Healthcare-Associated Urinary Tract Infections

David A. Pegues, MD
Hospital of the University of Pennsylvania

Outline

• Diagnosis of UTI in non-catheterized patients
• Diagnosis of UTI in catheterized patients
• CAUTI prevention strategies
Epidemiology

- **UTI:**
  - Common healthcare-associated infection\(^1\)
  - 12.9% of HAIs; estimated 93,300 cases per year in US in 2011
  - ~70% attributable to an indwelling urethral catheter
- ~25% of hospital inpatients will have a urinary catheter during admission\(^1\)
  - Most have urinary catheters 2-4 days
- **Daily risk of acquisition of bacteriuria:**
  - 3% to 8% per day of urinary catheterization
  - ~100% at 30 days
  - Duration of catheterization = biggest risk factor


Asymptomatic Bacteriuria and Symptomatic UTI Criteria

**CA-ASB**
- CA-bacteruia (\(>10^5\) cfu/ml)
- The absence of symptoms
- Easy to determine in patient without catheters because symptoms are easier to ascertain

**SUTI**
- CA-bacteruia (\(>10^3\) cfu/ml)
- New fever or rashes with no other source
- New lethargy, malaise
- CVA tenderness, flank, pelvic discomfort
- Acute hematuria
- Usual UTI symptoms if the catheter has been removed in the past 48 hours

## Diagnosis of UTI in Non-Catheterized Patients

### Q1: How was the urine collected?
- Clean catch urine collected midstream
  - Many samples are not clean
- Ask about whether they used a drainage bag
- Ask if the urinary tract is normal

### Q2: Is the patient symptomatic?
- Most non-catheterized patients should be able to report dysuria, urgency, frequency, suprapubic pain

### Q3: What does the U/A show?
- **Dipstick**
  - Nitrites reflect the presence of Enterobacteriaceae
    - Convert urinary nitrate to nitrite
    - Lacks sensitivity of detection of other organisms
      - overall sensitivity, 30-54%
  - Leukocyte esterase indicates WBCs
    - >10 WBC/hpf; (sensitivity, 75-96%; specificity, 94--98 %)
- **Microscopic pyuria**
  - More sensitive than leukocyte esterase
  - Microscopic method: >5-10 WBC/hpf centrifuged urine
  - If no pyuria, positive cultures likely represent contamination
Diagnosis of UTI in Non-Catheterized Patients

• Q4: What does the culture show?
  – Positive culture: ≥10^5 cfu/mL
  – Lower colony counts may be significant in some cases:
    • Women with acute symptoms and pyuria (＞10^2 cfu/mL)
    • Suprapubic aspiration
    • Patient receiving antibiotics at the time of culture
    • Men
    • Organism other than E. coli or Proteus (e.g., Pseudomonas, Serratia, Enterobacter)

Pathogenesis of CAUTI

• Inoculum at insertion
• Ascension of fecal or skin flora
• Biofilm formation
• Incomplete bladder emptying
• Contamination of collecting system

Diagnosis of UTI in Catheterized Patients

• **Q1: How was the urine collected?**
  - Short-term catheterization
    • Sample from the catheter port using aseptic technique
  - Long-term catheterization (>2 weeks)
    • Replace catheter before collecting a specimen
      - Multiple organisms present in biofilm—not all causing infection
    - **Do not** sample from drainage bag


Diagnosis of UTI in Catheterized Patients

• **Q2: Is the patient symptomatic?**
  - Majority of catheterized patients with CA-bacteriuria lack symptoms referable to the urinary tract

• **Cohort study of 1497 newly catheterized patients:**
  - 224 patients with 235 episodes of CA-bacteriuria and >10³ cfu/mL; 85% with >10⁵ cfu/mL
  - 194 (86.7%) of patients were able to respond to daily questions about symptoms
    • 15 (7.7%) reported urethral or pelvic pain, urgency, dysuria
  - Examined subset of 1034 patients without another site of infection besides the urinary tract

Tambyah PA, Maki DG. Arch Intern Med 2000;160:678-82.
Symptoms in Patients with CA-Bacteriuria

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Without CAUTI (N=945)</th>
<th>With CAUTI (N=89)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pain</td>
<td>5.9%</td>
<td>4.8%</td>
<td>.81</td>
</tr>
<tr>
<td>Urgency</td>
<td>7.6%</td>
<td>6.0%</td>
<td>.68</td>
</tr>
<tr>
<td>Dysuria</td>
<td>8.0%</td>
<td>6.0%</td>
<td>.66</td>
</tr>
<tr>
<td>Temp &gt;38.5°C</td>
<td>19.8%</td>
<td>17.7%</td>
<td>.77</td>
</tr>
<tr>
<td>Highest temp, mean</td>
<td>38.1°C</td>
<td>37.8°C</td>
<td>&lt;.01</td>
</tr>
<tr>
<td>Peripheral WBC, mean</td>
<td>11.3 per mm³</td>
<td>10.7 per mm³</td>
<td>.14</td>
</tr>
<tr>
<td>Urine WBC, mean</td>
<td>11 per µL</td>
<td>309 per µL</td>
<td>.009</td>
</tr>
</tbody>
</table>

• Conclusion: For hospitalized patients with catheters, urinary tract symptoms, fever, and leukocytosis have low predictive value for diagnosis of UTI

Tambyah PA, Maki DG. Arch Intern Med 2000;160:678-82.

Diagnosis of UTI in Catheterized Patients

• Q3: What does the UA show?
  – Pyuria
    • Evidence of inflammation in the GU tract
    • Presence, absence or degree of pyuria does not differentiate CA-ASB from CAUTI
    • Absence of pyuria in a symptomatic patient suggests an alternative diagnosis

NOTE: no studies have demonstrated that odorous or cloudy urine in catheterized patients has clinical significance

Culturing Stewardship

When to obtain or not obtain a urine culture in a patient with an indwelling urinary catheter

<table>
<thead>
<tr>
<th>Discourage Urine Culture Use</th>
<th>Appropriate Urine Culture Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urine quality: color, smell, sediments, turbidity (do not constitute signs of infection)</td>
<td>Part of an evaluation of sepsis without a clear source (CAUTI is often a diagnosis by exclusion)</td>
</tr>
<tr>
<td>Screening urine cultures (whether on admission or before non-urologic surgeries) Based on local findings suggestive of CAUTI (example, pelvic discomfort or flank pain)</td>
<td></td>
</tr>
<tr>
<td>Standing orders for urinalysis or urine cultures without an appropriate indication</td>
<td>Prior to urologic surgeries where mucosal bleeding anticipated or transurethral resection of prostate</td>
</tr>
<tr>
<td>“PAN” culturing (mindfulness in evaluating source is key)</td>
<td>Early pregnancy (avoid urinary catheters if possible)</td>
</tr>
<tr>
<td>Obtaining urine cultures based on pyuria in an asymptomatic patient</td>
<td></td>
</tr>
<tr>
<td>Asymptomatic elderly and diabetics (high prevalence of asymptomatic bacteriuria)</td>
<td></td>
</tr>
<tr>
<td>Repeat urine culture to document clearing of bacteriuria (no clinical benefit to patients)</td>
<td></td>
</tr>
</tbody>
</table>

Fakih M, Improving the Culture of Culturing. https://s3.amazonaws.com/Content_Calls/14JFEB_PHRC_CultureofCulturing-1.pdf

Diagnosis of UTI in Catheterized Patients

- **Q4: What does the culture show?**
  - Spectrum from colonization to infection
  - \( \geq 10^5 \) cfu/mL is the more specific for CAUTI
  - \( \geq 10^3 \) cfu/mL is more sensitive for CAUTI
    - Recommended in 2009 IDSA Practice Guideline
    - If used, there should be strong suspicion of CAUTI based on symptoms
  - Do not perform urine culture on asymptomatic patients

## Duration of Treatment

- **Screening and treating CA-ASB are not beneficial:**
  - Does not reduce subsequent risk of CA-bacteriuria or CAUTI
  - Leads to selection of resistant uropathogens
  - Exceptions:
    - Pregnant
    - Before a urologic procedure with mucosal bleeding anticipated
    - Neutropenia
    - Post renal transplant
- **CAUTI:**
  - Uncomplicated: 7 days
    - 3 days if a woman is ≤ 65 yo with catheter removed
  - Upper tract disease or delayed response: 10-14 days


## Treatment of Candiduria

- **RCT, multicenter, double blind placebo-controlled trial:**
  - 316 patients; 56% catheterized
  - ≥10³ cfu/mL yeast on 2 consecutive specimens obtained >24 h apart
  - Asymptomatic or minimally symptomatic
  - Fluconazole 200 mg daily or placebo x 14 days; renal dose adjusted
  - Compared rates of mycological eradication at EOT and 2 wk f/u

<table>
<thead>
<tr>
<th>Group</th>
<th>Fluconazole</th>
<th>Placebo</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>All enrolled patients (N=316)</td>
<td>79/159 (50)</td>
<td>46/157 (29)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Patients completing 14 d of therapy (N=238)</td>
<td>75/118 (63)</td>
<td>42/120 (35)</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>2-week follow-up (N=173)</td>
<td>59/87 (68)</td>
<td>56/86 (65)</td>
<td>.7</td>
</tr>
</tbody>
</table>

- **IDSA Guideline:** Therapy not usually indicated, unless patients are at high risk (e.g., neonates and neutropenic adults) or undergoing urologic procedures (AIII)

“Lifecycle” of the Urinary Catheter

1. Prevent Unnecessary and Improper Placement
2. Maintain Awareness and Proper Care of Catheters in Place
3. Prompt Catheter Removal
4. Prevent Catheter Replacement


Appropriate Indications for Indwelling Urinary Catheter Use

<table>
<thead>
<tr>
<th>Appropriate Indications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patient has acute urinary retention or obstruction</td>
</tr>
<tr>
<td>Need for accurate measurements of urinary output in critically ill patients.</td>
</tr>
<tr>
<td>Perioperative use for selected procedures:</td>
</tr>
<tr>
<td>• urologic surgery or other surgery on contiguous structures of genitourinary tract,</td>
</tr>
<tr>
<td>• anticipated prolonged surgery duration (removed in post-anesthesia unit),</td>
</tr>
<tr>
<td>• anticipated to receive large-volume infusions or diuretics in surgery,</td>
</tr>
<tr>
<td>• operative patients with urinary incontinence,</td>
</tr>
<tr>
<td>• need to intraoperative monitoring of urinary output.</td>
</tr>
<tr>
<td>To assist in healing of open sacral or perineal wounds in incontinent patients.</td>
</tr>
<tr>
<td>Requires prolonged immobilization (e.g., potentially unstable thoracic or lumbar spine)</td>
</tr>
<tr>
<td>To improve comfort for end of life care if needed.</td>
</tr>
</tbody>
</table>

Inappropriate Indications for Indwelling Urinary Catheter Use

<table>
<thead>
<tr>
<th>Inappropriate Indications</th>
</tr>
</thead>
<tbody>
<tr>
<td>As a substitute for nursing care of the patient or resident with incontinence</td>
</tr>
<tr>
<td>As a means of obtaining urine for culture or other diagnostic tests when the patient can voluntarily void</td>
</tr>
<tr>
<td>For prolonged postoperative duration without appropriate indications (e.g., structural repair of urethra or contiguous structures, prolonged effect of epidural anaesthesia, etc.)</td>
</tr>
<tr>
<td>Routinely for patients receiving epidural anesthesia/analgesia.</td>
</tr>
</tbody>
</table>

But what about the other well-intended reasons using urinary catheters?


Other Reasons and Risk of Urinary Catheters

- Other Reasons
  - Urine output monitoring outside the ICU
  - Incontinence without skin breakdown/decubitus
  - Prolonged post-operative use beyond 24 hours
  - Transfer from ICU to floor
  - Morbid obesity or immobility
  - Confusion or dementia
  - Patient request
- Other Risks
  - Secondary bacteremia, sepsis, metastatic infection
  - “One-point restraint” = decreased mobility
    - DVT/PE, pressure ulcers
    - Fall risk by tripping over catheter
    - Deconditioning
  - Patient discomfort, need to retrain bladder

Perceived Short term benefits

Real cumulative risks:
  - LOS
  - Cost
  - Mortality
Downstream Effects of Urinary Catheters

Prevention Strategies

- Sterile insertion and appropriate maintenance practices
- Alternative methods of catheterization
  - intermittent catheterization, condom catheter, suprapubic catheters
- Alternatives to catheterization
  - commode chair, urinal/bedpan, daily weights
- Other interventions
  - Coated catheters, antimicrobial agents, bacterial interference

Intermittent Catheterization

- **Primary use**
  - Standard method of determining PVR urine volumes
  - Combine with use of bladder scanner

- **Target population**
  - Chronic urinary retention—obstruction and neurogenic bladder
  - Acute urinary retention—following IUC removal

- **Vs. indwelling catheter**
  - Reduced risk of SUTI and pyelonephritis
  - Increased risk of urinary retention

- **Disadvantages**
  - Urethral trauma and stricture
  - Discomfort, especially with BPH (men) and atrophic urethritis (women)


Condom Catheters

- **Design:** Prospective, randomized, unblinded, controlled trial of 75 VAMC patients
  - condom catheter (34) vs. indwelling catheter (41)

- **Methods:** Outcome—cumulative risk of bacteriuria, symptomatic UTI, or death
  - Patient satisfaction

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Condom (N=34)</th>
<th>Indwelling Catheter (N=41)</th>
<th>Adjusted Hazard</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>N (%)</td>
<td>15 (44.1)</td>
<td>20 (48.8)</td>
<td>2.11</td>
<td>0.04</td>
</tr>
<tr>
<td>Time to outcome, median</td>
<td>11 days</td>
<td>7 days</td>
<td></td>
<td>0.09</td>
</tr>
<tr>
<td>Incidence, 1000 patient-days</td>
<td>70</td>
<td>131</td>
<td></td>
<td>0.07</td>
</tr>
<tr>
<td>Comfortable, %</td>
<td>89.5</td>
<td>57.6</td>
<td></td>
<td>0.02</td>
</tr>
<tr>
<td>Painful, %</td>
<td>5.0</td>
<td>36.4</td>
<td></td>
<td>0.02</td>
</tr>
</tbody>
</table>

Antimicrobial Catheters for Reducing CAUTIs

- **Methods:**
  - Unblinded, randomized clinical trial; 24 UK hospitals
  - 7102 patients requiring short-term urinary catheterization
  - Randomized 1:1:1 to receive silver alloy-latex vs. nitrofural-silicone vs. standard urinary catheter

- **Results:**

<table>
<thead>
<tr>
<th>Catheter</th>
<th>SUTI Rate by 6 wks</th>
<th>AOR (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Silver alloy</td>
<td>263/2097 (12.5%)</td>
<td>0.99 (0.81-1.22)</td>
</tr>
<tr>
<td>Nitrofural</td>
<td>228/2153 (10.6%)</td>
<td>0.81 (0.65-1.01)</td>
</tr>
<tr>
<td>Standard</td>
<td>271/2144 (12.6%)</td>
<td>reference</td>
</tr>
</tbody>
</table>

- **Conclusion:**
  - Routine use of antimicrobial-impregnated catheters was ineffective in reducing symptomatic UTI rates


Other Prevention Approaches

<table>
<thead>
<tr>
<th>Approach</th>
<th>Recommendation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Antimicrobial irrigation or placement in drainage bag</td>
<td>Not recommended</td>
</tr>
<tr>
<td>Prophylactic antimicrobials at catheter removal</td>
<td>Not recommended</td>
</tr>
<tr>
<td>Prophylactic antibiotics during catheterization</td>
<td>Not recommended due to concerns for emergence of resistant pathogens</td>
</tr>
<tr>
<td>Cranberry juice</td>
<td>Not recommended routinely</td>
</tr>
<tr>
<td>Methenamine salts</td>
<td>May be useful in patients s/p surgery catheterized for ≤7 days</td>
</tr>
</tbody>
</table>

2. Maintain Awareness of Catheters in Place

<table>
<thead>
<tr>
<th>Category</th>
<th>% Unaware of urinary catheter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medical Students</td>
<td>21%</td>
</tr>
<tr>
<td>Interns</td>
<td>22%</td>
</tr>
<tr>
<td>Residents</td>
<td>27%</td>
</tr>
<tr>
<td>Attending Physician</td>
<td>38%</td>
</tr>
</tbody>
</table>

- **Options:**
  - Daily care checklists
  - Routine reminders of catheter presence to physicians/nurses
  - Stop orders
  - Nurse-driven removal protocol


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Conclusions: What Can You Do?

- **Establish the diagnosis of healthcare-associated UTI before starting treatment:**
  - Urine culture with significant growth
  - Symptoms to support diagnosis without other source
  - Examine the urinalysis
  - Do not treat ASB

- **Interrupt the “lifecycle” of the urinary catheter:**
  1. Prevent unnecessary and improper catheter placement
  2. Maintain awareness and proper care of catheters in place
  3. Prompt catheter removal
  4. Prevent catheter replacement