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Not all nosocomial Escherichia coli bacteriurias are catheter associated

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RESEARCH BRIEF

Not All Nosocomial *Escherichia coli* Bacteriurias Are Catheter Associated

Urinary tract infections (UTIs) are the most common hospital-acquired infections and are thought to be primarily a consequence of urinary catheterization.[1] Strategies to prevent hospital-acquired UTIs focus almost exclusively on urinary catheter management. However, data to support the assumption that hospital-acquired UTIs can be equated with catheter-associated UTIs are very limited. In a recent editorial for a nationwide survey of practices to prevent hospital-acquired UTIs, the author stated that 80% of these infections were catheter associated but did not provide a reference.[2]

We performed a 12-month prospective cohort study involving inpatients with *Escherichia coli* bacteriuria (defined as greater than or equal to 5×10^4 colony-forming units/mL in a clean-voided urine culture, or greater than or equal to 5×10^3 colony-forming units/mL in urine culture from a catheterized patient) starting August 1, 2009, at Barnes-Jewish Hospital, a 1,250-bed teaching hospital in Missouri. Adult patients with a first positive urine culture 48 hours or more after admission were included. Urine cultures were performed at the treating physician's discretion. We excluded patients with polymicrobial bacteriuria and/or concurrent, non–*E. coli* bacteremia. Using medical records, the patients' clinical presentation, vital signs, and laboratory, radiological, and pharmacy data were recorded prospectively.

A bacteriuria episode was considered to be catheter associated if a catheter had been in place within 48 hours before urine cultures were obtained. Asymptomatic bacteriuria (ASB) was defined as the absence of urinary symptoms;[3] cystitis was defined as the presence of dysuria, frequency, or urinary retention; pyelonephritis was defined as flank pain or tenderness and/or fever (with or without cystitis symptoms). Sepsis was defined using established criteria. We reviewed blood cultures that were obtained within 1 day before or after bacteriuria was diagnosed.

We used SPSS 18 for data analysis. Univariate comparisons of categorical variables were performed with the χ^2 test or Fisher's exact test as appropriate. Continuous independent variables were analyzed using Student's *t* test or the Mann-Whitney *U* test. A 2-sided *P* value of less than .05 was considered significant. We entered variables with a *P* value of less than 0.1 in univariate testing into a multivariate logistic regression model. The study was approved by the Washington University Human Research Protection Office.

One hundred eighty-three patients had hospital-acquired *E. coli* bacteriuria during the study period and met study criteria. Patients received a diagnosis of ASB (77 patients; 42%), cystitis (28 patients; 15%), pyelonephritis (55 patients; 30%), or unclassifiable bacteriuria (e.g., bacteriuria diagnosed in intubated patients; 23 patients; 13%). Among asymptomatic patients, 65 (84%) were female.

Eighty-five of 183 episodes (46%; 95% confidence interval, 37%–56%) were catheter associated. Patients with catheter-associated bacteriuria were more likely to be male ($P = .003$), to have renal insufficiency ($P = .02$), and to have undergone a recent urological procedure ($P = .03$; Table 1). There was no difference in the prevalence of ASB ($P = .6$).

One hundred fifty-one patients with bacteriuria (83%) received antibiotic treatment, including 64 (83%) of the patients with ASB. The presence of a catheter did not determine whether antibiotics matched susceptibilities (70 [99%] of 71 with catheter vs 77 [96%] of 80 without catheter; $P = .6$). Among those patients tested for bacteremia, there was no difference in the frequency of bacteremia ($P = .5$). In-hospital mortality was similar among those with catheter-associated bacteriuria and those with non-catheter-associated bacteriuria ($P > .99$), as was the length of hospital stay after bacteriuria ($P = .08$). Independent factors predisposing to catheter-associated bacteriuria in bacteriuric patients are shown in Table 1.

It is widely assumed that the terms "hospital-acquired bacteriuria" and "catheter-associated bacteriuria" are synonymous. However, few data actually quantify urinary catheterization as a precursor of bacteriuria. The 1983 Centers for Disease Control and Prevention guidelines for prevention of catheter-associated UTI state that 66%–86% of episodes of hospital-acquired bacteriuria are secondary to urinary instrumentation.[4] The corresponding reference does not explicitly provide this information.[5] Also, to our knowledge, this statement has not been reevaluated over the past 3 decades. We found that only 46% of cases of hospital-acquired bacteriuria in a tertiary-care hospital were catheter associated, which is lower than was previously suspected. Why there was such a high proportion of noncatheterized patients with bacteriuria is unclear. Changes in genitourinary hygiene during hospitalization may play a role, as could medications that alter the bladder function. It is possible that hospital policies to reduce unnecessary device use resulted in a lower proportion of catheter-associated bacteriuria. The development of targeted preventive measures clearly depends on a better understanding of the pathogenesis of non-catheter-associated nosocomial bacteriuria.

In noncatheterized patients, ASB may have been present before hospital admission but remained undetected until later in the hospital course, leading to patients being mislabeled as having nosocomial bacteriuria. Testing this hypothesis would require that admission urine samples for culture be obtained from patients. Antibiotic treatment of ASB was common (occurring in 83% of cases), independent of catheter status. Although ASB-related antibiotic overuse in long-term care fa-

TABLE 1. Comparison of Patients with Catheter-Associated and Non-Catheter-Associated Hospital-Acquired *Escherichia coli* Bacteriuria

Variable	Total (n = 183)	Catheter-associated (n = 85)	Non-catheter-associated (n = 98)	P	OR (95% CI)
Male sex	46 (25)	30 (35)	16 (16)	.003	2.8 (1.4–5.7)
White race	124 (68)	60 (71)	64 (65)	.4	...
Age, median years (range)	70 (20–98)	68 (24–96)	71 (20–98)	.9	...
Body mass index, median index (range)	27.1 (12.1–64.2)	27.0 (17.2–64.2)	27.3 (12.1–63.1)	.7	...
Charlson comorbidity score, median score (range)	3 (0–13)	3 (0–13)	3 (0–11)	.4	...
Diabetes mellitus	64 (35)	31 (37)	33 (34)	.7	...
Renal insufficiency (Cr level >1.5 mg/dL)	42 (23)	26 (31)	16 (16)	.02	2.2 (1.0–4.6)
Any malignancy	50 (27)	26 (31)	24 (25)	.4	...
Dementia	32 (18)	10 (12)	22 (22)	.06	0.5 (0.2–1.2)
Benign prostatic hyperplasia	12 (7)	8 (9)	4 (4)	.1	...
Urological procedure during current hospitalization	8 (4)	7 (8)	1 (1)	.03	10.4 (1.2–88.8)
Fever	52 (28)	23 (27)	29 (30)	.7	...
Confusion or altered mental status	47 (26)	23 (27)	24 (25)	.7	...
Sepsis	98 (54)	47 (55)	51 (52)	.7	...
Pyelonephritis	55 (30)	25 (29)	30 (31)	.9	...
Asymptomatic bacteriuria	77 (42)	34 (40)	43 (44)	.6	...
Urinalysis results >10 WBC/hpf	121 (66)	61 (72)	60 (61)	.1	...
Outcome					
Bacteremia	9/70 (13)	3/33 (9)	6/37 (16)	.5	...
Length of hospital stay after bacteriuria, median days (range)	4.9 (0.1–66.1)	5.6 (0.2–36.5)	4.2 (0.1–66.1)	.08	...
In-hospital mortality	13 (7)	6 (7)	7 (7)	>.99	...

NOTE. Data are no. (%) of patients unless otherwise specified. Hosmer-Lemeshow goodness-of-fit $P = .635$ (for the multivariate logistic regression model). Body mass index was calculated as the weight in kilograms divided by the square of height in meters. CI, confidence interval; Cr, creatinine; hpf, high-power field; OR, odds ratio; WBC, white blood cell.

cilities has stimulated interventions,[6] comparable data for acute-care hospitals are lacking. ASB may be a major driver of antibiotic use (and antimicrobial resistance) in hospitals and therefore represents a target for antimicrobial stewardship.[7]

We identified a number of plausible independent predictors of catheter-associated bacteriuria. The lower prevalence of catheter-associated bacteriuria among bacteriuric women could be in line with their predisposition to ASB.[8] The need for monitoring fluid intake and output may contribute to a higher frequency of catheterization among bacteriuric patients with renal insufficiency. Finally, catheters have been shown to result in postprocedure UTIs.[9]

Our data were obtained from medical records, including both physicians' and nurses' notes. It is possible that some urinary catheterizations were unrecorded, which may have led us to underestimate the number of catheter-associated bacteriurias. The imperfect correlation between catheterization and its documentation has been addressed in a recent study.[10] Also, the proportion of catheter-associated episodes might be higher for nosocomial pathogens other than *E. coli.*

In summary, we found catheter-associated infection to be less common among cases of nosocomial *E. coli* bacteriuria than has been previously reported. A better understanding of non-catheter-associated bacteriuria could lead to improved infection-prevention strategies among hospitalized patients.

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