COLLEGE of AMERICAN PATHOLOGISTS

Laboratory Testing for Urinary Tract Infection and Asymptomatic Bacteriuria

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SYNOPSIS AND RELEVANCE

There are a variety of clinical scenarios where testing may be indicated to diagnose a urinary tract infection (UTI) or asymptomatic bacteriuria (ASB). Utilizing the appropriate test(s) on the appropriate patient can:

1. Facilitate prompt, appropriate treatment to prevent complications and relieve symptoms.
2. Avoid unnecessary antibiotic therapy to protect patients from side effects and minimize the emergence of antimicrobial resistant strains.
3. Advance diagnostic stewardship.
4. Minimize catheter-associated UTI (CAUTI) rates.

OBJECTIVES

1. Distinguish UTI from asymptomatic bacteriuria.
2. Facilitate appropriate utilization of laboratory testing for UTIs and asymptomatic bacteriuria.
3. Promote preanalytic practices that optimize test results and patient care.

BACKGROUND

Urinary tract infections (UTIs) account for a large portion of antibiotic use in humans that contributes to the emergence and spread of multi-drug resistant organisms.[1] Types of UTI include cystitis (confined to the bladder) and pyelonephritis (extension to the upper urinary tract).[2] Clinical features of cystitis include pyuria, dysuria, frequency, urgency, and suprapubic pain. Patients with pyelonephritis typically present with fever, chills, flank pain, and costovertebral angle tenderness. To regulate drug development and labeling, the FDA makes a distinction between uncomplicated and complicated UTIs. Uncomplicated UTI is acute cystitis in a female with normal anatomy lacking systemic signs attributed to pyelonephritis.[3] Complicated UTI is defined as signs or symptoms of pyelonephritis or systemic infection or UTI in a patient with an anatomic or neurologic abnormality of the urinary tract (eg, indwelling urinary catheter, obstruction, renal failure) or significant immunocompromise that increases the likelihood of treatment failure or a serious outcome.[1,2,4] Despite limitations (slow turnaround time, low specificity, bias toward common uropathogens), culture remains the gold standard test for UTI and one of the highest volume tests performed in microbiology laboratories.[1]

Asymptomatic bacteriuria (ASB) is defined as the recovery of ≥100,000 colony-forming units (CFU)/ml bacteria from a urine culture performed on a patient lacking signs and symptoms of UTI.[5] Screening for ASB is only recommended during pregnancy and prior to an endoscopic urologic procedure associated with mucosal disruption. Antimicrobial treatment of ASB in pregnancy, reduces the risk of pyelonephritis, preterm labor, and low birth weight. Lithotripsy and transurethral surgery of the prostate are examples of invasive urologic procedures for which preoperative ASB screening and treatment can prevent post-surgical infectious complications.

One of the most common infections that can be acquired during hospitalization is UTI and the major risk factor is presence of an indwelling urinary catheter.[6] Catheter-associated urinary tract infections (CAUTIs) are a mandated quality measure reported to the National Healthcare Safety Network and defined by at least one UTI symptom and ≥100,000 CFU/ml of a uropathogen from a urine culture.[7] Preventing CAUTI has been a high priority for healthcare institutions for the past decade to reduce potential complications and associated healthcare costs. Key principles to prevent CAUTIs include 1) avoid unnecessary catheter placement, 2) ensure catheter placement is performed using sterile technique, and 3) frequent reassessment of continued need for catheter with prompt removal.[8,9]

Culturing urine for bacteria is useful in the diagnosis and treatment of UTI and ASB. Urine within the bladder is normally a sterile body fluid. However, resident microbiota from the perineum, urethra, and vagina often contaminate urine specimens. Quantitation of bacteria in urine cultures helps the laboratory to distinguish contaminated specimens from those representing infection, but a key preanalytic principle is for clinicians to only order culture on patients who should be screened for ASB or have signs and symptoms of UTI. Female outpatients presenting with classic symptoms of uncomplicated cystitis usually do not need laboratory testing unless there are risk factors for antimicrobial resistance.[2] When urine culture is indicated, attention to preanalytical aspects (sample collection, use of a preservative or refrigeration, prompt processing) is of utmost importance. Cleansing prior to collection of "midstream" urine is recommended even though evidence to support this practice is lacking.[10] Accurate quantitation of growth is fostered by placement of urine specimens in boric acid preservative or refrigeration within 30 minutes of collection.[11] A primary advantage of refrigeration is the lack of interference with other assays that may be ordered on urine. Delayed processing of samples held at room temperature has been associated with increases in culture colony counts of 10% after 4 hours and >135% after 24 hours.[10] Increased transit time due to consolidation of laboratory services led many large healthcare systems to require boric acid preservative of urine submitted for culture since continual refrigeration and processing within 24 hours after collection can be difficult to achieve. Use of boric acid preservative as an alternative to refrigeration extends the time allowed between collection and processing for culture to 48 hours.

The quantitative threshold applied by clinical microbiology laboratories for susceptibility testing of potential uropathogens is usually 100,000 CFU/ml in a midstream voided specimen. However, lower quantities of 1000 CFU/ml may represent infection. The most common uropathogens are resident intestinal microbiota organisms (*Escherichia coli*, *Klebsiella* spp. *Enterobacte*r spp., *Proteus* spp. and *Enterococcus* spp.). The level of work up (identification and susceptibility testing) performed on a urine culture is based on the type of specimen (invasive collection or voided), the number of different organisms growing, and the quantity of potential uropathogens in relation to usual skin/urogenital microbiota.[11]

Some healthcare systems offer clinicians the option of ordering a reflex testing algorithm that begins with urinalysis (UA); urine culture is performed only if certain criteria are met. Experts agree that urine leukocyte count of 10 per high power field is an appropriate threshold for UA reflex to culture if the algorithm test is ordered (experts disagree regarding the utility of leukocyte esterase or nitrate as the threshold for reflex to culture).[12] Most patients with UTI will have a positive UA, but the sensitivity of pyuria for UTI is lower if the etiology is enterococci or yeast. Since pyuria cannot distinguish ASB from UTI, clinical signs and symptoms (rather than UA) should be the basis of whether a urine culture is ordered.[12] Ordering a reflex urine culture for a patient lacking UTI symptoms often leads to unnecessary antimicrobial therapy.[13] Clinical decision support tools for UTI to guide urine culture ordering are being implemented in many institutions to optimize antimicrobial stewardship and minimize CAUTI rates.

INSIGHTS

1. Female patients presenting with symptoms of acute simple cystitis do not require laboratory testing .
2. Urine culture is indicated for patients who meet clinical criteria for a complicated UTI.
3. Urine culture to screen for ASB is indicated during pregnancy and prior to an endoscopic urologic procedure associated with mucosal disruption.
4. Transferring urine specimens to a boric acid preservative tube is a best practice that ensures accurate quantitation of bacteria recovered in culture since the acceptable alternative (continual refrigeration from 30 min of collection to time of processing) is difficult to achieve.

INTERVENTIONS

It is important to assess current practice, explore the root cause of perceived problems and consider the potential impact of change when planning an intervention. Establish a relationship with clinicians in your institution who order urine cultures to assess their satisfaction with the service the laboratory is providing as well as their understanding of optimal preanalytic practices. Cultures impact quality measures that Infection Prevention and Antimicrobial Stewardship teams work to improve so participation on their committees by the Microbiology laboratory director is highly recommended. Establish laboratory quality metrics that will advance the goals established by key institutional committees. Partnering with a clinician to improve quality will help ensure interventions are appropriate and successful.

1. Work collaboratively with clinical practice and infection prevention teams to optimize clinical decision support guiding when urine cultures are ordered.
2. Optimize preanalytic practices to minimize overgrowth of bacteria in urine specimens held at room temperature prior to processing. Encouraging transfer of specimens to boric acid preservative tubes at time of collection is a best practice to ensure the accuracy of urine culture results.
3. Laboratory protocols for reporting growth and performing susceptibility testing should be based on method of collection (invasive vs. noninvasive) and quantity of different organisms recovered. Three or more different morphologies from noninvasive specimens without a predominant uropathogen may be reported as "Mixed growth suggesting contamination during collection. Recollect if clinically indicated."

INTERVENTION ANALYSIS

To optimize the preanalytic phase of urine cultures, monitor the number of urine cultures received in preservative. Share the values with nurse leadership on a monthly or quarterly cycle so that areas with the lowest rates of preservative use can be challenged to improve (see **Appendix A**).

Monitor CAUTI rates before and after interventions that promote diagnostic stewardship practices for urine cultures. This may be done by asking licensed caregivers questions during electronic order entry that help determine if a urine culture is indicated for that patient by applying clinical criteria for ASB screening or suspected complicated UTI. Tracking the rate caregivers follow best practice recommendations for urine culture orders is another metric that could be monitored (see **Appendix B**).

APPENDICES

APPENDIX A: URINE CULTURE SPECIMENS RECEIVED IN PRESERVATIVE

Description	Number of Specimens Before Interventions	Number of Specimens After Interventions	% Change
Urine culture specimens received in preservative	A1	A2	A2 – A1/A1 x 100% = A3%

APPENDIX B: INFECTION CONTROL OUTCOMES

When B3 is negative, there is a decrease in the number of patients with catheter-associated UTIs (CAUTI).

Description	Number of Patients Before Interventions	Number of Patients After Interventions	% Change
Patients with CAUTI reported to National Healthcare Safety Network	B1	B2	B2 – B1/B1 x 100% = B3%

QUESTIONS AND ANSWERS

QUESTION 1 OBJECTIVE

Distinguish UTI from asymptomatic bacteriuria.

QUESTION 1

Which of the following can distinguish UTI from asymptomatic bacteriuria?

A. Leukocyte esterase
B. Suprapubic pain
C. Urine odor
D. UA with >10 WBC
E. Urine culture results

The correct answer is B; A-D are incorrect. Only patient symptoms distinguish between UTI and ASB.

REFERENCE

Nicolle LE, Gupta K, Bradley SF, et al. Clinical Practice Guideline for the Management of Asymptomatic Bacteriuria: 2019 Update by the Infectious Diseases Society of America. *Clin Infect Dis*. 2019;68(10):e83-e110. doi:10.1093/cid/ciy1121

QUESTION 2 OBJECTIVE

Facilitate appropriate utilization of laboratory testing for UTIs and asymptomatic bacteriuria.

QUESTION 2

Which of the following would justify a urine culture order for a patient with an indwelling catheter?

A. Change in urine color
B. Altered mental status
C. Presence of sediment in urine
D. Odd urine odor
E. Costovertebral angle tenderness

The correct answer is E; A-D are incorrect. Among the options listed, only costovertebral angle tenderness would justify ordering a urine culture for a patient with an indwelling catheter.

REFERENCE

Claeys KC, Trautner BW, Leekha S, et al. Optimal Urine Culture Diagnostic Stewardship Practice-Results from an Expert Modified-Delphi Procedure. *Clin Infect Dis*. 2022;75(3):382-389. doi:10.1093/cid/ciab987

QUESTION 3 OBJECTIVE

Promote preanalytic practices that optimize test results and patient care.

QUESTION 3

What is the most important preanalytical factor for reducing false positive urine culture results?

A. Adequate volume
B. Time of collection
C. Time at room temperature
D. Cleansing before collection

The correct answer is C. Prolonged time at room temperature before processing increases bacteria colony counts that can change interpretation of the culture.
A is incorrect. A small amount of urine (<0.5 ml) is required for culture.
B is incorrect. A urine specimen may be collected any time of day.
D is incorrect. Although common practice, evidence for cleansing is lacking.

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