Culture of Urine Specimens

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Objectives

- List the culture media and incubation conditions used for urine specimens.
- Discuss which organisms are considered to be pathogens vs. contaminants or normal flora in urine and how colony count and type of specimen affect this decision.
- Discuss when susceptibility testing should be performed on a urine specimen isolate.

Anatomy

Front View of Urinary Tract

www.health.uab.edu/hospital

Normal flora

- Staphylococcus, coagulase negative (excluding S. saprophyticus)
- Streptococcus viridans group
- Lactobacillus spp.
- Corynebacterium spp.
- Neisseria spp. Other than gonorrhoeae or meningitidis
- Peptostreptococcus spp.
- Propionibacterium spp.
- Commensal Mycobacterium spp.
- Commensal Mycoplasma spp.

Pathogens

- Community acquired
  - E. coli (uropathogenic)
  - Klebsiella pneumoniae
  - Staphylococcus saprophyticus
  - Complicated or recurrent infections
    - Proteus mirabilis
    - Pseudomonas aeruginosa
    - Klebsiella spp. and Enterobacter spp.
- Hospital acquired
  - E. coli, Klebsiella, Proteus, Pseudomonas, Enterococcus, Candida

Pathogenesis

- Ascending
- Descending
- Virulence factors
  - Type 1 fimbriae
  - Capsules
  - Type P fimbriae
- Risk factors
  - Mechanical obstruction
  - Neurologic abnormality
  - Vesico ureteral reflux
Clinical Syndromes

• Urethritis
• Asymptomatic Bacteriuria
• Cystitis
• Acute Urethral Syndrome
• Pyelonephritis

Specimen Collection and transport

• Clean Catch
• Straight Catheter
• Indwelling Catheter
• Cystoscopic Specimens

Transport Devices

• Deliver to the laboratory within 2 hours of collection
• Refrigerate for up to 24 hours
• If specimens are delayed in transport and refrigeration is not possible, use transport tubes with preservatives

Direct examination

• Microscopic
  - Gram stain
    - Easy, inexpensive
    - 1 bacteria/100 of an unspun urine correlates with > 10^5 CFU/ml and 1 leukocyte/100 correlates with pyuria
    - Sensitivity 96%, Specificity 91%
    - Disadvantage
      - Unable to detect lower colony counts
      - Not reliable for the detection of PMN
      - Labor intensive
  - Pyuria
    - 8 PMN/mm^3 correlates with excretion of 400,000 PMN into the urine per hour which correlates with infection
    - Disadvantage
      - Urine microscopic examination of spun urine does not correlate well with the PMN excretion rate or the presence of infection
      - Pyuria can also be associated with vaginitis; thus is not specific for infection

Urine Screens - Chemical Methods

• LE/Nitrate Test Strips
• Uriscreen

Urine Screens - Automated Methods

• Video system examines images of uncentrifuged urine specimens. Capable of identifying many cellular structures including leukocytes and bacteriuria
  - IRIS
  - Sysmex UF-100
• Computerized fluorescent microscopic imaging technology used to analyze fluorescent probes which stain a monolayer of urine on a membrane
  - Cellenium -16US
• Release ATP from somatic cells then liberate and detect bacterial ATP.
  - Coral UTI Screen System
    - Sensitivity 86%, Specificity 75%
Media Inoculation

- 5% sheep blood agar
- MacConkey/EMB agar
- CNA or PEA agar
- CLED (cystine lactose electrolyte deficient) agar
- Chromogenic media

Culture Quantitation

- Surface Streak
  - Disposable loop
  - Calibrated loop
  - Automated system
- Pour plate

Urine Screens - Culture Kits

- Simple to use, relatively inexpensive
- Useful when transport can be a problem
- Require overnight incubation

Automated plating instruments
Specimen Workup - Clean Catch

<table>
<thead>
<tr>
<th>Number of Isolates</th>
<th>Colony Count</th>
<th>Additional Criteria</th>
<th>Identification</th>
<th>Susceptibility</th>
</tr>
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<tbody>
<tr>
<td>1</td>
<td>&gt; 10&lt;sup&gt;3&lt;/sup&gt;</td>
<td>Definitive AST</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>10&lt;sup&gt;2&lt;/sup&gt; - 10&lt;sup&gt;3&lt;/sup&gt;</td>
<td>Symptomatic female, Male with prostate infection</td>
<td>Definitive ID</td>
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<td></td>
<td>10&lt;sup&gt;1&lt;/sup&gt; - 10&lt;sup&gt;2&lt;/sup&gt;</td>
<td>WBC (LE) present</td>
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WBC (LE) presence: WBC (Leukocyte) in the specimen.

FAQs

- How long should cultures be incubated?
  - A minimum incubation of 18 hours is sufficient unless the specimen was collected by an invasive technique (straight cath).
  - The patient is immunocompromised.

- What is the significance of S. pneumoniae in the urine?
  - It is usually an incidental finding in both children and adults.

- Should the culture workup be modified for geriatric patients?
  - Mixed cultures or > 3 uropathogens should be worked up only if the patient is symptomatic or febrile and properly collected.

- Are anaerobic cultures appropriate?
  - Not a significant cause of urinary tract infections.

Specimen Workup - Cath

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WBC (LE) presence: WBC (Leukocyte) in the specimen.

FAQs

- What is the significance of E. coli O157 in the urine?
  - Usually not representative of Shiga-toxin producing E. coli.

- What is the appropriate response to: “My patients are special. Workup everything that grows.”?

Specimen Workup - Cystoscopic

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<td></td>
<td></td>
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<tr>
<td></td>
<td>10&lt;sup&gt;1&lt;/sup&gt; - 10&lt;sup&gt;2&lt;/sup&gt;</td>
<td>One predominant organism</td>
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<tr>
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<td>Definitive AST</td>
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FAQs

- Extent of workup of organisms:
  - Staphylococcus: ID and AST of S. aureus, ID of S. saprophyticus for females of childbearing age, AST not necessary for S. saprophyticus or other coagulase negative Staph.
  - Yeast: ID of C. albicans or C. glabrata. Species identification of others only upon request.
  - Beta-hemolytic Streptococcus: ID, particularly women of child-bearing age for GBS.
  - Enterococcus: Check for VRE on inpatients. ID to species level and AST for VRE only and on request.
  - G. vaginalis: ID only if present in quantities 10 times greater than all other flora.
  - Aerococcus: ID only if present in quantities 10 times greater than all other flora.
  - Corynebacterium (urease positive): ID and AST if > 100,000 and greater than 10 times that of all other flora.

- What is the appropriate response to: “My patients are special. Workup everything that grows.”?
Contact Information

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