunensis</i>	1	2
<i>Streptococcus agalactiae</i>	1	10

Table 4
Patient Demographics and Symptoms Defined by Standard or Expanded Spectrum Enhanced Quantitative Urine Culture

Patient and Clinical Variables	Total Cohort (N = 150)	Negative Standard Urine Culture (N=93)	Positive Standard Urine Culture (N=57)	p-value	Negative Enhanced Quantitative Urine Culture (N=40)	Positive Enhanced Quantitative Urine Culture (N=110)	p-value
Age (years)	62.3 (14.9)	59.3 (13.1)	67.1 (16.5)	0.0006 ^a	59.6 (13.8)	63.3 (15.3)	0.177 ^a
Race/Ethnicity				0.374 ^b			0.431 ^b
-White	121 (81%)	73 (78%)	48 (84%)		30 (75%)	91 (83%)	
-Hispanic	15 (10%)	12 (13%)	3 (5%)		7 (18%)	8 (7%)	
-Black	9 (6%)	5 (5%)	4 (7%)		2 (5%)	7 (6%)	
-Asian	4 (3%)	0 (0%)	0 (0%)		1 (2%)	3 (3%)	
-Other	1 (1%)	3 (3%)	1 (2%)		0 (0%)	1 (1%)	
BMI (kg/m ²)	29.3 (6.3)	28.8 (6.0)	30.3 (6.8)	0.091 ^a	27.8 (4.7)	30.0 (6.7)	0.087 ^a
Number of Vaginal Deliveries (N=148)	2.0 (1.0–3.0)	2.0 (1.0–3.0)	2.0 (2.0–4.0)	0.680 ^c	2.0 (1.0–3.0)	3.0 (2.0–3.0)	0.219 ^c
Sexually Active (N=146)	58 (39%)	42 (46%) (N=92)	16 (30%) (N=54)	0.056	18 (46%) (N=39)	40 (37%) (N=107)	0.338
Previous Antibiotics Treatment	45 (30%)	31 (33%)	14 (25%)	0.255	14 (35%)	31 (28%)	0.420
Current Anticholinergic Treatment	26 (17%)	13 (14%)	13 (23%)	0.166	3 (8%)	23 (21%)	0.055
Type of Anticholinergic Used				0.382 ^b			0.495 ^b
-Oxybutynin	9 (6%)	4 (4%)	5 (9%)		3 (8%)	6 (5%)	
-Solifenacin	8 (5%)	4 (4%)	4 (7%)		0 (0%)	8 (7%)	
-Fesoterodine	4 (3%)	2 (2%)	2 (3%)		0 (0%)	4 (4%)	
-Tolterodine	2 (1%)	2 (2%)	0 (0%)		0 (0%)	2 (2%)	
-Oxybutynin Patch	1 (1%)	0 (0%)	1 (2%)		0 (0%)	1 (1%)	
-Trospium Chloride	1 (1%)	0 (0%)	1 (2%)		0 (0%)	1 (1%)	
-Myrbetriq	1 (1%)	1 (1%)	0 (0%)		0 (0%)	1 (1%)	

Patient and Clinical Variables	Total Cohort (N = 150)	Negative Standard Urine Culture (N=93)	Positive Standard Urine Culture (N=57)	p-value	Negative Enhanced Quantitative Urine Culture (N=40)	Positive Enhanced Quantitative Urine Culture (N=110)	p-value
Previous Vaginal Estrogen Use	32 (21%)	15 (16%)	17 (30%)	0.047	4 (10%)	28 (25%)	0.041
Current Vaginal Estrogen Use	29 (19%)	14 (15%)	15 (26%)	0.090	4 (10%)	25 (23%)	0.081
Prior Urogynecologic Surgery	40 (27%)	17 (18%)	23 (40%)	0.003	8 (20%)	32 (29%)	0.266
Symptoms of Incontinence:							
- Stress Urinary Incontinence	16 (11%)	12 (13%)	4 (7%)	0.257	6 (15%)	10 (9%)	0.369^b
- Urgency Urinary Incontinence	26 (17%)	13 (14%)	13 (23%)	0.166	8 (20%)	18 (16%)	0.603
- Mixed Urinary Incontinence	40 (27%)	26 (28%)	12 (21%)	0.345	10 (25%)	28 (25%)	0.955
Urgency-Frequency Syndrome	19 (13%)	14 (15%)	6 (10%)	0.428	8 (20%)	12 (11%)	0.148
Myofascial Pain	55 (37%)	34 (37%)	21 (37%)	0.972	13 (33%)	42 (38%)	0.523
Painful Bladder Syndrome, Pelvic Pain and Dyspareunia	52 (35%)	33 (35%)	19 (33%)	0.788	13 (33%)	39 (35%)	0.737
Pelvic Organ Prolapse Quantification Stage (N=127)	1.5 (1.0)	1.6 (1.0) (N=82)	1.3 (1.0) (N=45)	0.107^a	1.7 (1.0) (N=35)	1.5 (1.0) (N=92)	0.236^d
Urinary Distress Inventory Scores (N=116)	48 (27)	50.0 (27.4) (N=74)	44.1 (26.7) (N=42)	0.269^a	49.4 (31.5) (N=30)	47.4 (25.7) (N=86)	0.724^d
Total Pelvic Floor Distress Inventory Scores (N=116)	103 (59)	108.3 (58.0) (N=74)	93.9 (60.0) (N=42)	0.207^a	112.0 (64.9) (N=30)	100.0 (56.7) (N=86)	0.338^d
UTI Symptom Assessment (UTISA) Score							
-Urinary Frequency	4.0 (1.0–6.0)	3.0 (1.0–5.0)	5.0 (2.0–6.0)	0.038^c	2.5 (0.0–4.5)	4.0 (2.0–6.0)	0.059^c
-Urinary Urgency	4.0 (1.0–6.0)	4.0 (0.0–5.0)	4.0 (2.0–6.0)	0.044^c	4.0 (0.0–4.5)	4.0 (1.0–6.0)	0.098^c
-Dysuria	0.0 (0.0–4.0)	0.0 (0.0–0.0)	4.0 (0.0–5.0)	<0.001^c	0.0 (0.0–0.0)	0.0 (0.0–4.0)	0.010^c
-Difficulty Emptying	1.0 (0.0–4.0)	1.0 (0.0–4.0)	2.0 (0.0–5.0)	0.137^c	0.0 (0.0–4.0)	1.5 (0.0–4.0)	0.627^c
-Pressure	0.0 (0.0–4.0)	0.0 (0.0–4.0)	0.0 (0.0–4.0)	0.502^c	0.0 (0.0–4.0)	0.0 (0.0–4.0)	0.812^c
-Low Back Pain	0.0 (0.0–3.0)	0.0 (0.0–2.0)	0.0 (0.0–3.0)	0.211^c	0.0 (0.0–2.0)	0.0 (0.0–3.0)	0.511^c
-Blood	0.0 (0.0–0.0)	0.0 (0.0–0.0)	0.0 (0.0–0.0)	0.519^c	0.0 (0.0–0.0)	0.0 (0.0–0.0)	0.438^c

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^a - Independent T test,

^b - Fisher's exact test,

^c - Wilcoxon Rank Sum test

Bold indicates statistical significance.