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Clinical Reviews

TOP TEN MYTHS REGARDING THE DIAGNOSIS AND TREATMENT OF URINARY TRACT INFECTIONS

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□ Abstract—Background: Urinary tract infections (UTI) are the most common type of infection in the United States. A Centers for Disease Control and Prevention report in March 2014 regarding antibiotic use in hospitals reported “UTI” treatment was avoidable at least 39% of the time. The accurate diagnosis and treatment of UTI plays an important role in cost-effective medical care and appropriate antimicrobial utilization. **Objective:** We summarize the most common misperceptions of UTI that result in extra-neous testing and excessive antimicrobial treatment. We present 10 myths associated with the diagnosis and treatment of UTI and succinctly review the literature pertaining to each myth. We explore the myths associated with pyuria, asymptomatic bacteriuria, candiduria, and the elderly and catheterized patients. We attempt to give guidance for clinicians facing these clinical scenarios. **Discussion:** From our ambulatory, emergency department, and hospital experiences, patients often have urine cultures ordered without an appropriate indication, or receive unnecessary antibiotic therapy due to over-interpretation of the urinalysis. **Conclusions:** Asymptomatic bacteriuria is common in all age groups and is frequently over-treated. A UTI diagnosis should be based on a combination of clinical symptoms with supportive laboratory information. This review will assist providers in navigating common pitfalls in the diagnosis of UTI. © 2016 Elsevier Inc.

□ Keywords—urinary tract infection; UTI; cystitis; urinalysis; treatment; diagnosis; stewardship; antimicrobial; asymptomatic bacteriuria

INTRODUCTION

Urinary tract infections (UTI) are the most common type of infection in the United States. Emergency medicine providers are frequently faced with making this common diagnosis. A Centers for Disease Control and Prevention (CDC) report in March 2014 regarding antibiotic use in hospitals reported “UTI” treatment was avoidable at least 39% of the time (1). How is it that something that seems so simple is so often misdiagnosed and treated in emergency departments (EDs)? The 10 myths outlined below address the common fallacies as they pertain to the diagnosis of UTI, and reveals the evidence behind the myth.

Myth 1: The Urine Is Cloudy and Smells Bad. My Patient Has a UTI

Truth 1: Urine color and clarity or odor should not be used alone to diagnose or start antibiotic therapy in any patient population.

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- a. Visual inspection of urine clarity is not helpful in diagnosing UTI in women (2). One hundred female patients at a university hospital had their urine tested by reading newsprint through the sample. The sensitivity, specificity, and positive and negative predictive values were 13.3%, 96.5%, 40.0%, and 86.3%, respectively.
- b. Foul-smelling urine is an unreliable indicator of infection in catheterized patients, and is usually dependent on patients' hydration status and concentration of urea in the urine (3,4).

Myth 2: The Urine Has Bacteria Present. My Patient Has a UTI. Also See Myth 8

Truth 2: The presence of bacteria in the urine on microscopic examination or by positive culture without UTI symptoms is NOT an indication of a UTI due to the possibility of contamination and asymptomatic bacteriuria (5).

- a. UTI is not a laboratory-defined diagnosis. Diagnosis should be based on clinical symptoms whenever possible, and confirmed by positive urine microscopy and culture.
- b. Quantitative colony counts should not be used to guide therapy in asymptomatic patients (6). In *symptomatic* females, colony counts of $>10^2$ cfu/mL are usually clinically meaningful. In *symptomatic* males, colony counts $>10^2$ cfu/mL are usually clinically relevant for diagnosis of UTI or prostatitis.

Myth 3: My Patient's Urine Sample Has >5 Squamous Epithelial Cells per Low-Power Field and the Culture is Positive. Because the Culture is Positive, I Can Disregard the Epithelial Cell Count and Treat the UTI

Truth 3: A good specimen has fewer than five epithelial cells per low-power field on urinalysis (7). Contaminated specimens should be considered for recollection or straight catheterization should be performed.

Myth 4: The Urine Has Positive Leukocyte Esterase. My Patient Should Have a Urine Culture Performed, Has a UTI, and Needs Antibiotics

Truth 4: A urinalysis with positive leukocyte esterase **should not be used alone** to support a diagnosis of UTI or start antimicrobial therapy in any patient population. Medical systems with reflex urine cultures for >5 white blood cells (WBC)/high-power field should be re-evaluated for their utility in the absence of patient symptoms (8–10).

- a. A dipstick leukocyte esterase test has high sensitivity and specificity for the presence of quantitative pyuria, 80–90% and 95–98%, respectively; **however**, a positive leukocyte esterase **alone** is NOT recommended for diagnosis of UTI (7,11). As in myth #2, symptoms are usually required for the diagnosis of UTI; pyuria or bacteriuria alone is not an indication for antimicrobial therapy and can result in an overtreatment rate of up to 47% (4,12).
- b. On rare occasions, a negative leukocyte esterase in the presence of UTI symptoms may still prompt a urine culture if clinically suspected (7,11). More appropriately, this situation should prompt a search for urethritis, vaginitis, or sexually transmitted infection.

Myth 5: My Patient Has Pyuria. They Must Have a UTI

Truth 5: A urinalysis with quantitative urine WBC counts **should not be used alone** to support a diagnosis of UTI or start antimicrobial therapy in any patient population.

- a. In *neutropenic or leukopenic patients*, the WBC count may be artificially low. In systems with reflex culture (the algorithm-based performance of culture based on laboratory values), reflex culturing may not occur. The microbiology laboratory should be contacted and a specific order for a urine culture made if **urinary symptoms are present** and urinary source of infection is suspected.
- b. Borderline WBC counts of 6–10 cells/mL may reflect the patient's state of hydration. For example, patients with *oliguria or anuria* (dialysis) usually have some degree of pyuria. If a UTI is defined solely by WBCs more than 3 per high-power field, then overtreatment can be as high as 44% (12). WBCs may also be seen in the presence of moderate hematuria.
- c. Noninfectious conditions, such as acute renal failure, sexually transmitted infections, or noninfectious cystitis from the presence of a bladder catheter may result in pyuria.

Myth 6: The Urine Has Nitrates Present. My Patient Has a UTI

Truth 6: Urine nitrates **should not be used alone** to diagnosis or start antimicrobial therapy in any patient population.

- a. Urine nitrate has a high true-positive rate for bacteriuria, but bacteriuria, as noted above in Myth 2, does not define a clinically significant UTI. Diagnosis of UTI should be considered in a patient with elevated urine nitrate in the presence of clinical signs and symptoms of UTI (5).

- b. A negative leukocyte esterase AND a negative urine nitrate largely rule out infection in pregnant women, elderly patients, family medicine, and urology patients (13). Alternative diagnosis should be thoroughly investigated in this scenario. The combination of a negative leukocyte esterase and negative nitrite test demonstrated a UTI negative predictive value of 88% (95% confidence interval [CI] 84–92%) (13).
- c. Even if both leukocyte esterase AND nitrite analyses are positive, the sensitivity for bacteriuria was only 48% (95% CI 41–55%), and specificity was 93% (95% CI 90–95%) among elderly nursing home residents, indicating the need to correlate with clinical symptoms that suggest a UTI (see Myth 2) (14).

Myth 7: All Findings of Bacteria in a Catheterized Urine Sample Should Be Diagnosed as a UTI

Truth 7: Virtually 100% of patients with an indwelling Foley catheter are colonized within 2 weeks of placement with 2–5 organisms (15). Catheter colony counts define bacteriuria but must be taken in a clinical context for diagnosis of UTI.

- a. Ninety-eight percent of chronically catheterized patients had bacteriuria and 77% were polymicrobial. The mean interval between episodes of bacteriuria with new organisms was 1.8 weeks (16).
- b. Bacteriuria and pyuria in chronically **catheterized** patients should **be treated only in the presence of signs and symptoms of infection** when assessable (e.g., fever, leukocytosis, suprapubic pain, and tenderness. Dysuria is obviously not assessable). Pyuria or bacteriuria *alone* is not an indication for antimicrobial therapy.
- c. Although antibiotics may delay the onset of bacteriuria in catheterized patients, this strategy ultimately selects for resistant microorganisms (17). Prophylactic anti-infectives are not recommended for patients with chronic catheters, but may be considered for short-term (usually no more than 2 weeks) use by urology specialists to delay the onset of bacteriuria in selected cases where benefits of prophylaxis may outweigh the risk.

Myth 8: Patients with Bacteriuria Will Progress to a UTI and Should Therefore Be Treated

Truth 8: Bacteriuria does NOT establish a diagnosis of a UTI. Antimicrobial therapy should not be initiated in asymptomatic patients.

- a. The prevalence of bacteriuria in elderly institutionalized patients without indwelling catheters varies from 25–50% for women and 15–49% for men, and increases with age (18). Bacteriuria and pyuria in the elderly is, to a large degree, an expected finding.
- b. Symptomatic UTI is substantially less common than asymptomatic bacteriuria (19).
- c. Asymptomatic bacteriuria has not been associated with long-term negative outcomes such as pyelonephritis, sepsis, renal failure, or hypertension (19).
- d. The overuse of antibiotics leads to antibiotic resistance and potential side effects (20).
- e. Pyuria, leukocyte esterase, or nitrate, individually, accompanying asymptomatic bacteriuria are NOT necessarily an indication for antimicrobial treatment in the general population (3). Some exceptions include: pregnancy and any urologic procedure with bleeding, such as urinary tract stenting (21,22).
- f. Recent evidence suggests that in younger women with true recurrent UTI, that bacteriuria may be “protective” for future UTI with more pathogenic organisms (23).

Myth 9: Falls and Acute Altered Mental Status Changes in the Elderly Patient Are Usually Caused by UTI

Truth 9: Altered mental status and falls in the elderly are caused by many factors. Evidence of systemic infection (fever, leukocytosis) or other signs and symptoms of UTI, especially dysuria (when able to assess), should be present to make the diagnosis of UTI in noncatheterized patients. Symptoms of active infection in a catheterized patient are obviously more difficult to assess (24).

- a. Elderly patients with acute mental status changes accompanied by bacteriuria and pyuria, *without clinical instability* or other signs or symptoms of UTI, can reasonably be observed for resolution of confusion for 24–48 h without antibiotics, while searching for other causes of confusion (25,26).
 - 1. In all elderly patients, acute mental status change and functional decline are nonspecific clinical manifestations of several circumstances, including, but not limited to dehydration, hypoxia, and poly-pharmacy adverse reactions. Diagnosis of UTI should be correlated with others signs of systemic inflammation.
- b. In the noncatheterized patient, acute changes in mental status was associated with bacteriuria plus pyuria in patients with clinically suspected UTI (27). However, these two findings are also frequently demonstrated in elderly patients with asymptomatic bacteriuria. Attribution of altered

mental status to bacteriuria can result in failure to identify the true cause (24,25).

- c. Falls without localizing urinary symptoms were not associated with bacteriuria or pyuria (28,29).
- d. Elderly patients, especially those with dementia or indwelling Foley catheters, have high rates of bacteriuria (18). Diagnosis of infection/sepsis of a urinary source with asymptomatic bacteriuria is not recommended unless other infectious sources have been excluded and patients meet urine criteria suspicious for infection. Diagnosis of UTI in the catheterized patient should always be a diagnosis of exclusion by investigating other causes for altered mental status in the absence of localized urinary tract findings (6).

Myth 10: The Presence of Yeast or Candida in the Urine, Especially in Patients with Indwelling Urinary Catheters, Indicates a Candida UTI and Needs to Be Treated

Truth 10: The occurrence of candiduria in the catheterized patient is common, especially in the intensive care unit, and most often reflects colonization or asymptomatic infection (30). Treatment of candida in the urine should occur only in rare situations, such as clear signs and symptoms of infection and no alternative source of infection.

- a. Treatment of asymptomatic candiduria in nonneutropenic catheterized patients has usually not been shown to be valuable (30).
- b. “Treatment” of candiduria should first include replacement/removal of urinary tract instruments (30).
- c. Except in selected highest-risk transplant recipients, or immunocompromised hosts receiving steroids, or clinical scenarios for patients at high risk of systemic candidiasis, candiduria has a low incidence of systemic complications, and conservative observation is usually indicated (30).
- d. Isolation of candida in the urine of noncatheterized patients should raise concerns about vaginal or external contamination. If a reliable specimen is repeatedly obtained with yeast, and the patient is symptomatic, consideration of antifungal therapy may be warranted (30).

DISCUSSION

The UTI Myths

Health care providers have, over the years, adhered to dogma surrounding the diagnosis of UTI that is incorrect. This information has been perpetuated, and has caused

significant overtreatment of asymptomatic bacteriuria. Common misconceptions such as color or smell have no predictive value as it pertains to the diagnosis of UTI, but are commonly utilized as “tests” to increase the posttest probability that a patient has a UTI. There also exists wide variation in the interpretation of a urinalysis between different providers. Our review demonstrates how no one test value can reliably make the diagnosis of UTI. Especially common in emergency medicine is using the diagnosis of UTI to account for an elderly patient’s altered mental status. Not only is this uncommon, but this type of anchoring hinders the clinician from diagnosing the real cause of the patient’s altered mental status.

Overtreatment of Asymptomatic Bacteriuria

Frequent overdiagnosis of UTI and subsequent treatment is a common problem that is perpetuated by many myths surrounding the diagnosis of UTI. This leads to unknowingly using antibiotics that have no benefit, but do carry risks. The CDC reports that nearly 40% of all antibiotics prescribed for presumed UTI could have been avoided (1). Unfortunately, the practice of overprescribing antibiotics has generated antibiotic resistance among organisms that continue to challenge our health care systems and harm patients (31). In addition, inappropriate antibiotic utilization increases health care costs. The National Health Expenditure Accounts Team estimates that in 2014 the United States spent \$9523 per person, or 17.5% of our gross domestic product, on health care (32).

Recommendations for Improved Accuracy when Diagnosing UTI

EDs that have implemented reflexive urine cultures based on urinalysis values should carefully evaluate whether this practice increases their treatment rate of asymptomatic bacteriuria. We believe increased education aimed at physicians, advanced practice providers, and nurses could go a long way toward disproving the common myths that frequently guide providers to make the wrong decision. There is also a role for clinical decision support built into our electronic medical records that could provide real-time assistance to providers such that it is easier to use evidence-based guidelines, and as a result, improved accuracy of the diagnosis of UTI could be ensured.

CONCLUSIONS

Emergency medicine providers frequently evaluate patients for urinary tract infections. There are many myths that have been perpetuated on the interpretation of patient

symptoms and laboratory results that lead to overtreatment of asymptomatic bacteriuria. By using clinical history and laboratory data in addition to understanding the evidence behind these common myths, emergency medicine providers will be better able to make an accurate diagnosis. This will result in increased patient safety and decreased health care costs.

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ARTICLE SUMMARY

1. Why is this topic important?

The over-interpretation of the urinalysis and urine culture often leads to the treatment of asymptomatic bacteriuria. This misuse of antibiotics has been identified by the Centers for Disease Control and Prevention as a target for improving antibiotic use in the hospital setting. A recent study performed at two Veterans Hospitals demonstrated a significant decrease in treatment of asymptomatic bacteriuria after using a diagnostic algorithm as an intervention.

2. What does this review attempt to show?

We have summarized common misconceptions of urinary tract infections facing the practitioner. By better understanding the literature surrounding the common misconceptions and associated truths behind urinary tract infections we hope practitioners will be better prepared to accurately diagnose and treat patients presenting with urinary tract infections.

3. What are the key findings?

Providers should be aware that no one laboratory or clinical finding can accurately make the diagnosis of a urinary tract infection. In addition, laboratory studies are difficult to interpret in those patients with indwelling catheters. Also, elderly patients with falls or altered mental status rarely have a urinary tract infection as the etiology of their presenting symptoms.

4. How is patient care impacted?

Correction of these myths in clinical practice may lead to reduced antibiotic prescriptions without detrimental effects on patient care. In addition, this will facilitate improved antibiotic stewardship in this commonly encountered clinical situation.