Background and Overview

**Article Title/Citation:**
Arterial Catheters as a source of Bloodstream infection: A systematic review and meta-analysis
O’Horo JC, Maki DG, Krupp AE, Safdar N
Critical Care Medicine 2014; 42:1334-1339

**Study objectives/purpose:** To evaluate the prevalence of arterial catheter-related bloodstream infection.

**Brief Background:** Catheter related bloodstream infections are associated with significant costs and adverse consequences. Arterial catheters are commonly used in critical care and are heavily manipulated.

Methods

**Study design and Methodology:**
Meta-analysis “with the aid of an expert librarian.”

**Search Strategy:**
- Databases include MEDLINE, CinAHL, EMBASE, and the Cochrane Review database searched from inception to December 2012
- All human trials that evaluated BSI in arterial catheters
- Excluded studies using arterial catheters for reasons other than critical illness (ECMO or bypasss circuit, arterial chemotherapy)
- No language restrictions
- References of articles were manually inspected for potentially relevant studies
- Included studies that have a definition of CRBSI including correlation of a catheter tip culture to a separate blood culture with signs and symptoms compatible with sepsis and no other source identified

**Search Terms**
- “Catheter-related infections/ep,mo,pc AND (BSI OR blood- stream OR “blood stream” OR bacteremia* or bacteraemi*),” (Catheter-related infections/ OR “catheter related” OR “catheter-associated” or PICC or “peripherally inserted”) AND (BSI OR bloodstream OR “blood stream” OR bacteremia* or bacteraemia* or blood/mi or septic*) AND (epidemiology*(tw,fs) or incidence)” and “Catheter related bacteremia/ep OR (catheter infection/ep and blood stream infection).”

**Following data was extracted from each study**
- Study Design
- Whether all catheters were cultured or not
- Practitioner who inserted catheter
- Site of insertion
• Whether full barrier precautions were used
• Agents for cutaneous antisepsis
• Adjunctive methods for infection prevention
• Total number of catheters with BSI
• Catheter colonization
• Total number of catheters
• Number of catheter days

Outcome measures/Endpoints:

Primary endpoint was to determine the prevalence of arterial CRBSI
• Determined by pooling the observed rates of catheter infection in studies where all catheters were cultured and comparing with studies where arterial catheters were cultured only when they were suspected as a source of BSI

Secondary endpoints included
• Catheter infection rates at different sites
• Insertion technique
• Agent used for antisepsis
• Maintenance practices for catheter once inserted

Statistical analysis:
Calculated Incidence of infection as
• Infections per 1000 arterial catheters
• Infections per 1000 catheter days

To decide if infections were underestimated, the authors pooled the studies where all catheters were cultured
• Subgroup analyses limited pooling only to studies where comparative studies evaluating similar endpoints were done

Results

Enrollment & Baseline Characteristics:

• TOTAL - 1153 distinct articles
  • 970 articles found using search strategy
  • Additional 187 articles found through manual inspection of references
• 1062 excluded based on abstract information
• 42 more excluded after full text review
In 34 studies
- 35,465 catheters and 182,768 catheter days
  3 neonatal, 1 paediatric, 1 adult and paediatric, 44 adults only
- 42 studies restricted to ICU and critical illness monitoring
- 7 included post-surgical monitoring

Summary of primary & secondary outcomes:

**PRIMARY OUTCOMES**
- 202 arterial CRBSI in 30,841 arterial catheters
Journal Club Handout

- Pooled incidence 3.40/1000 catheters (95% CI 3.39-3.41)
- 0.91/1000 catheter days (95% CI 0.84-1.12)
  - 1.26/1000 catheter days (1.05-1.52) in studies where all catheters were cultured
  - 0.70/1000 catheter days (0.55-0.87) in studies where the catheter was cultured only if suspect

SECONDARY OUTCOMES

Age
- Age subgroup was not significant - as 97% of CRBSI were adults
- In neonates, 10 arterial CRBSI were reported for 356 catheters in 9586 catheter days
  - 18/1000 catheters
  - 2/1000 catheter days
  - all CRBSI were in umbilical catheters

Site
- Radial - 26 studies
  - CRBSI 0.3% (0.1%-0.4%) of all catheters
- Femoral - 19 studies
  - CRBSI 1.5% (0.8-2.2%) of all catheters
- In comparative studies, relative risk of infection 1.94 times greater femoral than radial (1.32-2.84, p<0.001, I²=17%)

Sterile Practices
- One study specifically evaluated the impact of full barrier precautions versus sterile gloves with no difference
- 1 study reported non-sterile insertion, 10 reported using sterile gloves only and 23 reported insertion with gown, mask, full barrier drape

Site Cleaning
- Povidone-Iodine vs Isopropyl alcohol vs Chlorhexidine
  - No statistical advantage detected in arterial line subgroup
- One study found no difference between iodine and triclosan vs nothing
- Other study compared the three cleaning solutions for arterial and Central lines showing favour to chlorhexidine but nothing statistically significant for arterial line subgroup

Maintenance Practices
- Chlorhexidine impregnated dressings from two studies showed a decreased in infections
  - RR 0.35 (0.13-0.91, I²=0%)

Pertinent figures/diagrams:
Figure 2. Forest plot of radial versus femoral catheter with regard to risk of infection. Solid lines denote CIs of effect size (ES) estimate for individual studies, box sizes denote the study weighting, dashed line denotes the combined ES, and the diamond denotes the CI for the overall effect size.

Author’s Discussion and Conclusions

Brief summary of Authors’ main discussion points:

- Arterial catheter remains under appreciated as a source of CRBSI
- Arterial site and manner of insertion has relevance in preventing BSI
  - Radial better than femoral
  - Chlorhexidine better for cleaning
- Maintenance of catheters can help reduce the risk of CRBSI

Your Discussion and Conclusions

Study strengths:

- Large selection of articles that were reviewed (over 1000 from initial search string and searching references)
- Reasonable methodology regarding primary outcome (good question to ask) and secondary outcomes
There were lots of secondary outcomes, not sure if they altered their p value threshold for the secondary outcomes.

Reasonable conclusions based on the information collected.

Definition of CRBSI used by CDC was the one used by study (standardized since ???)

**Study limits, weaknesses, Potentials for bias:**
- Time bias with articles that are dating back to 1970
- Difference in the way that catheters were built in 1970’s and 80’s vs now (open systems vs closed systems, access via Vamp/needleless systems etc.
- Definition used may not be accurate in regards to infections
  - Culture the tip which is floating around in the blood when the intradermal portion is the most likely spot for “line infection” when dealing with short term catheters in the skin
- Significance of the result in the context of a reduction in the number of arterial lines being placed as per previous article presented.

**Conclusions and Recommendations:**

- Arterial Lines are a potential source of infection
- Site selection is important (radials are less infectious risk than femoral or umbilical)
- Maintenance with chlorhexidine impregnated dressings is better for reducing infections