CONCISE COMMUNICATION

Urine Cultures among Hospitalized Veterans: Casting Too Broad a Net?

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Since detection of asymptomatic bacteriuria among inpatients often leads to inappropriate antimicrobial treatment, we studied why urine cultures were ordered and correlates of treatment. Most cultures were obtained from patients without urinary complaints and a minority from asymptomatic patients. High-count bacteriuria, not clinical manifestations, appeared to trigger most antimicrobial use.

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Clinicians often treat patients with asymptomatic bacteriuria (ASB) with antimicrobials, even though this is not usually necessary except in pregnant women or those undergoing an invasive urologic procedure.[1] Such treatment remains an important driver of unnecessary antimicrobial use,[2-5] leading to antimicrobial resistance, *Clostridium difficile* infection (CDI), adverse drug events, and increased costs. Because ASB requires detection before being treated, unnecessary urine cultures can lead to unnecessary antimicrobial use.

For example, at the Minneapolis Veterans Affairs Medical Center (MVAMC), during and shortly after episodes of *C. difficile* infection, more than 80% of antimicrobials prescribed for urinary tract infection (UTI) were unnecessary, since most purported UTIs were actually ASB.[3] Similarly, most antimicrobial use for purported catheter-associated UTI was actually for ASB.[6] Because ASB contributes to inappropriate antimicrobial use, we prospectively evaluated MVAMC inpatients for appropriateness of urine culture ordering and associated antimicrobial use.

METHODS

For all urine cultures obtained from MVAMC inpatients from March 2011 through May 2011, we prospectively reviewed the source patient's computerized patient record system file within 1–3 days after culture collection and recorded symptoms, exam findings, and laboratory studies. Symptoms considered consistent with UTI included dysuria; urinary frequency; new urinary retention; hematuria; chills; altered mental status; and flank, suprapubic, or abdominal pain. Exam findings considered consistent with UTI included a temperature greater than 100.4°F or less than 96.8°F and suprapubic or flank tenderness. We categorized positive cultures as high-count growth (100,000 or more colony forming units [CFUs]/mL) or low-count growth (fewer than 100,000 CFUs/mL); the source of the culture (catheterized vs voided) was recorded. We classified antimicrobials typically used for UTI, if prescribed within 4 days of a culture order, as urine culture–associated antimicrobials.

We classified each urine culture order as appropriate, inappropriate, or indeterminate. Appropriate orders were those in patients who had a symptom or exam finding consistent with UTI (as defined above), fulfilled 2 or more systemic inflammatory response syndrome (SIRS) criteria,[7] and/or had a valid indication for a screening culture (ie, pregnancy or prior to urologic surgery). Inappropriate orders were those in patients with no UTI-consistent clinical manifestations or valid reason for obtaining a screening culture or that were for screening before nonurologic surgery, test of cure, and abnormal urine appearance or odor. Indeterminate orders were those in patients with clinical manifestations that did not qualify as consistent with UTI (eg, isolated leukocytosis). Before we classified orders without a discernible indication as to appropriateness, we paged the ordering provider to ask why they placed the order.

We assessed differences in proportions using a Fisher exact test and assessed associations between use of urine culture–associated antimicrobials and clinical factors using multivar-

TABLE 1. Clinical Manifestations Possibly Consistent with Urinary Tract Infection and Other Relevant Factors Present at Time of Culture Ordering for 496 Urine Cultures

Factors	No. (%)[a]
Reported symptom	
Confusion/altered mental status	92 (19)
Chills	43 (9)
Abdominal pain	30 (6)
Dysuria	29 (6)
Hematuria	26 (5)
Urinary retention	16 (3)
Urinary frequency	15 (3)
Flank pain	7 (1)
Suprapubic pain	5 (1)
Exam finding	
Suprapubic tenderness	2 (<1)
Costovertebral angle tenderness	0 (0)
Temperature <96.8°F	34 (7)
Temperature >100.4°F	115 (23)
Meeting ≥2 SIRS criteria	218 (44)
Temperature (<96.8°F or >100.4°F)	149 (30)
Heart rate >90	234 (47)
Leukocytes (<4,000 or >12,000, or >10% band forms)	203 (41)
Tachypnea (>20, or Pco_2 <32 mmHg)	135 (27)
Other relevant factors	
Indwelling or condom catheter or nephrostomy tube	165 (33)
Intermittent catheterization	36 (7)
Preurologic surgery	10 (2)
Pregnancy	0 (0)

NOTE. SIRS, systemic inflammatory response syndrome.

[a] Totals do not sum to 496, since some urine cultures were ordered in the absence of any of the above factors. Percentage values do not sum to 100, since more than 1 factor could be present at the time of urine culture ordering.

TABLE 2. Urine Culture Results and Associated Antimicrobial Use Stratified by Appropriateness of Urine Culture

Appropriateness and result	Urine cultures	Urine culture–associated antimicrobial use	*P*
Appropriate	344 (69)		
High-count growth	52 (15)	34 (65)[a]	<.001
Low-count growth	74 (22)	5 (7)	
No growth	218 (63)	12 (5)	
Inappropriate	74 (15)		
High-count growth	20 (27)	5 (25)[a]	.01
Low-count growth	25 (34)	3 (12)	
No growth	29 (39)	0	
Indeterminate	78 (16)		
High-count growth	16 (21)	7 (44)[a]	<.001
Low-count growth	20 (16)	0	
No growth	42 (54)	3 (7)	
All	496 (100)		
High-count growth	88 (18)	46 (52)	<.001
Low-count growth	119 (24)	8 (7)	
No growth	289 (58)	15 (5)	

NOTE. Data are no. (%), unless otherwise indicated. High-count growth, >100,000 colony forming units (CFUs)/mL; low-count growth, <100,000 CFUs/mL; no growth, <10,000 CFUs/mL (limit of detection). *P* values refer to comparing the percentage of urine culture–related antimicrobial use in relation to growth status within each level of appropriateness.

[a] For the percentage of urine culture–associated antimicrobial use in relation to decreasing level of appropriateness (65% vs 44% vs 25%; $P = .006$).

iable logistic regression analysis. The MVAMC institutional review board approved the study.

RESULTS

Over the 3-month prospective study, MVAMC providers obtained 496 urine cultures from 351 inpatients who were predominantly (97%) male, with a mean age of 68.0 years (standard deviation, 13.9). Indwelling or condom catheters were present in 33% of patients. We obtained clinical information from the computerized patient record system for 430 (87%) cultures and from clinicians for 66 (13%) cultures. Applying appropriateness criteria, 344 (69%) urine culture orders were appropriate, 74 (15%) were inappropriate, and 78 (16%) were indeterminate. However, only 43 (13%) of the presumably appropriate cultures were obtained for dysuria or frequency; 218 (63%) were obtained for nonspecific clinical manifestations, usually presence of 2 or more SIRS criteria (Table 1). Moreover, for 224 (65%) of the presumably appropriate cultures, the patient had a known or suspected non-UTI condition that could explain the clinical manifestation(s) that prompted the culture.

Of the 496 total cultures, 88 (18%) had high-count growth, 119 (24%) had low-count growth, and 289 (58%) had no growth. High-count growth was more common with inappropriate (20/74 [27%]) or indeterminate (16/78 [21%]) cultures compared with appropriate cultures (52/344 [15%]; $P = .04$). Among the 43 cultures obtained for dysuria or frequency, only 7 (16%) had high-count growth.

Urine culture–associated antimicrobial use was uncommon, occurring after only 69 cultures (14% of total). Both overall and stratified by appropriateness level, urine culture–associated antimicrobial use was significantly associated with high-count growth (Table 2). In contrast, it did not differ significantly in frequency in relation to culture appropriateness, occurring after 51 (15%) of 344 appropriate, 8 (11%) of 74 inappropriate, and 10 (13%) of 78 indeterminate cultures ($P = .63$). According to multivariable logistic regression analysis, only high-count growth—not urine culture order appropriateness, dysuria, frequency, or meeting 2 or more SIRS criteria—was significantly associated with culture-associated antimicrobial use, with an odds ratio of 22.1 (95% confidence interval, 11.7–41.6).

DISCUSSION

In this prospective study of all urine cultures obtained in a Veterans Affairs medical center, we found that although few patients had classic UTI symptoms of dysuria and frequency, most had some clinical manifestation that conceivably could result from UTI. However, many such manifestations are nonspecific, and in most subjects the treating providers knew or suspected that a potentially explanatory non-UTI condi-

tion was present and were managing it appropriately yet still obtained a urine culture.

Interestingly, clinical symptoms of UTI, culture appropriateness, and meeting 2 or more SIRS criteria were not significantly associated with urine culture–related antimicrobial use, whereas high-count growth in the culture was strongly associated with such use (odds ratio, 22). Since ASB is common,[1,4] this seeming reliance of providers on the culture to determine use or nonuse of antimicrobial therapy may result in unnecessary and potentially harmful antimicrobial use.

Strong evidence supports not obtaining urine cultures from asymptomatic patients;[1] conversely, in men with classic UTI symptoms, a culture should be obtained routinely[8] However, in our population, these clear-cut extremes were the exception; most patients had some clinical manifestation(s) consistent with possible infection but without genitourinary localization. Our findings are consistent with those of a similar study that found a low rate of UTI-specific symptoms but plentiful nonspecific clinical manifestations.[9] Taken together, these findings identify an area of uncertainty regarding the evaluation of hospitalized patients with possible infection, which warrants further investigation. With increasing bacterial resistance and decreasing antimicrobial development, improving antimicrobial use is imperative. Accordingly, identifying and reducing drivers of inappropriate use should be a health policy priority.

Study limitations include that it was a single-center study of inpatient, largely male veterans, which limits generalizability. Additionally, urinary catheter use was common, raising questions regarding culture accuracy and contamination. However, since providers are often unaware of patient's catheter status,[10] and the collection method is often unspecified, we doubt that this significantly influences the decision making regarding whether to diagnose and treat for UTI.

In summary, urine culture ordering was largely appropriate among hospitalized veterans but only according to a lenient definition that included multiple nonspecific symptoms and findings. Classic UTI symptoms were rare, possibly explaining the low rate of positive cultures. High-count growth was strongly predictive of subsequent antimicrobial therapy, suggesting that providers may place undue emphasis on quantitative urine culture results.

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