

CATHETER RELATED BLOODSTREAM INFECTIONS (CRBSI): aka line infection

- Vascular catheters essential part of patient care
 - IV fluid and medication administration
 - Renal replacement therapy
 - Monitoring via blood samples
- Nosocomial (hospital-acquired) bloodstream infections
- Cause of sepsis and septic shock
- Mortality: up to 27%

RISK FACTORS:

PATIENT	CATHETER (LINE)
<ul style="list-style-type: none"> • Chronic illness • Bone marrow transplant • Immunosuppression • Malnutrition • Parenteral nutrition • Previous blood stream infxn • Age (infants, elderly) • Loss of skin integrity <ul style="list-style-type: none"> ◦ Burns, SJS, etc • Presence of bacterial infxn • Children • Admission to ICU with: <ul style="list-style-type: none"> ◦ GI disease ◦ Cancer 	<ul style="list-style-type: none"> • Type of catheter <ul style="list-style-type: none"> ◦ Bare vs. abx-impregnated • Conditions of insertion <ul style="list-style-type: none"> ◦ Max barrier precautions during insertion • Site of placement <ul style="list-style-type: none"> ◦ Femoral or internal jugular >> subclavian • Catheter-site care • Skill of person inserting catheter • Duration • Use: <ul style="list-style-type: none"> ◦ Nutrition ◦ Hemodialysis

SIGNS AND SYMPTOMS:

- Temperature > 38°C ± chills or hypotension
- Pathogen cultured from one or more blood cultures
- Pathogen not related to an infection from another site
 - Patient has a vascular catheter
 - No other apparent source of infection
- In addition, for infants <1 years old: apnea or bradycardia

PATHOPHYSIOLOGY:

SKIN COLONIZATION	<ul style="list-style-type: none"> • Most common source • Deposition of biofilm (fibrinogen & fibrin + glyocalyx) produced by bacteria
HEMATOGENOUS SEEDING	<ul style="list-style-type: none"> • Bloodstream infection originating from another source → bacteria adhere to catheter and propagate • Often from GI site • Most common: critically ill, long-term catheters
INFUSATE CONTAMINATION	<ul style="list-style-type: none"> • Administration of contaminated IV products • Contamination during: manufacture, solution, preparation, or handling by healthcare workers • Rare and generally causes epidemic infections

LIKELY PATHOGENS:

- Coagulase-negative staphylococci (31%)
- Staphylococcus aureus (20%)
- Enterococci (9%)
- Candida species (9%)
- Others (mostly gram negatives from GI tract)

IN GENERAL, TREATMENT IS NOT REQUIRED IF:

- Positive catheter tip culture with no clinical signs of infection
- Positive cultures from catheter but negative cultures through peripheral vein
- Signs of phlebitis with no signs of infection

RISK FACTORS FOR CANDIDEMIA:

- Parenteral nutrition
- Prolonged use of broad-spectrum antibiotics
- Leukemia or lymphoma
- Bone marrow or solid organ transplant
- Femoral line
- Colonization with *Candida species* at multiple site

CRBI MANAGEMENT: ANTIBIOTICS

EMPIRIC BASED ON GRAM STAIN	GRAM POSITIVE	<ul style="list-style-type: none"> • Vancomycin • Many CoNS isolates are resistant to cloxacillin and cefazolin
	GRAM NEGATIVE	<ul style="list-style-type: none"> • Depends on clinical situation • Ceftriaxone/cefotaxime • Pip/tazo for pseudomonas coverage • Immunocompromised pts
C&S → NARROW SPECTRUM	GRAM POSITIVE	<ul style="list-style-type: none"> • Vancomycin • Cloxacillin • Cefazolin • Daptomycin ** • Linezolid ** • ** <i>IF RESISTANT</i>
AFFECTED CATHETER STILL IN PLACE		<ul style="list-style-type: none"> • Administer antibiotics through line • If multiple ports, can alternate between each port <ul style="list-style-type: none"> ◦ NOT evidence-based practice but became gold standard
DURATION OF THERAPY		<ul style="list-style-type: none"> • 7-14 days following 1st -ve blood culture • Longer if: <ul style="list-style-type: none"> ◦ Develops endocarditis ◦ Foreign material in body ◦ Metastatic sites

REMOVAL OF VASCULAR CATHETER:

- Severe sepsis/septic shock
- Hemodynamic instability
- Swelling or pus at site
- Persistent bacteremia after 72 hours of appropriate antibiotics
- Type of bug:

Short-term catheters (<14 days)	<ul style="list-style-type: none"> • <i>Staph aureus</i> • <i>Enterococci</i> • Gram-negative bacilli • Fungi • Mycobacteria
Long-term catheters (≥ 14 days)	<ul style="list-style-type: none"> • <i>Staph aureus</i> • <i>Pseudomonas aeruginosa</i> • Fungi • Mycobacteria

ANTIBIOTIC LOCK THERAPY:

- To achieve sufficient therapeutic concentrations at the site
- If catheter cannot be removed
- CoNS or gram negative organisms
 - Not for *Staph aureus*, *pseudomonas*, drug-resistant gram-negative bacilli or *Candida*
- Evidence of effectiveness is variable
- Antibiotic + heparin
 - Gentamicin-heparin
 - Vancomycin-heparin
 - Cefazolin-heparin

PREVENTION:

- Aseptic technique: during insertion, w/ dressing changes, w/ site care
- Choosing appropriate sites for insertion (subclavian best, femoral worst)
- Using PICC lines or surgically inserted catheters when possible
- Catheter materials: antimicrobial impregnated
- “Scrub the hub” when accessing the line
- Minimize the need to access the line
- Changing administration sets every 96 hours
- Preventing thrombosis:
 - (TKVO) to keep vein open rate
 - Heparin or citrate locking when not in use
- Minimizing duration of vascular catheter
 - Peripheral venous catheter < 4 days
 - Central venous catheter < 6 days
 - Arterial catheter < 4-6 days
 - PICC lines & surgically inserted – weeks to months (6-12 months)

SEPSIS:

- Body's overwhelming and life-threatening response to infection
 - Can lead to tissue damage, organ failure, and death
- 12th leading cause of death in Canada
- > 50% of deaths from infectious diseases
- 30-50% of people who develop sepsis die from it

SOURCES OF INFECTION;

- Pneumonia
- UTI
- Intra-abdominal infection
- CNS
- SSTI
- Catheter-related
- Endocarditis
- Infection of unknown source
- Other

RISK FACTORS:

AGE:	<ul style="list-style-type: none"> Elderly Neonates and infants
DEMOGRAPHICS:	<ul style="list-style-type: none"> Male Non-caucasian
PRE-EXISTING MEDICAL CONDITIONS	<ul style="list-style-type: none"> HIV Cancer Diabetes Cirrhosis Alcohol dependence Pressure sores

LIKELY PATHOGENS:

CNS	<ul style="list-style-type: none"> Strep pneumonia H. influenza 	<ul style="list-style-type: none"> N. meningitidis
PNEUMONIA	<ul style="list-style-type: none"> Strep. Pneumonia H. influenza M. catarrhalis Staph aureus 	<ul style="list-style-type: none"> Klebsiella pneumonia Chlamydia pneumonia Mycoplasma pneumonia
ENDOCARDITIS	<ul style="list-style-type: none"> Staph aureus 	<ul style="list-style-type: none"> Staph epi
INTRA-ABDOMINAL	<ul style="list-style-type: none"> E. coli Enterobacter 	<ul style="list-style-type: none"> Serratia Acinetobacter
URINARY TRACT	<ul style="list-style-type: none"> E. coli Klebsiella 	<ul style="list-style-type: none"> Proteus mirrabilis
SKIN & SOFT TISSUE	<ul style="list-style-type: none"> Staph aureus CoNS 	<ul style="list-style-type: none"> Staph species (S. pyogenes)
IV LINE	<ul style="list-style-type: none"> CoNS 	<ul style="list-style-type: none"> Staph aureus
UNKNOWN SOURCE	<ul style="list-style-type: none"> Staph aureus Strep pneumonia 	<ul style="list-style-type: none"> E. coli

DEFINITIONS:

BACTEREMIA	Presence of bacteria in the blood
VIREMIA	Presence of virus in the blood
FUNGEMIA	Presence of fungus in the blood (candemia)

SCORING TOOLS:

SIRS	Presence of ≥ 2 : <ul style="list-style-type: none"> Temperature: $< 36^{\circ}\text{C}$ or $> 38^{\circ}\text{C}$ Heart rate > 90 bpm* Respiratory rate > 20 bpm* WBC < 4 or $> 12 \times 10^6$ * in children, based on age normal, can also be bradycardic /apnea
SOFA	<ul style="list-style-type: none"> Sequential Organ Failure Assessment Score Have to look up scoring tool
qSOFA	<ul style="list-style-type: none"> Quick SOFA <ul style="list-style-type: none"> Respiratory rate $\geq 22/\text{min} = 1$ point Change in mental status = 1 point Systolic BP ≤ 100 mmHg = 1 point Score $\geq 2 =$ organ dysfunction

EMPIRIC ANTIBIOTICS:

CNS	<ul style="list-style-type: none"> Ceftriaxone or cefotaxime +/- vancomycin
PNEUMONIA	<ul style="list-style-type: none"> Ceftriaxone or cefotaxime + vancomycin (Staph aureus) +/- azithromycin or clarithromycin
ENDOCARDITIS	<ul style="list-style-type: none"> Vancomycin
INTRA-ABDOMINAL	<ul style="list-style-type: none"> Meropenem or imipenem Piperacillin/tazobactam Metronidazole
URINARY TRACT	<ul style="list-style-type: none"> Fluoroquinolones (ciprofloxacin) Ceftriaxone or cefotaxime +/- aminoglycosides Meropenem or imipenem
SKIN & SOFT TISSUE	<ul style="list-style-type: none"> Vancomycin Penicillin + clindamycin (Necrotizing Fasciitis II) Pip/tazo (Necrotizing fasciitis I)
IV LINE	<ul style="list-style-type: none"> Vancomycin Meropenem or imipenem
UNKNOWN SOURCE	<ul style="list-style-type: none"> Vancomycin + pip/tazo Vancomycin + meropenem or imipenem

Vanomycin = gram +ve Meropenem/imipenem = gram -ve

SEPSIS DIAGNOSIS:

SEPSIS	<ul style="list-style-type: none"> A life threatening organ dysfunction caused by a dysregulated host response to infection Confirmed or suspected infection + SIRS SOFA or qSOFA score 										
SEVERE SEPSIS	<ul style="list-style-type: none"> Sepsis + sepsis-induced organ dysfunction Most recent guidelines no longer recommend using this term 										
END ORGAN DYSFXN	<table border="1"> <tr> <td>CNS</td> <td> <ul style="list-style-type: none"> Encephalopathy: agitation, confusion, altered LOC </td> </tr> <tr> <td>LUNGS</td> <td> <ul style="list-style-type: none"> Acute respiratory distress syndrome </td> </tr> <tr> <td>CVS</td> <td> <ul style="list-style-type: none"> Heart failure </td> </tr> <tr> <td>LIVER</td> <td> <ul style="list-style-type: none"> Decreased clotting (increased INR) Impaired bilirubin metabolism \rightarrow \uparrow free bilirubin </td> </tr> <tr> <td>GU</td> <td> <ul style="list-style-type: none"> Decreased or no urine output Acute renal failure </td> </tr> </table>	CNS	<ul style="list-style-type: none"> Encephalopathy: agitation, confusion, altered LOC 	LUNGS	<ul style="list-style-type: none"> Acute respiratory distress syndrome 	CVS	<ul style="list-style-type: none"> Heart failure 	LIVER	<ul style="list-style-type: none"> Decreased clotting (increased INR) Impaired bilirubin metabolism \rightarrow \uparrow free bilirubin 	GU	<ul style="list-style-type: none"> Decreased or no urine output Acute renal failure
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SEPTIC SHOCK	<ul style="list-style-type: none"> Severe sepsis + low BP despite admin of adequate IV fluids Severe sepsis + end organ damage Requiring vasopressors to maintain adequate perfusion Subset of sepsis with circulatory and cellular/metabolic dysfunction associated with higher risk of mortality 										

MANAGEMENT:

- Medical emergency
- IV fluids: at least 30 mL/kg up to max 60 mL/kg
 - Crystalloid (0.9% NaCl, albumin)
- Blood cultures
- IV antibiotics (within 1 hour)
- Source control
- Goal directed therapy
 - Vasopressors, corticosteroids, etc...

SIGNS & SYMPTOMS:

Shivering, fever or hypothermia

Extreme pain discomfort

Pale skin

Sleepy, difficult to rouse, confused

I feel like I might die

Short of breath

SUMMARY:

- Early identification of sepsis important
- Early initiation (within 1 hour) of appropriate empiric antibiotics
 - Decreases mortality
- Surviving Sepsis Campaign
- Targeted therapy once bug identified
- Adjustment of drug dosage based on organ function
- Monitoring and goal directed therapy key