Infections in the ICU

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DISCLOSURES

Off-Label Usage
- Many

Financial Relationships with Relevant Commercial Interests
- None

Infections in ICU

Major Problems (Easier to Test)
- Problems that lead to ICU admission
  - Sepsis, pneumonia, meningitis ....
- Problems that develop in ICU
  - Intravascular catheters
  - Urinary Catheters
  - Ventilator Association Pneumonia

Major Infection Control Interventions (Difficult to Test)
- Antibiotic utilization control
- Infection prevention
- Active surveillance of nares, rectum, skin....
- Hand hygiene
- Targeted interventions
  - Intravascular catheters, urinary catheters, ventilators
  - Impregnated catheters, endotracheal tubes
- General decolonization
  - Chlorhexidine baths
- Targeted decolonization
  - MSSA and MRSA: Mupirocin/Chlorhexidine

The ID Consultant and the ICU

What Could Be on the Board Exam
- Foley Catheters
- Hyperthermia Syndromes
- Sepsis
- Catheter Infections
- Pneumonia - Ventilator Associated

Foley Catheters in ICU

- Bacteriuria
  - Present in almost all patients with catheter >7 days
  - Treatment not necessary in most cases
  - Bacteriuria and pyuria is not necessarily an indication for rx
- Candiduria
  - Rarely clinically relevant even in renal transplants
  - Consider potential for ascending infections if foreign body or obstruction
  - If real UTI: don’t use echinocandin or vori or posa-poor urine levels
- Complications of Foley’s other than UTI
  - Epididymitis/Orchitis
  - Mechanical problems
  - Stones
Question #1

Which of the following patient populations with Foley catheters should be screened for bacteriuria and treated if positive

A. All ICU patients
B. All renal transplant patients in ICU
C. All neutropenic patients in ICU
D. All patients with Type I diabetes in ICU
E. Urology patients who will have a procedure where mucosal bleeding is anticipated

Answer

Pre Foley Catheter
- For patients who will have a Foley catheter inserted, screening for bacteriuria and antibiotic prophylaxis are not generally recommended
  - Men undergoing urologic procedures where mucosal bleeding is anticipated

Foley In Place
- Bacteriuria or funguria (even Candida!) is not itself a reason for Rx

Post Foley Catheter
- Screening cultures are NOT routinely recommended
  - For women, routine screening after Foley is optional, but treatment is probably reasonable if women have bacteriuria for 48 hrs after Foley removed.

Additional Infection Prevention Points for Foley Catheters
- **Recommended**
  - Closed drainage system
- **Not Routinely Recommended**
  - Enhanced meatal care
  - Antibiotic/Antiseptic coated catheters
  - Antibiotics in drainage bag
  - Bladder irrigation
  - Periodic cultures to screen for bacteriuria
  - Routine catheter changes over time
  - Antibiotics at time of catheter removal

Additional Points About Bacteriuria

Definitions Are Not Likely Important for Boards
- **Bacteriuria**
  - **Men**
    - one voided urine >100,000 colonies of one bacteria
  - **Women**
    - two voided urines >100,000 with same bacteria
  - **Catheterized patient**
    - Bacteriuria = asymptomatic and >/=100,000 or 100…depends on definition
    - **UTI**
      - Bacteriuria plus 1000 colonies and pyuria etc., or 100,000 regardless of UA
      - Pyuria is not very helpful
    - **absence of UTI clinically, whereas moiday

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Additional Points About Bacteruria
Definitions Are Not Likely Important for Boards Continued

- Asymptomatic bacteriuria with no Foley
  - pregnant women early in pregnancy and screen periodically thereafter
  - urologic procedure with mucosal bleeding just prior to surgery and continue while Foley in place
  - Renal and other solid organ transplants-maybe
- Pyuria plus asymptomatic bacteriuria
  - NOT indication for Rx

What Is Purple Urine Syndrome
Associated with Catheterized Patients?

- Urine, tubing and bag become purple
- Risk factors
  - Females, constipation
- Pathogenesis
  - Providencia, Klebsiella, Proteus
  - Urinary organisms metabolize amino acids to create red and blue colors
- Clinical relevance
  - None
  - Testable but irrelevant!

Hyperpyrexia (T>41.5C)
(Thermoregulatory Center Unchanged but Body Cannot Lose Heat)

- Heat Stroke (No diaphoresis!)
  - Classic-non exertional
  - Exertional
- Drugs
  - Cocaine, ecstasy, etc..
- Neuroleptic Malignant
- Malignant Hyperthermia
- Serotonin Syndrome

Note: Many of these can be associated with leukocytosis of 20k-40k

Management of Hyperthermia

- CAB’s
  - Circulation, Airway, Breathing
- Promote Cooling
  - Evaporation with H2O mist and fans
  - Suppress shivering (benzodiazepines)
- Treat complications
  - Respiratory alkalosis, pulmonary edema, ARDS
  - Coma
  - Coagulopathy
  - Rhabdomyolysis, renal failure
  - Liver failure
Question #2
You are called at 9 a.m. to the surgical floor to see a 29-year-old previously healthy male with a fever of 40ºC who returned 14 hours previously from the operating room where his dislocated shoulder was repaired.
He did well post-operatively except for some nausea. He received linezolid pre-operatively.
The patient is somnolent, flushed, diaphoretic, and rigid. His blood pressure is rose from 130/70 to 180/100 twenty minutes ago. Now the BP is 110/60. He is given one ampule of Narcan, but does not respond.
Which of the following would you give:
A. Antihistamines
B. High-dose corticosteroids
C. Dantrolene
D. IVIG
E. Dilantin

Three Syndromes You Should Know
Malignant Hyperthermia
• Somnolent and Lead Pipe Rigid
• In Operating or Recovery Room
  • High fever and mixed metabolic/respiratory** acidosis
• Classic Trigger: Halothane type anesthesia->>Succinylcholine
• Family History
• autosomal dominant
• calcium metabolism abnormality skeletal muscle
• Rx: Benzodiazapine and dantrolene

Malignant Hyperthermia Continued
Syndrome- 5% Mortality
• Muscle contraction (masseter spasm)/Lead Pipe Rigid
• End tidal CO2 rises
• Tachycardia, Cardiovascular instability
• Rhabdomyolysis
Genetic defect
• Ca++ transport in skeletal muscle
• Autosomal dominant
  • (excessive calcium accumulation)

Triggers
• Usually < 1 hour after trigger (up to 10 hours)
  • In Operating Room or Recovery Room
  • All cases
    • Halothane type drugs
    • Succinylcholine

Treatment
• Dantrolene but….recurs in 25%
• All Operating Rooms should stock dantrolene
• 24 hour MH Hotline: 1800-MH HYPER
• https://medical.mhaus.org

Neuroleptic Malignant Syndrome
• Agitated and rigid
• Classic trigger: Haloperidol when started or dose is changed
• Withdrawal of antiparkinson drugs also classic
• Rx: Benzodiazepines and dantrolene and dopamine agonists

Serotonin Syndromes
• Agitated and hyperreflexive
• Classic triggers: SSRI inhibitors, Antiemetics, Tricyclic Antidepresses
• Rx: Benzodiazepines and cyproheptadine
Neuroleptic Malignant Syndrome (NMS)

- Frequent trigger = haloperidol
- Any "neuroleptic" (antipsychotic)
- Antiemetics such as metoclopramide
- Withdrawal of antiparkinson drugs (L dopa)
- Onset 1-3 days after drug initiation (but can be much longer)
- Time of drug initiation/When dose changed
- 4 Hallmarks
  - Mental Status Change
  - Hyperthermia
  - Rigidity
  - Autonomic Instability
- Overrepresented
  - Patients with prior Catatonia, Severe Agitation
- Management
  - Dantrolene (direct muscle relaxant for up to 10 days)
  - Dopamine agonists (bromocriptine and others)

www.nmsis.org, 1-888-667-8367

Serotonin Syndrome

- Syndrome = Excess Serotoninergic Activity
- Triggers
  - Linezolid + MAO Inhibitor beware with drugs below
  - Antiemetics (Granisetron)
  - SSRI inhibitors (Bupropion)
  - Tricyclic antidepressants (amitryptalline)
  - (Selective serotonin reuptake inhibitors)
- Clinical Manifestations
  - Acute onset in 24 hrs of new drug/drug change
  - Distinctive Features
    - Nausea/vomiting/diarrhea followed by shivering
    - Hyperreflexia
  - Treatment
    - Rapid resolution after withdrawal offending drug

Teaching Points for Hyperthermia Rigid/Somnolent vs Rigid Agitated vs Hyperactive/Agitated

- Muscular rigidity (lead pipe) in Operating Room and Somnolent
- Malignant hyperthermia
- Muscular rigidity and agitated with drug list
- Neuroleptic Malignant Syndrome
- Muscular hyperreactivity and agitated with clonus/nausea and vomiting
- Serotonin syndrome

Guide for the Pharmacologically Impaired

Drug Categories and Examples

- Monoamine Oxidase Inhibitors-Depression
  - Phenelzine (Nardil)
  - Tranylcypramine (Parnate)
  - Isocarboxazid (Marplan)
- Butryophenones-Psychosis
  - Haldol
- Tricyclic Antidepressants
  - Imipramine (Tofranil)
  - Stellazine (Elavil)
- Dopamine Agonists
  - Bromocriptine (Parlodel)
- Selective Serotonin Release Inhibitors-Depression, Psychosis
  - Citalopram (Celexa)
  - Fluoxetine (Prozac)
  - Paroxetine (Paxil)
  - Sertraline (Zoloft)
  - Escitalopram (Lexepro)

Hypermethyl Concerns

- Malignant Neuropsychic and Serotonin Release
- Malignant Neuropsychic
- Serotonin Release
- Malignant Neuropsychic and Serotonin Release

Shock

- Distinguishing different causes of shock
- Treatment of shock
- Technology
  - Out of favor
    - Swan Ganz catheter
  - In favor
    - Ultrasound/Echo/Cardiac output catheters

The Clinical Spectrum of Sepsis

- Severe sepsis and organ failure
- Fever, Tachycardia, Tachypnea, Abnormal WBC and Evidence of Infection

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Top 10 Causes of Death in the USA

- Accidents (unintentional injuries) - 121,599
- Chronic Lower Respiratory Disease - 124,583
- Cancer - 559,888
- Heart Disease - 631,636
- Diabetes - 72,449
- Alzheimer’s Disease - 72,432
- Influenza and Pneumonia - 56,326
- Nephritis - 45,344
- Septicemia - 34,234

Question #3

You are asked to consult on a 30 year old patient with fever and hypotension in the ICU. The patient had been previously healthy, had multiple traumatic injuries 3 weeks ago, and has been in the ICU being weaned from the ventilator.

Which of the following hemodynamic profiles would be most consistent with septic shock?

<table>
<thead>
<tr>
<th>Cardiac Index</th>
<th>SVR</th>
<th>RV</th>
<th>PAP</th>
<th>PCWP</th>
<th>SV02</th>
<th>Normal Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>5.0</td>
<td>500</td>
<td>20/10</td>
<td>20/5</td>
<td>5</td>
<td>80%</td>
</tr>
<tr>
<td>B</td>
<td>2.0</td>
<td>1700</td>
<td>35/15</td>
<td>35/25</td>
<td>25</td>
<td>50%</td>
</tr>
<tr>
<td>C</td>
<td>2.5</td>
<td>1700</td>
<td>40/15</td>
<td>40/25</td>
<td>10</td>
<td>60%</td>
</tr>
<tr>
<td>D</td>
<td>2.5</td>
<td>1700</td>
<td>20/5</td>
<td>20/7</td>
<td>2</td>
<td>50%</td>
</tr>
<tr>
<td>E</td>
<td>2.5</td>
<td>1500</td>
<td>30/10</td>
<td>30/10</td>
<td>10</td>
<td>60%</td>
</tr>
</tbody>
</table>

Sepsis is the Most Common Cause of Distributive Shock But...Not the Only One!

- Sepsis
- Toxic Shock Syndrome
- Anaphylaxis
- Adrenal/Thyroid
- Neurogenic (spinal)
- Toxic (Organophosphates, Abacavir)
- Hepatic
- Pancreatic
- Severe anemia

Differential Diagnosis of Shock

- Distributive
- Hypovolemic
- Cardiogenic
- Extracardiac Obstructive

For the boards: hemodynamics are getting to be outdated (Swan Ganz rarely used) but...could they ask you to recognize some typical patterns?
Management of Sepsis

• Diagnosis
  • Only 50% of clinically defined cases will have a positive blood culture
  • “Time to positivity” is useful for determining source

Differential Time to Positivity

<table>
<thead>
<tr>
<th>Time</th>
<th>Episode = CRBSI</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt;150</td>
<td>Yes: 94, No: 12</td>
</tr>
<tr>
<td>120-149</td>
<td>Yes: 2, No: 2</td>
</tr>
<tr>
<td>100-119</td>
<td>Yes: 1, No: 1</td>
</tr>
<tr>
<td>60-99</td>
<td>Yes: 2, No: 3</td>
</tr>
<tr>
<td>30-59</td>
<td>Yes: 3, No: 12</td>
</tr>
<tr>
<td>15-29</td>
<td>Yes: 0, No: 13</td>
</tr>
<tr>
<td>&lt;15</td>
<td>Yes: 6, No: 40</td>
</tr>
</tbody>
</table>

Total

108 Yes, 83 No

Raad, Ann Intern Med 1/2004

Mortality Risk with Increasing Delays in Initiation of Effective Antimicrobial Therapy

Kumar CCM 2006

Antimicrobial Therapy for Sepsis

• “Right drug, right dose, right time”
• Empiric regimens should be broad
  • Consider anti-candida
  • Narrow spectrum as data return
  • Combination therapy is not necessary once antibiotic susceptibility is known…except maybe for Pseudomonas aeruginosa

Which Antibacterials Can Be Given by Rapid Infusion

<table>
<thead>
<tr>
<th>Drug</th>
<th>Minimum Infusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pen-G</td>
<td>60-120 min</td>
</tr>
<tr>
<td>Pip-tazo</td>
<td>20-30 min</td>
</tr>
<tr>
<td>Tic-clav</td>
<td>30 min</td>
</tr>
<tr>
<td>Cefepime</td>
<td>30 min</td>
</tr>
<tr>
<td>Daptomycin</td>
<td>10 min</td>
</tr>
<tr>
<td>Meropenem</td>
<td>3-5 min</td>
</tr>
<tr>
<td>Imipenem</td>
<td>20-30 min</td>
</tr>
<tr>
<td>Ertapenem</td>
<td>30 min</td>
</tr>
<tr>
<td>Doripenem</td>
<td>60 min</td>
</tr>
</tbody>
</table>


<table>
<thead>
<tr>
<th>Pathogen</th>
<th>BSI’s per 10,000 admissions</th>
<th>Percentage of BSIs (n = 20,978)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coagulase-negative staphylococci</td>
<td>15.8</td>
<td>31.3</td>
</tr>
<tr>
<td>Staphylococcus aureus</td>
<td>10.3</td>
<td>20.2</td>
</tr>
<tr>
<td>Enterococcus species</td>
<td>4.8</td>
<td>9.4</td>
</tr>
<tr>
<td>Candida species</td>
<td>4.6</td>
<td>9.0</td>
</tr>
<tr>
<td>Escherichia coli</td>
<td>2.8</td>
<td>5.6</td>
</tr>
</tbody>
</table>

Wisplinghoff et al. CID 2004;39:309 (c) 2013 Infectious Disease Board Review Course
Management of Sepsis for the Boards

• Initial Fluid Resuscitation
  - Crystalloid +/- Albumen
    - Administer 1000cc crystalloid or 300-500 cc colloid over 30 min and total 2 liters over 4-6 hours
    - Do NOT use hetastarch (renal dysfunction)
  - Blood to maintain Hct >30 indicated only if fluid resuscitation fails to meet targets as method to improve O2 tissue delivery; long term Hg 7-9g/dl is adequate

• Pressors
  - Monitor with arterial line
  - Norepinephrine is preferred
  - Vasopressin useful if shock is refractory
  - Do NOT use low dose dopamine for renal perfusion
  - Dobutamine indicated for myocardial dysfunction or refractory hypotension

Management of Sepsis Out of Date Concepts!

• Glucocorticosteroids (Hydrocortisone 100mg q8h)
  - Enhance shock reversal
  - No survival benefit except perhaps for highest risk pts
  - No role for ACTH stimulation test

• Tight glucose control
  - Harmful, no benefit

• Antiendotoxin and Anticytokine therapies
  - No benefit

• Antithrombosis (Activated Protein C-APC)
  - APC OFF the market

Activated Protein C (APC, Xigris)

• No longer marketed (2011) due to lack of efficacy

  - If this is offered as an answer, it’s a distracter or out of date, i.e., wrong!

Surviving Sepsis Campaign Bundles

TO BE COMPLETED WITHIN 3 HOURS

1. Measure lactate level
2. Obtain blood cultures prior to administration of antibiotics
3. Administer broad spectrum antibiotics
4. Administer 30 mL/kg (2 Liters) crystalloid for hypotension or lactate >4mmol/L

TO BE COMPLETED WITHIN 6 HOURS

5. Apply vasopressors for hypotension that does not respond to initial fluid resuscitation to maintain a mean arterial pressure (MAP) ≥ 65 mm Hg
6. In the event of persistent arterial hypotension despite volume resuscitation (septic shock) or initial lactate >4 mmol/L (36 mg/dL):
   - Measure central venous pressure (CVP)
   - Measure central venous oxygen saturation (ScvO2)
7. Remeasure lactate if initial lactate was elevated

*Targets for quantitative resuscitation included in the guidelines are CVP ≥ 8 mm Hg, ScvO2 of 70%, and normalization of lactate

Catheter Related Infections

• Prevention
• Management
The 100,000 Lives Campaign
(80,000 Catheter Related Blood Stream Infections in US/Yr)

Prevent Central-Line Infections
- Hand Hygiene
- Maximal Barrier Precautions Upon Insertion
- Chlorhexidine Skin Antisepsis
  - Also consider chlorhexidine body washes and patches
- Optimal Catheter Site Selection
  - Subclavian has lowest rate
- Avoid femoral site
- Daily Review of Line Necessity
  - Prompt Removal of Unnecessary Lines
- Routine catheter replacement NOT necessary
- Guidewire changes NOT recommended as routine

Bob Weinstein Rule Regarding Source
- Short Term Vascular Catheter-Skin
- Long Term Catheter-Lumen

Antibiotic Impregnated Catheters and Hubs Plus Antibiotic Lock Solutions
- Not likely testable on the boards
- They have a role
  - but...its not well defined
- Antibiotic lock solutions are the most plausible and conventional when used to help salvage catheters left in place after CLABSI (reduce biofilm)

Categorization of Intravascular Line Infections
- Local Catheter Infection
  - Exit Site
    - Often salvaged medically-topical or systemic
  - Tunnel
    - Almost never salvaged medically
- Catheter Colonization
  - Do not routinely culture tips
    - maybe if infection suspected?
  - If Staph aureus grows from tip, you should treat
    - Catheter is source
      - >150 cfu from 5 cm segment of tip
      - >100 cfu from broth culture

Catheter Related Infections
- Prevention
- Management

Question #4
The laboratory reports that both blood cultures are growing gram positive cocci in clusters.
Which of the following would be the most convincing evidence that the line was the source of the infection?

A. 1 hour prior to blood culture drawn peripherally
B. 3 hours prior to blood culture drawn peripherally
C. 1 hour after blood culture drawn peripherally
D. 4 hours after blood culture drawn peripherally
E. Time to positivity is not a reliable indicator of source of bacteremia
Question #4

The laboratory reports that both blood cultures are growing gram positive cocci in clusters.

Which of the following would be the most convincing evidence that the line was the source of the infection?

The blood culture drawn through the IV line turns positive:

A. 1 hour prior to blood culture drawn peripherally
B. 3 hours prior to blood culture drawn peripherally
C. 1 hour after blood culture drawn peripherally
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Raad, Ann Intern Med 1/2004

Suspected Catheter Related Bacteremia

What if the Blood Culture is Negative But the Cath Tip Grows Staph Aureus?

- Catheter tips are not routinely cultured!!
- Risk of subsequent bacteremia is high
  - 24% if no antibiotics within 24 hrs
  - 4% if antibiotics
  - (Non randomized, retrospective, Bonten CID 2008)
- Treat for at least 5-7 days

Always Remove Catheter

- Syndromes
  - Severe Sepsis
  - Septic thrombophlebitis/Venous obstruction
  - Endocarditis
  - Positive blood cultures>72 hrs after approp Rx
- Organisms
  - Staph aureus
  - Pseudomonas aerug
  - Atypical mycobacteria
  - Bacillus species
  - Candida species
  - Malleszia
  - Propronibacteria
  - Micrococcus

Duration of Therapy for Catheter Related Infections

- Testable only for Staph aureus
- Otherwise: look up

A 42 year old male in the ICU for cardiogenic shock has Staph aureus line related bacteremia.

Which of the following would mandate a course of therapy >14 days?

A. Positive blood culture positive at 24 hrs of appropriate therapy but negative at 72 hrs
B. Temp 38.5 after 48 hrs of appropriate therapy but afebrile by 72 hrs
C. Staph is MRSA
D. Prolonged neutropenia pre and post bacteremia
E. Negative TEE on day 2 of appropriate therapy

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Who Is Low Risk and Eligible for 14 Day Therapy for Staph aureus Bacteremia?
• TEE negative (performed at least 5-7 days post pos BC)
• Cardiac abnormalities do not mandate long therapy by themselves
• None of the Following
  • Neutropenia, steroids, immunosuppression, diabetes
  • Prosthetic joint, valve,
  • Recent endovascular graft
  • Pacemaker
  • Deep foci, Endocarditis or suppurative phlebitis
  • Metastatic foci
  • No Fever after 72 hrs and no positive blood culture > 72-96 hrs after therapy initiated

Question #5
To prevent ventilator associated pneumonia, which of the following interventions is most effective?
A. Twice weekly surveillance cultures of tracheal secretions
B. Silver impregnated endotracheal tube
C. Oral care daily with chlorhexidine
D. H2 blockers to suppress gastric acidity
E. Rifaxamin by nasogastric tube

Prevention of Ventilator Associated Pneumonia
• General strategies
  • Hand hygiene, prompt weaning
• Prevent aspiration
  • Use cuffed tube with inline suctioning
• Prevent aerodigestive colonization
  • Avoid H2 blockers and PPIs
  • Oral hygiene (evidence marginal)
  • (Oral/Gut decontamination controversial)
• Minimize contamination of equipment
  • Routine tubing change unnecessary

APPENDIX
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Institute for Healthcare Improvement

5 Million Lives Campaign
- Prevent Pressure Ulcers by reliably using science-based guidelines for prevention of this serious and common complication
- Reduce Methicillin-Resistant Staphylococcus aureus (MRSA) infection through basic changes in infection control processes throughout the hospital
- Prevent Harm from High-Alert Medications starting with a focus on anticoagulants, sedatives, narcotics, and insulin
- Reduce Surgical Complications by reliably implementing the changes in care recommended by the Surgical Care Improvement Project (SCIP)
- Deliver Reliable, Evidence-Based Care for Congestive Heart Failure to reduce readmission
- Get Boards on Board by defining and spreading new and leveraged processes for hospitals Boards of Directors, so that they can become far more effective in accelerating the improvement of care

Ventilator Bundle Elements
1. Elevation of the head of the bed to between 30 and 45 degrees
2. Daily awakening: “sedation vacation”
4. DVT prophylaxis (unless contraindicated)
5. Stress bleeding prophylaxis

Surgical Site Infection Prevention
1. Appropriate use of antibiotics within 60 min pre skin incision
2. Appropriate hair removal
3. Controlled 6 AM postoperative serum glucose in cardiac surgery patients*
4. Immediate postoperative normothermia in colorectal surgery patients*

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Management of Catheter-Related Bloodstream Infection

Short-term Central Venous Catheter or Arterial Catheter

- Uncomplicated: treat with systemic antibiotics for 4-6 weeks
- Complicated: treat with systemic antibiotics + antifungal therapy (if fungal infection suspected)

Management of Long-Term Central Venous Catheter or Port-Related Bloodstream Infection

- Uncomplicated: treat with systemic antibiotics for 4-6 weeks
- Complicated: treat with systemic antibiotics + antifungal therapy (if fungal infection suspected)

Catheter-Related Bloodstream Infection and Tunneled Hemodialysis Catheters

- Blood culture
- Persistent bacteremia/fungemia and fever
- Step antibiotic
- Remove CVC/P if persistent bacteremia/fungemia and fever

Findings in Patient with Moderately Severe Serotonin Syndrome

- Hyperactivity (greater in extremities)
- Autonomic instability (nose twitching)
- Clonus (greater in extremities)
- Tremor (not Staph aureus, Candida, Pseudomonas)

Antiseptic or Antibiotic Impregnated Devices - Not Testable on Boards

- Catheters: indicated if, after full implementation of bundle recommendations, institutional goals are not met; should goal be zero infections?
- Hubs: not standard of care and not testable

Antibiotic Lock Solutions (Dwell to Kill Organisms in Biofilm)

- Probably not testable-low grade evidence
- Lock Therapy indications: long term catheters as adjunct to systemic rx, no sign of exit site or tunnel infection, salvage is goal
- Dwell time: 24-48 hrs
- Drug Concentrations: look up