Background

Types of infection

- Local site infection
- Blood stream infection
- Septic thrombophlebitis
- Metastatic infection
  - Abscess – lung, brain, eye
  - Osteomyelitis
Background

Catheter types

- Non-tunnelled: majority of infections
- Tunnelled: cuff inhibits migration
- P.I.C.C.: Lower infection rate
- Implanted: lowest infection rate

Costs of infection

- Average rate: 5/1000 line days
- Mortality: 0-35%
- Cost per infection: $25-50,000
Infection Rates

**Paediatric ICU**
- surgical: 5.3 / 1000 line days
- trauma: 7.9
- burns: 9.7

**Neonatal ICU**
- <1000g: 11.3
- 1000-1500g: 6.9
- 1501-2500g: 4.0
- >2500g: 3.8

**Adult ICU**
- General medical: 5.9

Australian Data¹

- >3500 episodes annually
  - 1.5 infections / 1000 admissions

- Case fatality rate 24%
  - Attributable mortality 12%

Paediatric CVAD

- Data extrapolated from adult studies
- Mostly PICU/NICU/Oncology
- Many variables
  - Age, birthweight
  - Underlying disease
- Rates higher than adults
- Potential contaminants more significant
- Peripheral BC more difficult
## Organisms

<table>
<thead>
<tr>
<th>Organism</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coag. Neg. Staph.</td>
<td>37%</td>
</tr>
<tr>
<td><em>S. aureus</em></td>
<td>13%</td>
</tr>
<tr>
<td><em>Enterococcus</em> spp.</td>
<td>13%</td>
</tr>
<tr>
<td>Gram Neg. rods</td>
<td>14%</td>
</tr>
<tr>
<td><em>Enterobacter</em> spp.</td>
<td>5%</td>
</tr>
<tr>
<td><em>P. aeruginosa</em></td>
<td>4%</td>
</tr>
<tr>
<td><em>K. pneumoniae</em></td>
<td>3%</td>
</tr>
<tr>
<td><em>Candida</em> spp.</td>
<td>8%</td>
</tr>
</tbody>
</table>

### Trends
- Increasing *Enterococcus* spp.
- Increasing resistant *Candida* spp.
- MRO – ESBL, IBL, VRE, MRSA

Pathogenesis

Migration of skin bacteria
tip → lumen
Catheter hub colonisation
Haematogenous seeding
Infusate contamination
Bacterial virulence
  • Adherence
  • Glycocalyx (slime)
Risk Reduction Approaches

1. Education
2. Site of insertion
3. Catheter material
4. Aseptic technique / skin antisepsis
5. Dressings
6. Impregnated catheters
7. Prophylactic antibiotics / ‘locks’
8. Catheter rotation
9. Administration set change
Risk Reduction Approaches

1. Education - specialised “IV Team”

2. Site of insertion
   - Density of skin flora
   - Risk of thrombophlebitis
     - Lower > upper extremity
     - Jugular > femoral > subclavian

3. Catheter material
   - PVC > teflon
Risk Reduction Approaches

4. Aseptic technique
   - Maximal sterile precautions
     - Mask, sterile gown, gloves, large drape
     - Superior to sterile gloves / small drape alone¹

5. Skin antisepsis
   - 2% aqueous chlorhexidine
   - 70% ethanol
   - 10% povidone iodine

Risk Reduction Approaches

5. Dressings
   - Transparent sterile semipermeable polyurethane
   - Infection/phlebitis = gauze
   - Permits visual inspection, secures device
   - Avoid suturing

6. Impregnated catheters
   - Antiseptics or antibiotics
   - Expensive

Risk Reduction Approaches

6. Impregnated catheters

- Chlorhexidine / silver sulphadiazine
  - Outer and/or inner surface
  - Anaphylaxis (rare)
  - Effective up to 14 days
  - Cost effective if rates >3.3/1000

- Minocycline / rifampicin
  - $t_{1/2}$ 25 days for *S. epidermidis*
  - Resistance may develop

- Platinum / silver ionic metals
7. Antibiotic prophylaxis

- **Systemic antibiotics**
  - Vancomycin successful in neonates only
  - Resistance – VRE

- **Local antibiotic / antiseptic ointment**
  - Povidone iodine - ↓ exit site infection, BSI
  - Mupirocin – resistance develops

- **Antibiotic ‘locks’**
  - Heparin + vancomycin + ciprofloxacin
8. Catheter rotation
   - Peripheral cannulas
     - >72-96 hours increases phlebitis in adults
     - Duration less clear in children
   - CVADs
     - Routine change unnecessary

9. Administration set change
   - Change every 72-96 hours
   - More frequent if giving lipid / blood
Central vs Peripheral

Infection rates
- Peripheral: 0.36/1000
- Central: 23.0/1000

Duration (average)
- Peripheral: 1.5 days
- Central: 5.5 days

Reasons
- Sicker / longer catheterisation
- Multiple lumens
- Different insertion sites
- TPN (especially lipid)
Clinical Manifestations

- Fever, sweats, rigors
- Hypotension
- Tachycardia
- Embolic events
- Thrombophlebitis
Diagnosis

- **Peripheral vs central blood cultures**
  - Differential positivity
  - Time to positivity
    - CVAD >2hr earlier – sensitivity 90%, PPV 80%
  - Quantitative culture
    - 5-fold larger numbers

- **CVAD tip culture**
  - Many methods – roll, sonication, flush, vortex, brush
  - >15 colonies – sensitivity 85%
  - PPV 16-31%
  - Removed through infected skin
Diagnosis

Other methods

- Sterile intraluminal brush
  - CVAD removal not necessary
  - Sensitivity 95%, specificity 84%
  - 6% develop transient bacteraemia

- Entry-site culture

- Acridine orange
  - Sensitivity 85%, specificity 94% (neonates)

- Electron microscopy
Treatment

CVAD removal
- *S. aureus*, *Candida* spp.
- ? GNR, CNS

Empiric therapy
- Vancomycin/flucloxacillin + aminoglycoside

Duration
- 2/52 A/B controls GNR infection in 80%
  - *S. aureus* – 14 days
  - *Candida* spp. – fluconazole / amphotericin B