

Symptoms and Risk Factors Associated with First Urinary Tract Infection in College Age Women: A Prospective Cohort Study

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Abbreviations and Acronyms

PC = principal component

PCA = PC analysis

UTI = urinary tract infection

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Purpose: We identified epidemiological risk factors for the initial urinary tract infection in females of college age compared to age matched controls.

Materials and Methods: We performed a prospective cohort study from July 2001 to January 2006 at the student health care facility at our institution. A total of 180 women experiencing a first urinary tract infection were compared to 80 asymptomatic women with no urinary tract infection history who served as controls. Urinalysis and urine culture were done at study enrollment. Questionnaires were used to obtain information on clinical symptoms and behaviors, including sexual and dietary practices, and alcohol consumption. Logistic regression was performed to identify potential risk factors in women who presented with an initial urinary tract infection compared with controls. Principal component analysis was then done to identify key sexual activity variables for multiple regression models.

Results: Urinary frequency and urgency were the most common urinary tract infection symptoms. Recent sexual activity was a significant risk factor for urinary tract infection with vaginal intercourse ($p = 0.002$) and the number of sexual partners in the last 2 weeks ($p < 0.001$) as the 2 primary variables. Alcohol consumption was associated with 2 of the 3 main principal components of sexual activity. Caffeinated beverage consumption also increased the risk of urinary tract infection ($p < 0.04$). *Escherichia coli* was the predominant pathogen isolated, followed by urease positive microbes.

Conclusions: Recent sexual activity, the frequency of that activity and the number of sexual partners pose an increased risk of urinary tract infection. Alcohol consumption frequency and amount correlated with these behaviors.

Key Words: urinary tract, urinary tract infections, epidemiology, sexual behavior, alcohol drinking

URINARY tract infection is a common bacterial infection seen in practice,¹⁻⁶ most commonly in women 18 to 24 years old with 33% requiring treatment by age 24 years.⁷ Annually, 10% of women are diagnosed with cystitis⁸ and 60% have at least 1 UTI in their lifetime.⁵ After an initial UTI 27% to 48% of women with a normal urinary tract experience recurrent UTIs, including 20% within 6 months and 44%

within 1 year, while 5% continue to have UTIs chronically.^{5,9-12} UTI symptoms can range from mild to severe with impacts on health and quality of life. The annual financial impact of UTIs in the United States is estimated to be \$3.5 billion, including \$2.5 billion for women.¹³ Furthermore, more than 8 million outpatient visits and 479,000 hospitalizations annually are a result of UTIs.

Table 1. Study population demographics

	Control	UTI	p Value
No. pts	79	178	
Mean \pm SD age	20.9 \pm 2.24	21.3 \pm 2.91	0.24
% Marital status (No.):			0.81
Married/living together	3 (2)	2.9 (5)	
Divorced	0	0.6 (1)	
Single	97 (73)	96.5 (168)	
% Ethnicity (No.):			0.24
White	60 (47)	71 (125)	
Black	13 (10)	7 (13)	
Hispanic	18 (14)	12 (21)	
Asian	9 (7)	10 (18)	
Mean \pm SD college (yrs)	2.51 \pm 1.79	2.33 \pm 1.63	0.45

We examined risk factors in college age women experiencing a first UTI. For many women this is the age when a potential lifelong battle with recurrent UTIs begins. We present demographic and life style data that identified risk factors for the acquisition of an initial UTI.

MATERIALS AND METHODS

We performed a prospective cohort study at the student health care facility at our institution. Enrollment was done and followup visits were made between January 2001 and July 2006. The study was approved by the University of Florida institutional review board.

Screening Before Enrollment

All prescreening was performed by student health care facility staff independently of the study. Women who presented to the student health care facility for nonurological reasons and who had no UTI history were provided information on the study and given the option to enroll as part of the control group. Women who presented with clinical symptoms of UTI were similarly informed of the study. Those who refused enrollment received standard care and did not complete questionnaires or undergo additional testing. Women who met the established criteria and were interested in participating in the study were referred to the study nurse. Due to patient privacy we received no information on women who refused the option to speak with the study nurse. The total study included 260 women, including the 80 controls described and 185 in the UTI group who presented with symptoms of UTI and were leukocyte esterase positive (table 1).

Enrollment and Followup

After referral the study nurse obtained informed consent from all participants. Five of the 185 women originally in the UTI group were excluded from analysis after triage screening due to exclusion criteria or unusable responses on enrollment information. No control was excluded. All symptomatic women received appropriate antimicrobial treatment and made a followup visit 2 weeks after treatment.

Study Questionnaire

All women completed a questionnaire modeled after that of Foxman and Chi,¹⁴ which assessed urinary tract symp-

toms, demographic information, menstrual and yeast infection history, smoking/alcohol/dietary habits and sexual/contraceptive history. Participants self-reported the occurrence and duration of urinary frequency, urgency, dysuria, abdominal pain, nocturia, hematuria, fever, chills, back pain and flank pain. Sexual history included total lifetime and time specific sexual partners, and specific sexual activity/behavior in the 2 weeks immediately before enrollment. Sexual behavior included the frequency of masturbation/heavy petting, ie manual stimulation to the enrollee genitals, penile/vaginal intercourse, anal intercourse and providing/receiving oral sex as well as no previous participation in these sexual practices.

Laboratory Studies

In control and symptomatic enrollees identical diagnostic tests were performed, including standard urinalysis and microbial culture of clean catch urine as well as vaginal and urethral swabs. Samples were plated on MacConkey and blood agar using quantitative loops. Microbial isolates were identified using BBL™ Crystal™ identification system kits. For mycoplasma culture samples were diluted tenfold in 10B broth and plated on A8 agar. Mycoplasma species, including *M. hominis*, *M. genitalium*, *Ureaplasma urealyticum* and *U. parvum*, were identified by the characteristic appearance on agar and confirmed by species specific polymerase chain reaction. Samples were also screened for chlamydia, gonorrhea and yeast. Bacterial vaginosis was assessed using clinical diagnostics of vaginal pH and discharge, wet mount microscopy and Gram stain.^{15–17} Microscopy was performed by 2 independent observers.

Study Inclusion and Exclusion Criteria

Each participant was 18 years old or older, able to be followed and had no UTI history. Women were excluded from analysis if they were younger than 18 years, pregnant, had had a prior UTI, had undergone urethral catheterization or had a concurrent yeast or sexually transmitted infection.

Analysis

Since the women were free not to answer questions, the number of responses to some questions varied. Univariate logistic regression analysis was done to initially screen for potential risk factors associated with UTI. Variables included sexual behavior, dietary habits and hygiene. The crude OR and 95% CI were calculated for potential risk factors. Due to the multicollinearity of sexual activity variables, we performed PCA to identify key sexual activity variables that were uncorrelated and could be used in a multiple variable regression model. A univariate level of significance of $p \leq 0.20$ was required for a potential risk factor to be entered in the multiple logistic regression model. All analyses were performed using SAS/STAT® software.

RESULTS

Demographics and Urinary Symptoms

The study and control groups did not differ in age, ethnicity, marital status or education (table 1). The most common presenting symptoms in the UTI group were frequency and urgency (fig. 1). Less frequent but still substantial symptoms were dysuria,

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