Catheter-Related Complications: Risk Factors, Prevention, and Management of Infections

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Central Venous Access

- Crucial for providing TPN in patients with short gut syndrome/intestinal failure
- Access points
  - Jugular
  - Subclavian
  - Femoral
  - Less desirable
    - Intrahepatic, Intralumbar
Catheter Related Blood Stream Infections/Central line associated blood stream infections

• Serious and common complication of long term HPN
• Critical preventive measures to prevent infection
  – Parent/caregiver education
  – Strict adherence to aseptic technique
  – Standardized protocols for catheter management

Loss of vascular access is an indication for intestinal transplant

Ross et al Am J Infection Control 2016 Dec 1;44(12):1462-1468
Catheter Related Blood Stream Infections/Central line associated blood stream infections

- Associated with high risk pediatric populations
- HCUP National Inpatient Samples
  - Increase length of stay of 19 days
  - Hospital costs $55,000
- Adults
  - Increased mortality 2.27
  - $32,000


How do we approach this problem?
Risk Factors
• Dataset created by ASPEN in 2011
  – Designed to collect and compile data on pediatric and adult home parenteral nutrition (HPN) patients.
  – N=1046 patients from 29 sites
  – 112 (10.7%) had Central line associated blood stream infections (CLABSI)
    • 0.87/1000 PN-days
  – Higher rates
    • M vs F (0.69 vs 0.38, p=0.005)
    • Children (1.17 vs 0.35, p<0.001)
    • Blacks (0.91 vs 0.41, p=0.0035)
    • Medicaid recipients (1.0 vs 0.38, p=0.0171)

Ross et al Am J Infection Control 2016 Dec 1;44(12):1462-1468
Ross et al *Am J Infection Control* 2016 Dec 1;44(12):1462-1468
Ethanol Locks
Ethanol Locks

• Ethanol locks are contraindicated in the following:
  – Patients younger than 6 months of age
  – Patients with an allergy or sensitivity to ethanol
  – Patients with a CVC made of polyurethane (ex: PICC lines)
• Instilled for 2-6 hours

Variation in practices
  with different concentrations of ethanol, dwell time
• N=130
  – Nine articles 2008-2016
  – Mean difference in infection rates favoring ethanol
    • 6.27 /1000 catheter days (95% CI, 4.89 - 7.66)
    • 63% reduction
  – Mean difference in catheter replacement rates
    • 4.56 ( 95% CI, 2.68 to 6.43)
  – Mean difference in catheter repair rate
    • -1.67 ( 95% CI, -2.3 to -1.05)

Ethanol locks had lower infection rates and catheter replacements but increased catheter repairs=

?? Integrity of the catheter

Rahhal et al *JPEN* 2018;42:690-701
Central venous catheter salvage in home PN CRBSIs

- **N=588 1993-2011**
- **297 CRBSIs occurred in 137 patients**
  - 65 single
  - 72 multiple
  - 0.38/1000 catheter days.
  - 88% or organisms were single

- **Not attempted**
  - **N=49**
    - Sepsis, fungal infection, catheter problems
    - 5 deaths
      - 2 severe sepsis, 3 metastatic infection

Catheter related blood stream infection salvage rate

- CNS 79%
- Multiple organisms 70%
- Gram Negative Bacteria
- MSSA 56%
- MRSA 33%
- Gram Positive bacilli 44%
- Miscellaneous 88.5%

34% of the lines were removed

Quality Improvement Initiatives
Quality Improvement

• 3 Fundamental Questions
  – What are we trying to accomplish?
  – How will we know that change is an improvement?
  – What changes can we make that will result in improvement?
Quality Improvement

• **Specific** (clearly state goals)
• **Measurable** (numeric metric: counts, proportions)
• **Achievable/Actionable** (within your power to implement)
• **Realistic/Relevant** (feasible, aligns with institutions’ priorities)
• **Timely** (occurs within a specific time frame)
Key Driver Diagram

**Key Driver**
- Standardized pre-arrival process
- Family engagement
- Standard post-arrival process
- Pre-occupation with failure
- Staff Engagement

**2° Drivers**
- Rapid identification and segmentation of febrile IF populations
- Pre-arrival preparation of antibiotics
- Timely vascular access
- Timely rooming and assessment
- Pre-arrival prep of room and supplies
- Communication with family, GI and ED.

**Global Aim**
Improving outcomes by decreasing time to antibiotics

Increase % of IF patients who received antibiotics within 60 minutes of ED arrival from 46% to 90%
A Quality Improvement Initiative to Decrease Time to Antibiotics for Children with Intestinal Failure, Fever, and a Central Line

- Applied QI approach from oncology
- N=276 encounters from November 2012 to March 2017 of IF patients
- Sustained reduction from median time of arrival to antibiotic administration 71 – 45 minutes
- Time to antibiotics < 60 minutes in 77% of their IF

This data was not sufficient to examine the impact on outcome

Harihandan et al Ped Quality Safety 2018
Central Catheter-Associated Bloodstream Infection Reduction With Ethanol Lock Prophylaxis in Pediatric Intestinal Failure

- N=24, Median age 3, 18 M
- Underlying Diagnosis
  - SBS 17 (71)
  - Motility disorders 4(17)
  - Intestinal transplant 3(12)
- Median residual small bowel length 48 cm (20-150)
- 63% had Broviacs
- 75% cycled antibiotics

Ardura et al JAMA Pediatrics 2015:169:324-331
• Protocol
  – Aseptic technique
  – Daily dressing changes/site assessment specialized CVC nurse or parent
  – 2-15 second alcohol scrub with each catheter entry
  – Alcohol impregnated disinfection caps
  – 70% alcohol, amount dictated by weight
Central Catheter-Associated Bloodstream Infection Reduction With Ethanol Lock Prophylaxis in Pediatric Intestinal Failure

- 14 children > 3 months
- CCABSI rates/1000 catheter days
  - 7.01 vs 0.64  p=<0.001
- CCABSI/patient, Median (range)
  - 2 (0-9) vs 0 (0-2) p=0.004
- New central catheter insertions
  - 3(0-6) vs 0 (0-2) p=0.001

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• New central catheter insertions
  – 3(0-6)  vs 0 (0-2) p=0.001
• No differences
  – Catheter repairs
  – Uses of tPa or cysteine
  – Catheter occlusions
  – Hospitalizations or durations

A best-practice CCABSI prevention bundle using ethanol locks successful, safe, and decreased risk of infections in children with IF.

Ardura et al JAMA Pediatrics 2015:169:324-331
Portions of maintenance bundle

- Change CVC dressing and site care every 7 days
- Scrub with alcohol 15 s for each entry
  - Cover connectors
- Use of Chlorohexidine patch for all dressing changes
- Distraction free zone
- Daily discussion for need
- Peripheral blood draws
- Minimize use of the CVC
- Daily bathing
Enhanced central venous catheter bundle for pediatric parenteral-dependent intestinal failure

- January 1, 2013 – Feb 28, 2017
- Pre-intervention compliance 56-97% following education 1/2016
- Pre-intervention 1679 encounters vs 613 Post-intervention
- Median age 4 years
- Similar length of stays


2019 Oley Ul Health Combined Conference June 21–24 • Marriott Resort Lincolnshire
Enhanced central venous catheter bundle for pediatric parenteral-dependent intestinal failure

- January 1, 2013 – Feb 28, 2017
- Pre-intervention compliance 56–97% following education 1/2016
- 3 months > 90% compliance
- CLABSI rates 1.41/1000 days to 0.4/1000 days
  -  P=0.003
  - 85% absolute reduction in CLABSI rates over 12 months

Maintenance bundles may be beneficial

New Frontier
Taurolididine

• An antimicrobial agent that permanently binds to the cell walls of bacteria and fungi, resulting in the prevention of microbial adherence.
• Inhibits microbial toxin
• Resist the emergence of resistant microbial organisms

Tribler et al *Am J Clin Nutr* 2017;106:839-848
Clinical outcomes of home parenteral nutrition patients using taurolidine as catheter lock: A long-term cohort study

- N=270
  - F 193 (72)
- SBS 117 (43)
- GI dysmotility 95 (35)
- More on opiates

- N=10
  - F 10 (100)
  - SBS 3 (30)
  - GI dysmotility 7 (70)
  - HPN longer than other cohort

Wouters et al Clin Nutrition 2018 in press
Clinical outcomes of home parenteral nutrition patients using taurolidine as catheter lock: A long-term cohort study

- N=24 patients had adverse events 2% taurolidine
- Median time to adverse events 596 (IQR 281-1853)
- No life threatening events
  - 2/3 patients had an anaphylactic rate
  - Increased CLABSI rate 4.01 (95% CI 1.23-13.04) switched to NS

Wouters et al Clin Nutrition 2018 in press
### Incidence of catheter-related complications in patients using Taurolidine or Saline locks

Wouters et al *Clin Nutrition* 2018 in press

Lower age, non-tunneled catheters infusion frequency

<table>
<thead>
<tr>
<th></th>
<th>Events</th>
<th>Catheter Days</th>
<th>Rate (95% CI)</th>
<th>Adjusted Rate Ratio (95% CI)</th>
<th>P-Value</th>
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<tbody>
<tr>
<td><strong>Tauro</strong> (n = 270)</td>
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<tr>
<td>CLABSIs</td>
<td>203</td>
<td>338521</td>
<td>0.60 (0.52 – 0.69)</td>
<td>4.01ᵃ (1.23 – 13.04)</td>
<td>0.02</td>
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<tr>
<td>CRVTs</td>
<td>95</td>
<td>338521</td>
<td>0.28 (0.23 – 0.34)</td>
<td>0.95ᵇ (0.23 – 4.02)</td>
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<tr>
<td>CVAD Occlusions</td>
<td>39</td>
<td>338521</td>
<td>0.12 (0.08 – 0.16)</td>
<td>0.89ᶜ (0.07 – 11.06)</td>
<td>0.93</td>
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<td><strong>Saline</strong> (n = 10)</td>
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<tr>
<td>CLABSIs</td>
<td>13</td>
<td>8225</td>
<td>1.58 (0.87 – 2.60)</td>
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<td>CRVTs</td>
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<td>0.24 (0.04 – 0.75)</td>
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<td>CVAD Occlusions</td>
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<td>8225</td>
<td>0.12 (0.01 – 0.53)</td>
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Conclusion

• Number of risk factors
  – Number of lumens, type of line, race, gender, caregiver

• Management
  – Meticulous care of the line
  – Maintenance bundles/QI initiatives have shown effectiveness

• Prophylaxis/Treatment
  – Ethanol locks

• Newer therapies
  – Taurolidine (not available in US)