American Journal of Infection Control 42 (2014) 682-4

Contents lists available at ScienceDirect

American Journal of Infection Control

journal homepage: www.ajicjournal.org

Brief report

A comparison of the microbiologic profile of indwelling versus external urinary catheters

Larissa Grigoryan MD, PhD [a], Michael S. Abers BA [b], Quratulain F. Kizilbash MD, MPH [c,d], Nancy J. Petersen PhD [e,f,g], Barbara W. Trautner MD, PhD [e,g,h,*]

[a] Department of Family and Community Medicine, Baylor College of Medicine, Houston, TX
[b] Baylor College of Medicine, Houston, TX
[c] Department of Medicine, University of Texas, Tyler, TX
[d] Texas Center for Infectious Diseases, San Antonio, TX
[e] Houston VA Center for Innovations in Quality, Effectiveness, and Safety, Houston, TX
[f] Michael E. DeBakey Veterans Affairs Medical Center, Houston, TX
[g] Section of Health Services Research, Department of Medicine, Baylor College of Medicine, Houston, TX
[h] Section of Infectious Diseases, Department of Medicine, Baylor College of Medicine, Houston, TX

Key Words:
Bacteriuria
Catheter-associated UTI

We studied the microbiology reports of urine cultures collected from external (condom catheters) versus indwelling (Foley) catheters. The equal prevalence of *Enterobacteriaceae* and *Enterococci* in samples from both catheter types calls into question the practice of switching from indwelling to external catheters to decrease catheter-associated bacteriuria.

Catheter-associated urinary tract infection (CAUTI) is 1 of the most common hospital acquired infections.[1] One recommendation to decrease the rate of CAUTI is to consider external (condom) catheters as an alternative to indwelling catheters.[1] Studies on the microbiologic profile of external catheters were performed more than 25 years ago, and the only randomized study comparing external and indwelling catheters did not include any microbiology data.[2] We recently studied all urine cultures collected from inpatient wards and nursing home units in 2 Veterans Affairs (VA) hospitals and found that urine cultures collected from patients with condom catheters were more likely to be positive for the presence of bacteria than urine cultures from patients with indwelling catheters.[3] Therefore, if external catheters are less likely to lead to bacteriuria with typical uropathogens than indwelling catheters is unclear.

Another gap in our knowledge about external catheter safety is the lack of microbiology studies of urine cultures associated with external catheters in comparison to urine cultures from indwelling catheters. Because condom catheters are not included in standard medical device surveillance, little is known about the typical microbiology profile associated with their use. We compare here the type and the number of organisms recovered from urine cultures in patients with external and indwelling catheters.

METHODS

We conducted a cross-sectional study in 5 medicine and 5 extended-care wards of a VA tertiary care facility, with approval from the institutional review board and the Research and Development Committee. All patients who had both a urinary catheter (external or indwelling) and positive urine culture during the period October 2010-June 2011 were included. We included the first positive urine culture and used our laboratory threshold for reporting bacterial or fungal growth; that is, $\geq 10^3$ organisms/mL, which meets the Infectious Diseases Society of America definition of CAUTI for any urinary catheter type.[4] Each identified organism

* Address correspondence to Barbara W. Trautner, MD, PhD, MEDVAMC (MCL 111), 2002 Holcombe Blvd, Houston, TX 77030.
E-mail address: trautner@bcm.edu (B.W. Trautner).

This work was supported by grants from the Department of Veterans Affairs (VA HSR&D IIR 09-104 and VA RRP 12-433) and the National Institutes of Health (grant No. DK092293) to BWT. This manuscript is the result of work supported with resources and use of facilities at the Houston VA Center for Innovations in Quality, Effectiveness, and Safety (CIN13-413) at the Michael E. DeBakey VA Medical Center, Houston, TX. The opinions expressed reflect those of the authors and not necessarily those of the Department of Veterans Affairs, the US government, the National Institutes of Health, and Baylor College of Medicine. The National Institutes of Health had no role in the design and conduct of the study; the collection, management, analysis, and interpretation of the data; or the preparation, review, or approval of the manuscript. Research activities conducted by LG were supported by National Research Service Award No. 5 T32 HP10031.

Conflicts of interest: None to report.

0196-6553/$00.00 - Published by Elsevier Inc. on behalf of the Association for Professionals in Infection Control and Epidemiology, Inc.
http://dx.doi.org/10.1016/j.ajic.2014.02.028

Table 1
Comparison of patient characteristics and of number and type of microorganisms between patients with external and indwelling urinary catheters

Variable	External catheters	Indwelling catheters	*P* value*
Patient characteristics (n = 308)	(n = 135)	(n = 173)	
Age, y	73.3 ± 10.6	71.4 ± 11.9	.14
Male	135 (100)	163 (94.2)	–
Deyo comorbidity score	3.8 ± 3.0	4.2 ± 3.3	.24
Hispanic†	6 (4.5)	13 (7.8)	.34
Black	57 (42.2)	64 (37.0)	.10
No. of organisms	2.3 ± 1.0	1.7 ± 0.9	**< .0001**
Organisms in urine cultures (n = 593)	(n = 305)	(n = 288)	
Gram positives	149 (48.9)	118 (41.0)	.054
Staphylococci	20 (6.6)	18 (6.3)	.88
Enterococci	28 (9.2)	25 (8.7)	.83
Corynebacterium and *Lactobacillus*	7 (2.3)	4 (1.4)	.41
Gram positive, not speciated	94 (30.8)	71 (24.7)	.09
Gram negatives	135 (44.2)	128 (44.4)	.96
Enterobacteriaceae‡	66 (21.6)	68 (23.6)	.57
Non-*Enterobacteriaceae*	9 (3.0)§	24 (8.3)¶	**.004**
Gram negative, not speciated	60 (19.7)	36 (12.5)	**.02**
Candida	21 (6.9)	42 (14.6)	**.002**

NOTE. Data are presented as mean ± standard deviation or n (%). Boldface indicates a significant result.
*P values refer to *t* test for continuous variables, χ^2, and Fisher exact test for nominal variables.
†Data missing for 7 patients.
‡*Enterobacteriaceae* includes *Citrobacter, Escherichia coli, Enterobacter, Klebsiella, Morganella, Proteus, Providencia,* and *Serratia*.
§Including 8 *Pseudomonas* and 1 *Stenotrophomonas*.
¶Including 18 *Pseudomonas*, 3 *Acinetobacter, 1 Delftia acidovorans, and 1 Sphingomonas*.

was categorized into 1 of the following categories: *Enterobacteriaceae*, non-*Enterobacteriaceae*, gram-negative (species not identified), *Staphylococci*, *Enterococci*, *Corynebacterium* and *Lactobacillus,* gram-positive (species not identified), or *Candida.*

Statistical analysis

Data were checked for normality. The mean number of organisms per patient and characteristics of patients with external and indwelling catheters were compared using *t* tests, χ^2 tests, and Fisher exact tests. The frequency of specific organisms in each catheter type was compared using χ^2 tests. To assess possible correlation among organisms with a given patient, we also conducted hierarchical logistic regression analysis. Using the specific organism as the dependent variable and nesting organisms within patients, we calculated the odds of having a given organism for those with an external catheter compared with those with an indwelling catheter. All statistical tests were 2 sided at $\alpha = 0.05$. Data were analyzed using SAS (version 9.2; SAS Institute Inc, Cary, NC).

RESULTS

In total, 308 unique patients were included. The mean number of organisms per culture was significantly higher in patients with external catheters compared with those with indwelling catheters (Table 1). Of 308 urine cultures collected (1 culture per patient), a total of 593 organisms were identified (Table 1). The prevalence of all gram-positive organisms combined was somewhat higher in urine cultures from external catheters than indwelling catheters, but individual gram-positive organisms (*Staphylococci*, *Enterococci*, *Corynebacterium,* and *Lactobacillus*) did not differ significantly in urine cultures from external and indwelling catheters. The prevalence of all gram-negative organisms and *Enterobacteriaceae* were also similar between groups. Gram-negative non-*Enterobacteriaceae* (mostly *Pseudomonas*) were significantly more common in urine cultures from indwelling catheters than external catheters. In contrast, nonspeciated gram-negative organisms were significantly more common in external catheters. *Candida* was more common in patients with an indwelling catheter. We obtained similar results when we tested for differences in prevalence of organisms between catheter types using hierarchical regression analysis.

DISCUSSION

We report an up-to-date comparison of the microbiologic profile of indwelling and external urinary catheters in hospitalized and nursing-home patients. The most common types of uropathogens, *Enterobacteriaceae* and *Enterococci*, were equally prevalent in both catheter types. Both *Candida* and non-*Enterobacteriaceae* were significantly more prevalent in urine cultures from indwelling catheters. The mean number of organisms per patient was higher in patients with external catheters compared with patients using indwelling catheters. Because *Enterobacteriaceae* and *Enterococci* were equally common in both catheter types, switching from indwelling to external catheters would not necessarily decrease bacteriuria.

Our findings suggest that the organisms that are cultured from the urine with both catheter types are likely to derive from the same source: perineal flora.[5] This is consistent with recent findings from a Korean study[6] where a wide variety of *Enterobacteriaceae* were isolated from urine cultures from external catheters of patients with spinal cord injury. In our study, the prevalence of *Pseudomonas* and *Candida* were both higher in urine cultures from indwelling catheters. *Pseudomonas* and *Candida* are both known to form biofilms,[7,8] and biofilms are a common denominator in indwelling catheter infections.

Our results might not be generalizable to all patients with urinary catheters because our sample included patients from a single VA tertiary care hospital. Much of the condom-catheter-associated bacteriuria that we observed may represent contamination. Because nursing standards do not address how to collect a urine culture from a patient with an external catheter, we believe there is variation in urine culture collection procedures in our hospital and other facilities.[9] Regardless, from a clinician's perspective, a microbiology lab report of bacteria or *Candida* represents a positive culture and is likely to be treated as such. Physicians are often unaware that their inpatients have a urinary catheter,[10] and it is even less likely that they will know which type of catheter a patient had in place when the urine sample was collected. Finally, we lack data on the specific type of condom catheters used, how they were applied, and if patients wore them continuously or intermittently. There is a lack of evidence to support an optimal protocol for external catheter placement, maintenance, and culturing, representing a major gap in clinical knowledge.

CONCLUSIONS

Our study results call into question the practice of switching from indwelling to external catheters to prevent bacteriuria with typical uropathogens (eg, *Enterobacteriaceae* and *Enterococci*). Expert panels need to consider the important gaps in our knowledge about the effect of external catheters on patients and about the best external catheter practices before encouraging preferential use over indwelling catheters.