

Infection Control: Blood Stream Infections

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Your taxes at work

Intra Vascular Access: Short Term

- **Peripheral venous catheter**
Rare BSI if removed within 4 days
- **Peripheral arterial catheter**
BSI risk 3-13 / 1,000 cath-days
- **Non-tunneled central venous catheter**
inserted into subclavian vein or jugular vein
90% of all CR-BSI
- **Pulmonary artery catheter**
monitor hemodynamic parameters
average 3 days

- Catheters (thin, flexible hollow tubes) w one end positioned outside the body
- Ports surgically placed under skin require special needle for access
- Opposite end of the tubing is positioned within the large vein near the heart

**5 million placed
in USA yearly**

Short term	< 8 days
Intermediate	8 – 29 days
Long Term	>30 days

Intra Vascular Access: Long Term

- Tunneled central venous catheter

Surgically implanted into subclavian or jugular vein

subcutaneous tissue grows in polyester fiber cuff surrounding stabilizing catheter

Hickman, Broviac, Groshong

Hickman, Groshong w Dacron cuff inside exit site to inhibit migration of skin organisms into catheter tract

- Totally implantable device

inserted into subclavian or jugular vein

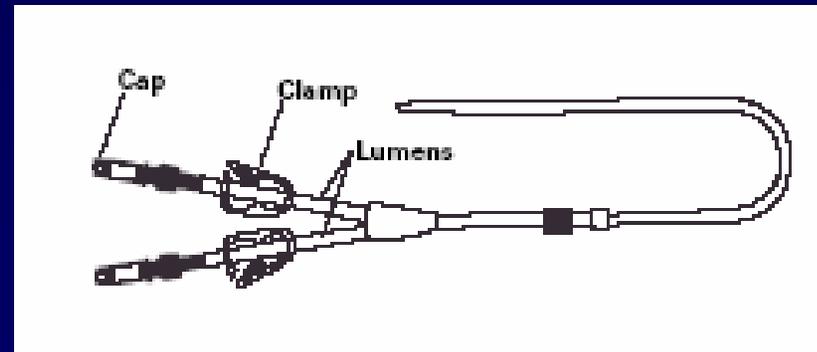
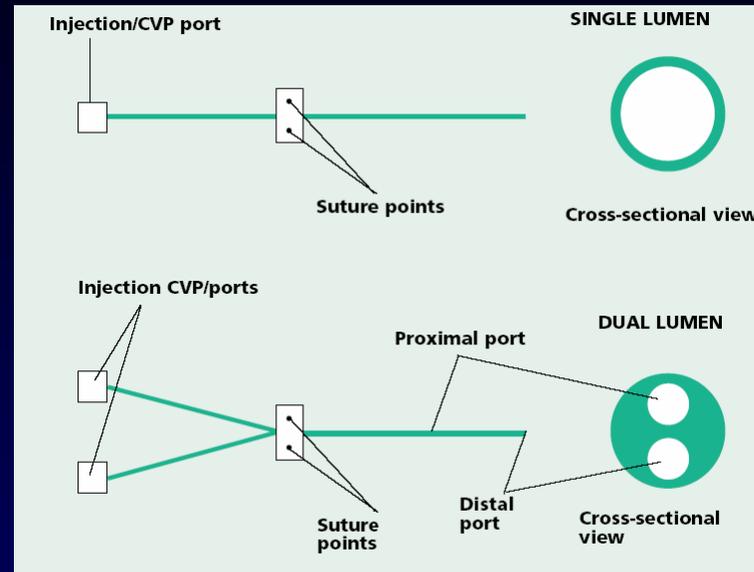
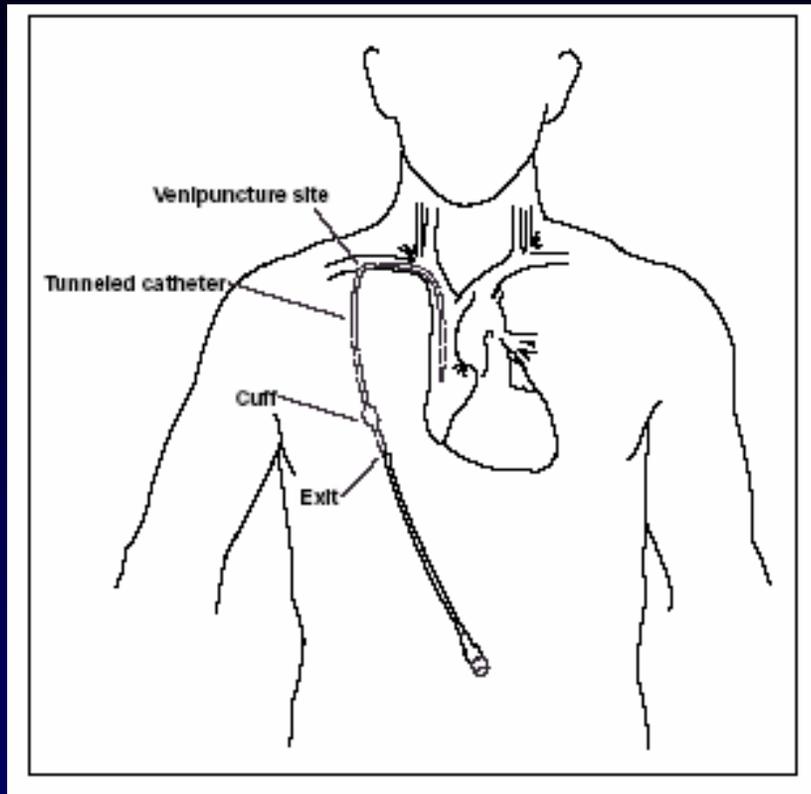
attached to a fluid reservoir placed in surgically created subcutaneous pocket on upper chest,

or into an arm vein with a peripheral port pocket

- Peripherally inserted central venous catheter (PICC)

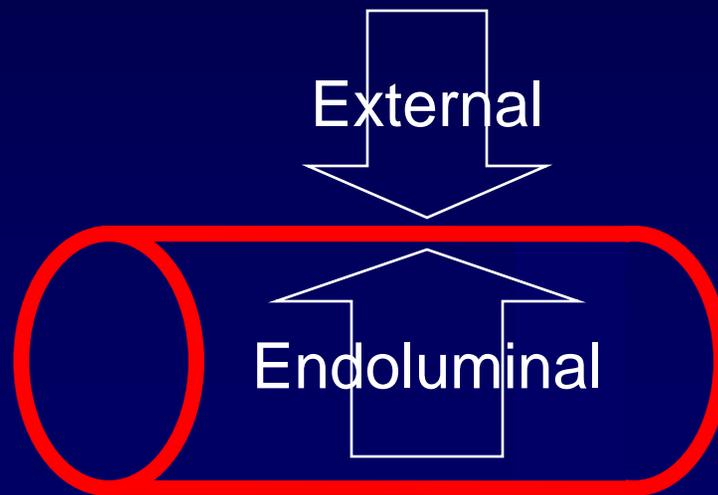
Inserted via peripheral vein of upper arm into superior vena cava

Central venous Access Devices



Colonization

- Microbial growth occur
 - Endoluminal
 - External catheter surface under skin
- Semiquantitative culture: ≥ 15 CFU /segment
- Quantitative: ≥ 100 CFU



CFU Counts

- Segments = distal 5cm tip or proximal 5cm subcutaneous
- Qualitative method
 - Drop segment in broth
 - Incubate 2-3 days
 - Culture pos or neg
- Semiquantitative or roll plate method:
 - Roll segment 4 times on sheep agar
 - Incubate 3 days
 - Count
- Quantitative method:
 - Drop segment in 1 mL broth, sonicate to loosen microbes
 - Serial dilutions plated
 - Incubate
 - Count

Local catheter infection

- **Exit site infection:**
 - Purulent drainage from catheter exit site
 - Or erythema, tenderness & swelling within 2cm of catheter exit site
- **Port pocket infection**
 - Erythems & necrosis over reservoir of totally implantable device
 - Or purulent exudate in subcutaneous pocket containing reservoir
- **Tunnel infection:**
 - erythema, tenderness & swelling of tissue overlying catheter more than 2cm from exit site
- Differentiate infection from simple phlebitis due to local inflammation. Physico-chemical phlebitis occur in 30% peripheral venous cath in 2-3 days

Transient Bacteremia

- **Very common:**
 - **Roberts FJ 1991. Rev ID 13: 34-46;**
 - **7% transient bacteremias in 2000 blood cultures**
 - **StaphCoagNeg 40%, StrepViridans 30%**
 - **Best practices: 2-3%**
- **Risk factors**
 - **Dental procedures: from tooth brushing, to extraction**
 - **Intubation**
 - **Lacrymal duct probing**
 - **Burn wound manipulation**
 - **GI endoscopy, Ba enema**
 - **Dermato surgery**
 - **Urologic endoscopy**
 - **IUD replacement**
- **Need for antibiotic prophylaxis ?**

Transient Bacteremia

Detection: Look at

- Clinical presentation: Signs and symptoms...
- Microbe recovered:
 - Does it match patient profile ?
 - Disease profile ?
- Number of positive cultures

Definitions

Primary Lab Confirmed BSI

1 - Pathogen

- Recognized pathogen from 1 or more blood culture
- Not related to infection at other site

Primary Lab Confirmed BSI

2 - Contaminant

- One of following:
 - Fever $>38^{\circ}\text{C}$
 - or chills
 - or hypotension $<90\text{mm}$

- AND Common skin contaminant
 - from 2 or more blood cultures
 - Drawn on separate occasions

- AND Common skin contaminant
 - from 1 or more blood cultures
 - With Ivasc line
 - Tx prescribed for infection

- AND positive antigen in blood for
 - *Hemophilus influenzae*
 - Or *Neisseria meningitidis*
 - Or group B streptococci

Primary Lab Confirmed BSI

3 - Pediatric

- One of following:
 - Fever >38 °C rectal
 - or hypothermia <37 °C
 - Or apnea
 - Or bradycardia

- AND Common skin contaminant
 - from 2 or more blood cultures
 - Drawn on separate occasions

- AND Common skin contaminant
 - from 1 or more blood cultures
 - With Ivasc line
 - Tx prescribed for infection

- AND positive antigen in blood for
 - *Hemophilus influenzae*
 - Or *Neisseria meningitidis*
 - Or group B streptococci

Clinical Sepsis

ADULT

- One of following:
 - Fever $>38^{\circ}\text{C}$
 - or hypotension $<90\text{mm}$
 - Or Oliguria $<20\text{mL/hr}$
- AND no blood culture or negative blood culture
- AND no infection related to other site
- AND Tx ordered for sepsis

PEDIATRIC

- One of following:
 - Fever $>38^{\circ}\text{C}$ rectal
 - or hypothermia $<37^{\circ}\text{C}$
 - Or apnea
 - Or bradycardia
- AND no blood culture or negative blood culture
- AND no infection related to other site
- AND Tx ordered for sepsis

Secondary BSI

- **Recognized pathogen from 1 or more blood culture**
- **Related to infection at other site**

Catheter Related Blood Stream Infection (BSI)

- Similar microorganism in catheter colonization and blood culture
- Clinical evidence of BSI
 - Fever or hypothermia
 - \pm hypotension, tachycardia, tachypnea, confusion

Source of Infection

Cath as Source of Infection

- Similar microbes from cath and BSI
- Blood drawn thru cath > 100 CFU /mL
- Or comparison blood drawn thru catheter and blood drawn from peripheral vein with ratio of 8:1
- Other ratio were used (3:1) or absolute difference (30 CFU)
- Or timing: blood thru cath positive > 2 hours before other peripheral vein
- 70% of CVC-BSI show no local signs around cath

Source of Infection

- **Thrombin sheath covers internal & external surface of cath rich in host protein:**
 - **Fibronectin (S.a. & S.e.)**
 - **Fibrinogen (S.a.)**
 - **Collagen...**
- **Some S.a. & Candida produce exopolysaccharide causing biofilm to form**
- **Biofilm may protect from antibiotics**
- **Material important:**
 - **S.a. prefers silicone to polyurethane, teflon or PVC**

Source of Infection

- Colonization of central venous cath is universal within 24 hrs (Radd I 1997),
BUT only a few cause infection
- Short term cath:
 - from skin at cath entry
 - Moving under skin along surface
 - May cause local or BSI
- Long term cath (>3 weeks): from cath hub to lumen ⇒ BSI (Raad I 1997. JID 168: 400-407)

BSI Risk Factors: Catheter Type

- Peripheral I-Venous Cath: low risk
- Peripherally Inserted Central cath (PICC) low risk
- Central Venous Cath (CVC): 2% of cath, 97% of CR-BSI
- Total Parenteral Nutrition IF improperly used
- TPN with lipid infusions (S.epi)
- TPN for use other than parenteral nutrition
- Femoral > Jugular > subclavian vein
- Inserter inexperience
- Transparent dressings
- Antibiotic ointment ⇒ /2 bacterial, x5 fungal infection

Risk Factors

Technical Risk Factors

- **Skin preparation:**
 - Tincture of iodine
 - Alcoholic chlorhexidine
 - Povidone iodine
- Sterile glove
- New needle each attempt
- Quick transfer to bottle
- Quantity of blood
 - Concentration in blood usually < 1 CFU /mL
 - > 10 mL up to 20 mL
- Timing between two cultures not so important
- Location: not cath site

Personal Risk Factors

- Severity of disease (APACHE score)
- ICU: risk * 10
- Neutropenia / oncology patients
- Chronic liver disease /cirrhosis
- Burn
- Spinal cord injury
- Hemodialysis
- Organ transplant recipient

Personal risk Factors

- Old age
 - 0.3 / 1,000 pt.days in Nhomes
 - Case Fatality 20-30%
 - *E.coli* 25%, *Proteus* 15%, *Staph. aureus* 10%
 - UTI 50%, RTI 10%
- Neonates
 - Early / Late onset post delivery
 - Low birth weight
 - Ivasc Cat 3-10 /1,000 CVC days
 - StaphCoagNeg, *Staph. aureus*, *E.coli*, Pseudom, Candida

Incidence

Incidence

- 150 million catheter sold yearly in USA
- 3 million central venous cath (CVC)
- Increased cath use ⇒ increased incidence:
 - Percent of Nosocomial infection: 1975 = 5%
2000 = 14%
 - Overall incidence: 1975 = 2-4 /1,000 discharges
2000 = 10-15 /1,000 discharges

Microbes

CR-BSI Agents

- *Staph. epidermidis* (coag neg) 28%
- *Staph. aureus* 26%
- Candida 17%
- Enterobacter 7%
- Serratia 7%
- Enterococci 5%
- Klebsiella 4%
- Pseudomonas 3%

- Association cath colonization / BSI vary
 - Candida 68%
 - *S. aureus* 60%
 - *S. epi* 32%

Resistance among BSI Agents

Pathogen		ICU	Non ICU	
• Staph. coag neg - MRSE		75%	65%	
• <i>Staph. aureus</i> - MRSA			50%	40%
• Enterococci - Vanco R		12%	12%	
• Pseudomonas aer.	FQuinolone	26%	25%	
•	Imipenem	20%	12%	
•	Ceftazidime	15%	8%	
•	Piperacillin	17%	12%	
• Enterobacter	Cef-3	6%	5%	
• <i>E.coli</i>	Cef-3		6%	5%