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Brief report

Evaluation of patients' skin, environmental surfaces, and urinary catheters as sources for transmission of urinary pathogens

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In hospitalized patients with urinary tract infection or asymptomatic bacteriuria, urinary pathogens frequently contaminate skin, high-touch environmental surfaces, and urinary catheters. Contamination is more common in patients with a urinary catheter in place and with gram-positive pathogens. Patients' skin and environmental surfaces may provide an important source for transmission of urinary pathogens.

Urinary tract infection (UTI) is the most common health care–associated infection in the United States, accounting for approximately one-third of these infections occurring in hospitals.[1] Asymptomatic bacteriuria (ASB) is also very common in health care settings, particularly in elderly patients and patients with indwelling urinary catheters.[2-4] It is likely that patients with UTI or ASB provide the major reservoir for transmission of urinary pathogens.[5] Although urinary pathogens are known to frequently contaminate the perineum of patients with UTI,[4] information on the frequency of contamination of commonly examined skin sites and high-touch environmental surfaces in patients with bacteriuria is limited. Here we tested the hypothesis that skin and environmental contamination with urinary pathogens is common in patients with UTI or ASB, and evaluated risk factors for skin and/or environmental contamination.

METHODS

The Cleveland VA Medical Center Institutional Review Board approved the study protocol. During a 4-month period (July through October 2010), we conducted a prospective study of consecutive inpatients with bacteriuria ($>10^5$ colony-forming units of a urinary pathogen per mL of urine) identified in the microbiology laboratory. Medical records review was performed to obtain demographic data and information on medications, signs and symptoms of UTI, and laboratory tests. Patients were considered to have symptomatic UTI if urinary symptoms were documented (eg, dysuria, frequency, urgency, suprapubic or flank tenderness) and considered to have ASB if no symptoms were documented. Patients with indwelling urinary catheters and condom catheters were included in the analysis.

Swabs were collected using BBL CultureSwabs (BD Diagnostic Systems, Sparks, MD) from standardized areas of each patient's skin (combined arm and hand, combined chest and abdomen, axilla, and groin), environment (combined phone and call button and combined table and bed rail), and urinary catheter if present within 3 days of a positive urine culture. For skin and environmental sites, 5 × 10 cm areas were sampled, and for the hand, phone and call button, the entire surface area was sampled. For urinary catheters, the swab was applied to a 10-cm length of catheter at the exit site from the urethra.

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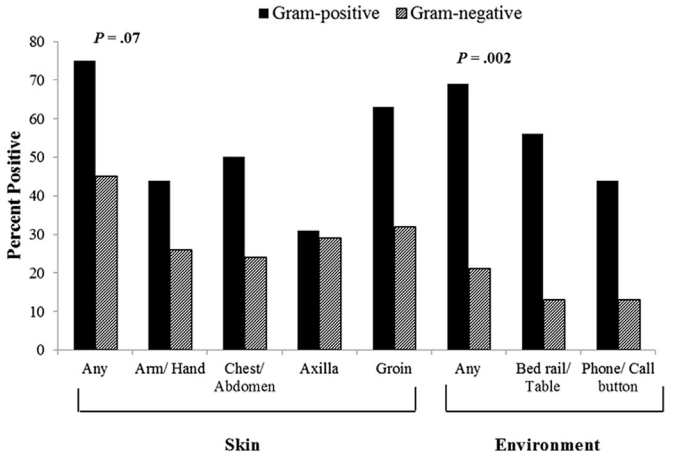

Fig 1. Frequency of contamination of skin and environmental sites in 54 patients with UTI or ASB, stratified by gram-positive (16 patients) and gram-negative (38 patients) urinary pathogens. Any environmental contamination does not include urinary catheter contamination. Skin or environmental contamination was considered present if pathogens concordant with the organism in urine were cultured.

Identification and susceptibility test results for urinary isolates were obtained from the microbiology laboratory. Based on these results, swabs were plated onto appropriate selective media agar to determine whether the urinary pathogen was present. Selective media included MacConkey agar for gram-negative bacilli, Enterococcosel agar for enterococci, and mannitol salt agar for staphylococci (all from BD Diagnostic Systems). After plating, the swabs were also incubated in 1 mL of brain-heart infusion broth (BD Diagnostic Systems) overnight and specimens with positive growth were plated onto appropriate selective media plates. Identification and susceptibility testing of isolates was performed in accordance with Clinical Laboratory Standards Institute guidelines.[6] Skin, environment, and catheter isolates were considered to be concordant with the urinary isolates if identification and susceptibility results were identical.

Bivariate analyses were conducted to compare characteristics of patients with versus without positive skin and/or environmental contamination; urinary catheter contamination was not included in these analyses. Fisher's exact test was used for categorical data, and Student's unpaired *t* test was used for normally distributed data. Data were analyzed using SPSS version 10.0 (SPSS, Chicago, IL) and Stata 11 (StataCorp, College Station, TX).

RESULTS

Of the 54 patients with bacteriuria enrolled in this study, 31 (57%) had skin and/or environmental contamination with pathogens concordant with the organism in urine, including 29 (54%) with skin contamination and 19 (35%) with contamination of 1 or more environmental sites. There was no difference in the frequency of skin and/or environmental contamination between patients with UTI (n = 30) and those with ASB (n = 24) (data not shown). Of the 31 patients with a urinary catheter (29 with an indwelling catheters and 2 with a condom catheter), 18 (82%) had contamination of the catheter; 17 of these 18 (94%) had contamination of skin or other environmental sites.

Thirty-eight patients (70%) had gram-negative pathogens in urine, and 16 (30%) had gram-positive pathogens. The most common gram-negative pathogens in urine were *Klebsiella pneumoniae* (n = 12), *Proteus mirabilis* (n = 9), *Escherichia coli* (n = 6), and *Pseudomonas aeruginosa* (n = 5); the gram-positive pathogens were *Enterococcus* spp (n = 13) and *Staphylococcus aureus* (n = 3).

Table 1
Characteristics of 54 study patients with a UTI or ASB, stratified by the presence or absence of skin and/or environmental contamination with the urinary pathogens

Characteristic	All subjects (n = 54)	Skin/ environmental contamination (n = 31)	No skin/ environmental contamination (n = 23)	*P* value
Age, y mean (SD)	68 (14)	66 (16)	71 (11)	.13
Length of stay, d, median (IQR)	5.5 (2-29)	5 (2-28)	5 (2-40)	.53
Urinary catheter, n (%)	31	22 (71)	9 (39)	.03
Male sex, n (%)	49	29 (94)	20 (87)	.64
Nursing home resident, n (%)	12	9 (29)	3 (13)	.20
Antibiotic use in the past month, n (%)	40	22 (71)	18 (78)	.75
Urinary incontinence, n (%)	7	4 (13)	3 (13)	1.00
Decreased mobility, n (%)*	15	12 (39)	3 (13)	.06
Organism type, n (%)				
Gram-negative	38	17 (55)	21 (91)	.006
Gram-positive	16	14 (45)	2 (9)	
Dementia, n (%)	10	4 (13)	6 (19)	.29

IQR, interquartile range; *SD*, standard deviation.
*Decreased mobility was defined as a score of 1 or 2 on the mobility subcategory of the Braden score for prediction of pressure ulcer risk (1, completely immobile; 2, very limited; 3, slightly limited; 4, no limitation).

Figure 1 shows the frequency of contamination of different skin and environmental sites for patients with bacteriuria with gram-positive and gram-negative pathogens.

Table 1 shows a comparison of the characteristics of 31 patients with and 23 patients without skin and/or environmental contamination. The presence of urinary catheter and gram-positive pathogens in urine was significantly associated with skin and/or environmental contamination. In addition, decreased mobility was more common in patients with skin and/or environmental contamination, but the difference was not statistically significant. There were no significant differences in any other characteristic, including age, sex, length of stay, ward, nursing home residence, previous surgical history, previous use of antibiotics, diarrhea, urinary or fecal incontinence, dementia, or cerebrovascular accident.

DISCUSSION

In our hospitalized patients with UTI or ASB, urinary pathogens frequently contaminated skin, high-touch environmental surfaces, and urinary catheters. Contamination was significantly more common in patients with urinary catheters and with gram-positive pathogens in urine, and there was a trend toward increased contamination in patients with decreased mobility. These findings provide support for the hypothesis that skin and environmental surfaces of patients with bacteriuria represent an important source for transmission of urinary pathogens.

The finding that urinary catheters are associated with skin and environmental contamination with urinary pathogens is consistent with previous studies demonstrating an association between indwelling devices and skin and/or environmental contamination in patients colonized with methicillin-resistant *S aureus*.[7,8] Urinary catheters might increase the risk for skin contamination with urinary pathogens due to contamination of the external surface of the catheter and due to reduced ability to bathe effectively. The presence of the catheter may also increase the risk of skin and environmental contamination due to increased frequency of interactions with healthcare workers.

The high frequency of contamination of skin and environmental surfaces with enterococci and *S aureus* is consistent with previous