THE SIDNEY KIMMEL COMPREHENSIVE CANCER CENTER

Evaluating Intravenous Needleless Connectors: An Evidenced Based Practice Project

JOHNS HOPKINS NURSING

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Significance and Background

According to the Centers for Disease Control and Prevention (CDC) catheter-related bloodstream infections (CR-BSIs) remain a major cause of morbidity and mortality in the U.S. The design of intravenous (IV) needleless connector (NC) plays a substantial role in CR-BSI risk. NC technology has changed greatly in the past twenty years. Approximately ten years ago our National Cancer Institute-Designated Comprehensive Cancer Center (NCI-CCC) made the decision to use a conventional open system for central lines based on increasing CR-BSI rates associated with the introduction of a (then) new positive pressure needleless valve.

Purpose

1. Identify differences between NCs
2. Identify causes of bio-film
3. Identify differences between a split tip and mechanical valve NC
4. Identify at least three characteristics of a NC associated with decreased CR-BSI

Interventions

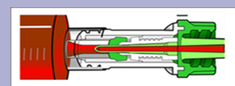
The advanced practice group and a graduate clinical nurse specialist student, completed the EBP project. A literature review used the following MeSH terms: needleless connector, IV connector, positive pressure valve, negative pressure valve, neutral pressure valve, and biofilm, infection /contamination rates. Twenty-five articles were reviewed utilizing the Johns Hopkins Nursing EBP model. Thirteen were included in the EBP review. The use of a systematic evidenced based practice review is an appropriate strategy for product evaluation and helps to remove product bias when choosing to use a new device in healthcare.

Evaluation of Literature

The EBP evaluation of the literature revealed the following. Increased infection rates were identified with the use of NPNC . Decreased infection rates were identified in PPNC compared to NPNC, but inferior rates when compared to split septum and NNP devices. The literature supported decreased infection rates in split septum devices, but increased risk for inappropriate use with blunt cannula access. Of the devices identified in the literature, infection rates were lowest in NNCs, with an internal split septum design.

Discussion

NCs are an example of technology that has been evolving over the past two decades. Because of this, no one study has compared all types of NCs together. Instead, characteristics of NCs that were associated with reduced infection rates were identified from the literature and formed the basis for the EBP recommendations.



Straight Fluid Path
Neutral Needleless Connector
Minimal Priming Volume
Minimal Dead Space

Factors Associated with CR-BSI

Biofilm

- A collection of microorganisms adhering to a internal surfaces of indwelling medical devices (e.g. NCs)
- Complicated fluid pathways create areas that lie outside of the fluid path creating surfaces that promote biofilm.
- Residual inter-lumen/NC blood promotes biofilm growth

Needleless Connector Design

- Blunt cannula allows for straight fluid path, but may encourage inappropriate practice that may lead to needle sticks since needles may be used in addition to blunt cannula needles
- Mechanical valves are luer-activated with internal moving mechanisms that have increased surface areas/complicated fluid paths promoting biofilm
- Split Septum allows for a straight fluid path inside connector and minimizes surface area and promotion of biofilm

Characteristics of NC

Negative Pressure Needleless Connectors (NPNC)

- Requires Clamping Sequence to prevent backflow of blood

Positive Pressure Needleless Connectors (PPNC)

- Requires Clamping Sequence to prevent backflow of blood
- Designed to create positive fluid displacement upon disconnection

Neutral Needleless Connectors (NNC)

- Specific flushing sequence not required to prevent backflow of blood

Priming Volume

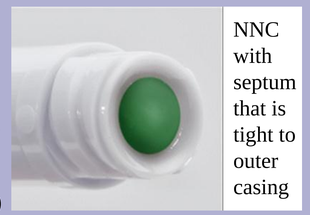
- Correlation between large priming volume and increased formation of biofilm

Dead Space

- The area inside the construct of the NC into which fluid can leak and become trapped promoting biofilm

Hub Contamination

The CDC recommends isopropyl alcohol hub cleansing. In-house hub cleaning testing with ultraviolet (UV) light under the supervision of Hospital Epidemiology and Infection Control (HEIC) demonstrated superior hub cleaning of NNC (No visible contamination Under UV light) when compared to current in-house NPNC.



NNC with septum that is tight to outer casing

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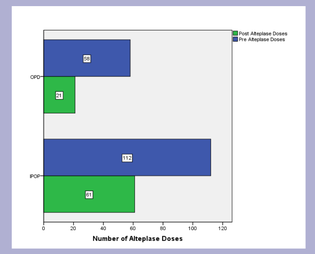
References available on request.

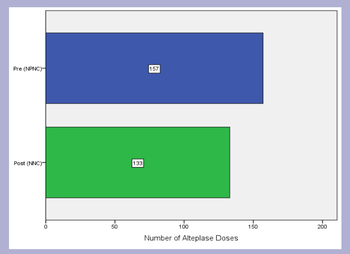
Evaluation

Based on our EBP project, a neutral internal split septum design NC was successfully piloted in our NCI-CCC. This NC included variables identified with lower infection rates (straight fluid path, neutral design, and minimal dead space and priming volume) as compared with other NCs. Additional findings include decreased use of alteplase for declotting catheters in both the Oncology out-patient (OPD) and in-patient settings.

Oncology Out-Patient: Alteplase Doses
Pre (NPNC) IPOP Nov. 2011-Apr. 2012
Post (NNC) IPOP May 2012-Oct. 2012
Pre (NPNC) OPD Nov 2011- Feb 2012
Post (NNC) OPD Sept. 2012-Dec. 2012



Oncology In-Patient Alteplase Doses
Pre (NPNC) Jan. 2012-April 2012
and Post (NNC) Oct. 2012-Jan. 2013



CR-BSI rates following the pilot period in the in-patient setting showed a modest decrease. Currently out-patient infection rates are not calculated by HEIC. The pilot is currently being completed in a non-oncology setting and based on similar finding will be implemented across the hospital's adult patient population.

Oncology In-Patient CR-BSI
Pre (NPNC) May 2012-Aug. 2012
Post (NNC) Sept. 2012-Dec. 2012