Short Peripheral IV Catheters and Infections

Lynn Hadaway, M.Ed., RN, BC, CRNI

Financial Disclosure

- Disclosure
  - Literature search commissioned and funded by BD Medical, Inc.
  - Lynn Hadaway is a paid consultant for BD Medical, Inc.

Peripheral IV Catheters

- 330 million sold annually in the USA
- Many unanswered questions about outcomes with their use
- Very little attention to infection risks
- Integrative literature review to thoroughly evaluate what is known
Learning Objectives

+ Explain the process and results of the integrative literature review.
+ Analyze the issues found in these publications.
+ Outline the current standards and guidelines for insertion and care of peripheral catheters.

Conflicting Approaches

+ National Healthcare Safety Network at CDC
  + Voluntary submission of infection data
  + Used for public reporting
  + CLABSI – central line associated bloodstream infection
  + Tip location in great thoracic vessel
  + No data on peripheral catheters
  + Surveillance definition
    + CVAD present within 48 hours before signs and symptoms develop
    + Not related to any other infected site
    + Produces an over-estimate of the true incidence

+ CRBSI – catheter related bloodstream infection
  + A diagnostic term including all catheters
  + Clinical and laboratory data to determine treatment
  + Paired blood cultures taken from catheter and peripheral site
  + Fever alone is not sufficient evidence to remove catheter
**Conflicting Approaches**

- Centers for Medicare and Medicaid (CMS)
  - No payment for treatment of certain hospital acquired conditions
  - "Vascular catheter-associated infection"
  - No restriction on type of catheter
  - No restriction on type of infection

**Literature Review Process**

- Search question
  - For patients of all ages and in all healthcare settings, what are the possible causes, outcomes, and prevention methods for all infectious complications associated with short peripheral catheters?

- Included all articles with data or discussion of any type of infection associated with short peripheral catheters from 2000 thru June 2011
- Excluded articles with data/discussion
  - Only on mechanical and chemical causes of phlebitis
  - Data on CVAD infection
Literature Review Process

+ Search Terms
  + Peripheral catheter
  + Peripheral IV catheter
  + Peripheral venous catheter
  + Peripheral IV catheter insertion
  + Peripheral venous catheter insertion
  + Venipuncture

+ Peripheral catheter complication
+ Peripheral catheter & infection
+ Peripheral catheter & phlebitis
+ Suppurative thrombophlebitis & catheter
+ Bacteremia & catheter
+ Bloodstream infection & catheter

Literature Review

1400 abstracts reviewed, 588 studies examined
45 met inclusion criteria

Final report published in Journal of Infusion Nursing, July/August 2012

Types of Infections

+ Local infections (case reports)
+ Cellulitis and soft tissue infections
+ Osteomyelitis
  + 3 children with osteomyelitis in close proximity to peripheral catheter site; skin organisms lead to thrombophlebitis and then osteomyelitis
Types of Infections

+ Phlebitis/thrombophlebitis
+ Ranges from 2% to 80%
+ 5% to 25% of peripheral catheters colonized with bacteria at removal
+ No data on rates of each type of phlebitis
+ Suppurative thrombophlebitis—purulent drainage from insertion site

Types of Infections – BSI/Bacteremia

Systematic Literature Review (Maki, 2006)
• Studies from January 1966–July 1, 2005
• 110 studies of plastic catheters
• 10,910 catheters; 28,720 device-days
• 13 BSIs = pooled mean rate of 0.1 event per 100 devices
• 0.4 pooled mean events per 1000 device days
• Lowest rates of all devices by percentage

Types of Infections – BSI/Bacteremia

Lowest Rates but High Absolute Numbers
• 330 million catheter sold annually in USA
• 2 attempts, 2 catheters per site
• 165 million inserted
• 165,000 patients with BSI annually
Types of Infection – BSI/Bacteremia

- Retrospective analysis of S. aureus bacteremia from July 2005 thru March 2008
- Blood and catheter tip cultures correlated to clinical findings

- 544 cases
  - 18 definite, 6 probably cases of bacteremia related to short peripheral IV catheters
  - 12% of all S. aureus bacteremias
  - 67% of definite cases inserted in Emergency Dept, 46% in right antecubital, 21% in left antecubital
  - Calculated rate of 0.06 bacteremias per 1000 catheter days
  - Annual adult patient discharge data from USA
  - Estimated as 828 S. aureus bacteremias annually in hospitalized adults

Author, Year, Country | Numbers | PVC Infection Rates Reported
--- | --- | ---
Maki, USA, 2006 Literature review spanning 38.5 years | 110 studies 10,910 PVCs 28,720 device-days | 0.1 BSIs per 100 devices 0.4 mean # BSIs per 1000 device days
Pujol, Spain, 2007 Descriptive study over 18 months | 147 patients | PVC < 77 (51%) or 0.19 cases/1000 patient days PVC 73 (49%) or 0.18 cases/1000 patient days
Nahirya, Uganda, 2008 | 391 PVC cultured catheter tip, hub, and blood | 81 (20.72%) colonized PVC tip 44 (11.25%) colonized PVC hub 19 (4.86%) with same organism at tip and hub 16 (4.09%) PVC tip with same organism as blood 7 (1.79%) with same organisms at tip, hub and in blood
Lee, Taiwan, 2009 | 3165 patients with 6538 PVCs Semi-quantitative culture of all catheters at removal. | 160/162 PVCs (99.8%) with phlebitis; showed no microbiological evidence of infection No purulent exit site infection No CRBSI
Webster, Australia, 2010 | 6 RCTs comparing routine change at fixed time interval vs when clinically indicated 1445 participants 1 trial in England 5 in Australia 4 published 2 unpublished | Catheter related bacteremia:
  - Low risk population = 1/1000 device days in both groups
  - High risk population = 7/1000 device days in routine removal group; 4/1000 removal when clinically indicated
Pathophysiology

- Not well understood
- Most likely mechanism of peripheral catheter-BSI
  - Colonization of the vascular catheter tract
  - Biofilm formation
  - Occurs during insertion and manipulation
- No evidence about the connection between thrombophlebitis and BSI (Zingg & Pittet, 2009)

Identified Clinical Issues – Catheter Design

- Ported catheters
  - German study found 27% of patients with possible infection from ported catheters (Grune, 2004)
  - 2495 catheters, 1582 patients
  - 104 events per 1000 catheter days
  - Fever and local signs and symptoms
  - No culture data provided

Identified Clinical Issues – Skin Antisepsis

- No studies supporting circular motion
- Very few studies provided any information about the agents, application technique or time, or drying time
- Venipuncture for blood culture and blood donor collection focuses on skin antisepsis
  - Numerous studies show better outcomes with chlorhexidine gluconate (McDonald, 2010; Ramirez-Arcos, 2010; Marlowe, 2010; Tepus, 2008)
Identified Clinical Issues – Skill of Inserter

Taiwanese study (Lee, 2009)
- By emergency dept nurses – 3.7% with phlebitis
- By IV nurses – 2.1% with phlebitis
- All phlebitis was considered to be infectious
- 180/312 phlebitis cases had microbial evidence of colonization
- No purulence or BSI's reported

USA study (Palefski, 2001)
- 639 catheters inserted by IV nurses; 137 inserted by generalists nurses
- 36% by generalist nurses, 20% by IV nurses removed for complication
- No reports of infection in either group

Identified Clinical Issues – Predisposition to Phlebitis

Higher rates with more than 1 catheter site
- 1st catheter with phlebitis = 5.1 X more likely to have phlebitis with subsequent catheter
- Pain on infusion with 1st catheter = 11.7 X more likely with subsequent catheters (Palefski, 2001)
- 1st catheter – phlebitis rates of 2.7%
- 2 or more catheters = phlebitis rate of 13.4%
  (Gallant, 2006)

Identified Clinical Issues – Vein Visualization Technology

Infrared light
- No infection data reported yet
- ED physicians inserting 18 g into deep basilic or brachial veins
- Chlorhexidine skin prep, sterile coupling gel, sterile transparent dressing covering probe
- No infections, 4% with infiltrations within 24 hours
  (Chergui, 2002)
- Retrospective data on 864 ED patients
  - 402 with traditional methods, 3 sterile tissue infections
  - 402 with ultrasound, nonsterile glove and nonsterile bacteriostatic lubricant gel, 2 skin/shaft tissue infections
  (Adhikari, 2010)

Ultrasound – 2 studies
- No infection data reported yet
- ED physicians inserting 18 g into deep basilic or brachial veins
- Chlorhexidine skin prep, sterile coupling gel, sterile transparent dressing covering probe
- No infections, 4% with infiltrations within 24 hours
  (Chergui, 2002)
Identified Clinical Issues – Catheter Stabilization

- Catheter with stabilization platform plus securement dressing
- Traditional catheter hub with stabilization device added

Multiple studies on stabilization devices
- None have included data on any type of infections
- Fewer unplanned restarts due to phlebitis reported

Identified Clinical Issues – Age Differences

Pediatric and neonatal patients
- 70% reduction in false positive blood cultures when drawn from separate venipuncture vs from a peripheral catheter insertion (Norburg, 2003)

Cultures of 391 peripheral catheter tips and hubs upon removal from hospitalized pediatric patients in Uganda
- 15.29% with tip colonization
- 4.88% with same organism in both locations, S. aureus most prevalent, followed by S. epidermidis (Nahirya, 2009)

Comparison of peripheral catheters to PICCs in low birth weight infants
- One study with more infections and deaths with peripheral catheters (Liossis, 2003)
- One study with more infections in the PICC group (Wilson, 2007)

Identified Clinical Issues – Healthcare Setting Differences

Infusion nurses in hospital and home care compared to generalist nurses
- Home care nurses data not reported separately (Palefski, 2001)

Very small study on frequency of flushing peripheral catheters in hospital, ambulatory and home care
- Not enough statistical power to draw conclusions (Campbell, 2005)
Limitations of the Literature Review

- Many practice differences between countries
- No data on each type of phlebitis
  - Mechanical
  - Chemical
  - Infectious
- Many studies reporting infection outcome but did not report on specific techniques
  - Skin antisepsis
  - Stabilization
  - Dressing

Standards & Guidelines

- Infusion Nursing Standards of Practice, Infusion Nurses Society, 2011
- Guidelines for the Prevention of Intravascular Catheter Related Infection, Centers for Disease Control, 2011
- Association of Safe Aseptic Practice

Hand Hygiene

- Methods
  - Soap and water wash
  - Alcoholic hand gels
  - NO artificial nails
- Before & after
  - Catheter insertion & removal
  - Maintenance care
  - Medication administration
  - Flushing & locking
  - Blood sampling
**Catheter & Site Selection**

- **INS**
  - Selection based on prescribed therapies, duration of therapy less than a week, availability of peripheral sites, diagnosis, known complications, and **inserter's experience**
  - Active or passive safety mechanism
  - Steel winged needle for short-term or single-dose administration
  - Upper extremity in adults; lower extremity may be used in infants
  - Nondominant arm, proximal to previous sites, avoid area of joint flexion
  - 1 catheter – 1 attempt!

- **CDC**
  - Adults – upper extremity
  - Pediatrics – upper or lower extremity or scalp in neonates and infants
  - Select catheters on the basis of the intended purpose and duration of use, known infectious and non-infectious complications and **experience of individual catheter operators**.
  - Duration greater than 6 days – choose midline or PICC
  - Evaluate site daily by palpation

**Skin Antisepsis**

- **INS**
  - Wash skin with soap and water if visibly soiled
  - Single-use containers of antiseptic agent
  - Chlorhexidine is preferred agent
  - Tincture of iodine, iodophor, and 70% alcohol may be used

- **CDC**
  - Prepare **clean** skin with 70% alcohol, tincture of iodine, iodophor or chlorhexidine
  - Follow manufacturer’s instructions for method of application
  - Allow to air dry; no wiping, fanning, blotting
Skin Antisepsis

- INS and CDC
  - Clean gloves for peripheral catheter insertion
  - Use sterile gloves to palpate vein after applying skin antiseptic agent

- Association of Safe Aseptic Practices
  - ANT-T: Aseptic Non-touch technique - Method to ensure aseptic preparation of peripheral insertion site
  - Once site prepped, do not touch unless sterile gloves are used
  - All invasive procedures warrant aseptic technique

Catheter Stabilization

- INS
  - Defined as device/system specifically designed and engineered to control movement at the catheter hub, thereby decreasing catheter movement within the vessel and risk of catheter malposition.
  - Shall be used to preserve the integrity of VAD, minimize movement, and prevent dislodgement & loss of access
  - Method does not interfere with assessment/monitoring of site; impede circulation or delivery of infusion
  - Stabilization device preferred over tape/sutures when feasible

- CDC
  - Use sutureless securement device to reduce risk of infection for intravascular catheters.
  - Recognized as an intervention to decrease risk of
    - Phlebitis
    - Catheter migration and dislodgement
  - May be advantageous in preventing CRBSIs.
Add-On Devices

- INS, Standard #18 & 26
  - Reduce the manipulation of all the components of the entire infusion system (e.g., administration set junctions, catheter hub) to as few as needed to deliver the infusion therapy
  - All administration set junctions
  - All catheter hubs
- Decrease potential for contamination with all add-on devices
  - Limited use of add-on devices to reduce
  - Number of manipulation episodes
  - Accidental disconnections or misconnections
  - Costs

Catheter Removal

- INS
  - Replacement when clinically indicated and when infusion treatment does not include peripheral parenteral nutrition
  - Decision to replace peripheral catheter based on
    - Assessment of patient's condition
    - Access site
    - Skin and vein integrity
    - Length and type of prescribed therapy
    - Venue of care
    - Integrity and patency of catheter
    - Dressing and stabilization device used
  - No routine replacement in pediatrics
  - With any patient complaint of discomfort or pain

Catheter Removal

- CDC
  - No need to replace peripheral catheters more frequently than every 72-96 hours to reduce risk of infection and phlebitis in adults
  - No recommendation is made regarding replacement of peripheral catheter in adults only when clinically indicated
  - Replace peripheral catheters in children only when clinically indicated.
Numerous Other Aspects of Infection Prevention

- Tourniquet – single patient use only
- Flush and lock solution only from single-use containers
- Scrubbing needleless connectors on all catheters with each entry
- Attach only sterile devices to all catheters
- Proper management of all infusion sets
- Do not disconnect continuous infusion sets from catheter
- Protect male luer end of sets used for intermittent infusion with sterile end cap
- INS – change every 24 hours
- CDC – change frequency is unresolved issue

Peripheral Catheters Cause Infection

Exact number and rates are hard to determine with current studies.

- Pathophysiology is not well understood
- Many cases go undetected
- Prevention is dependent upon knowledge and skill of caregiver following published standards and guidelines
- More studies are needed!!

Reference

- Download a complete evidence table with data from all studies at
  http://www.hadawayassociates.com/OutcomeData.pdf