Neutral Displacement Intravenous Connectors: Evaluating New Technology

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Abstract

Background: *The University Hospital of Northern British Columbia (UHNBC) utilized an opaque positive displacement intravenous (IV) line connector in 2011 and for several years previously. With concerns generated in the United States surrounding positive displacement and the potential increased risk for infection, as well as the training requirements related to ensuring that a proper clamping sequence was followed, a neutral displacement IV connector was implemented in October 2011.*

Methods: *Catheter-related blood stream infections and catheter occlusions were monitored at UHNBC for 4 months before (June through September 2011) and 4 months after (November 2011 through February 2012) the implementation of the neutral displacement IV connector by the Parenteral Services nursing team. A staff survey was conducted that reviewed the satisfaction with the newly implemented IV connector.*

Results: *The results of tracking catheter occlusions with a neutral displacement IV connector showed an average of 4.04 occlusions that required tissue plasminogen activator per 1,000 catheter days, compared with 5.47 occlusions that required tissue plasminogen activator per 1,000 catheter days with the positive displacement IV connector. During the evaluation period there was a 26% decrease in catheter occlusions with the implementation of the neutral displacement IV connector. Blood stream infection rates remained at zero for the entire evaluation with both displacement types of IV connectors. Nursing staff members were satisfied with the newly implemented IV connector.*

Conclusions: *UHNBC will continue to utilize the neutral displacement IV connector hospital-wide, and continues to monitor both catheter occlusions and catheter-related blood stream infections. Following UHNBC, facilities in the rest of Northern Health have implemented the neutral displacement IV connector.*

Keywords: *neutral displacement, catheter occlusions, CRBSI, IV connector*

Introduction

Infusion therapy, although seemingly a simple and nonrisky therapy, can be exceedingly complex. From selecting the appropriate vasculature, to ensuring the appropriate tubing is utilized, a number of practices and technologies plus the skill levels of health care practitioners are to be considered in the achievement of excellent patient care. Given the complexities, new technology in the field of infusion therapy therefore needs to be assessed within the clinical setting in which it will be utilized.

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Catheter-Related Blood Stream Infections (CRBSIs)

In recent years, an increasing amount of attention has been given to hospital acquired infections (HAIs), including CRBSIs.[1] Given the potentially devastating effects of a CRBSI on a patient, as well as the significant cost burden on already stretched hospital budgets, it is no wonder why this is the case.[1] Organizations such as the Canadian Patient Safety Institute[2] have instituted programs such a Safer Healthcare Now (SHN) to assist hospitals across Canada in both adopting effective strategies to reduce the incidence of HAIs, including central line associated blood stream infection in the form of "bundles," as well as to monitor how strategies have affected outcomes.[3] Outcome monitoring allows hospitals to understand the efficacy of strategies that come in the form of practice or technology changes. For example, SHN assists hospitals in understanding how to track CRBSI rates through a specific and standardized formula that takes in account the number of

catheter days. Once a strategy has been implemented, a hospital can continue to track infection rates accordingly to evaluate the influence the strategy has had on patient outcomes.[3] This is sometimes referred to as a quality improvement process.

In several provinces across Canada there are systems through provincial health bodies that allow the reporting of HAI results to the provincial ministries, the public, or both. In Ontario, the Ministry of Health and Long Term Care's Patient Safety Indicators showcase individual hospitals' central line infection rates and allows them to be compared with like-sized hospitals across the province.[4] In other provinces in Canada, such as Quebec, this system is not yet viewable by the public.

Another topic of relevance to CRBSI is the launch of the Quality Improvement Plan through the Excellent Care for All Act in Ontario and perhaps to be replicated in other provinces.[5] As a part of the Quality Improvement Plan, hospital administrations must declare certain quality indicators that they will target for improvement during a given year. With HAIs, including CRBSI, being a part of this plan, there is a heightened awareness of ensuring practice and product changes do not negatively affect outcomes.

Catheter Occlusions

In recent years, there has been an increasing amount of attention on catheter occlusions. The focus of much of this attention is related to the detrimental effects of an occluded line on a patient, as well as the costly repercussions of line occlusion.[6] Recently, there has been inquiry into the potential link between catheter occlusions and the development of a CRBSI, increasing the attention on catheter occlusions by health care providers even more. This has come in the form of questions to speakers at conferences such as the Infusion Nursing Society Annual Convention in Las Vegas, NV, during April 2012, and the Canadian Vascular Access Association Annual Conference in Montreal, Canada, during May 2012.

Unlike the procedure for tracking CRBSI, many hospitals do not track their rates of occlusions and are unaware of how to accomplish this task. Methodologies that look at the occurrence of each occlusion (ie, point prevalence) are sometimes completed more regularly in hospitals that utilize electronic documentation systems or have dedicated infusion therapy teams, and therefore have data easily accessible. In hospitals that are aware of the number of catheter days present, the number of times a dose of Cathflo Activase (Genentech, Inc, San Francisco, CA) is dispensed can be utilized as a proxy for understanding a general occlusion rate.[7] Although this methodology is not without error, it will give clinicians a general understanding of how often occlusions occur.

Given the multiple factors that contribute to catheter occlusions as well as the detrimental effects of catheter occlusions, it is important that monitoring of occlusion rates occur similarly to that of CRBSIs.

Intravenous (IV) Connectors

There has been great debate over needleless connectors and their influence on catheter occlusions and CRBSIs. Broadly, needleless connectors can be divided into 2 main categories: mechanical and split septum. This categorization is based on the design both internally and externally of the needleless connector.[8]

Split septum IV connectors are an older form of technology and have been sometimes recognized as aiding facilities in the ability to achieve excellent rates of CRBSI.[8] On the other hand, because these IV connectors are needle-accepting, there is risk to health care workers in accidently contracting a sharps injury. A sharps-related injury would only occur if a health care worker decided to not use the plastic cannula provided. In a recent study it was showcased that needlestick injuries decreased when a facility went from a split septum technology to a luer activated technology. This is evidence that health care workers did not always use plastic cannulas when employing spilt septum technology.[9]

Mechanical IV connectors have been divided into 3 groups according to their displacement type.[8] The first is a negative displacement IV connector. In a negative displacement IV connector, there is blood reflux into the catheter upon disconnection of a syringe.[8] Therefore, negative displacement connectors may affect catheter occlusion rates in a negative way by increasing the number of thrombotic catheter occlusions. A very specific clamping sequence utilizing positive pressure flushing must be completed each and every time the IV connector is accessed to ensure catheter patency.

The second type of IV connector uttilizes positive displacement. These connectors were originally designed to help prevent catheter occlusions; however, there have been concerns about their potentially negative influence on CRBSI.[10-12] Positive displacement IV connectors have reflux into the catheter upon syringe connection, and reflux out of the catheter upon syringe disconnection. To ensure that reflux occurs out of the catheter upon syringe disconnection, clamping must occur after the syringe is disconnected.

The third type of IV connector is a neutral displacement IV connector. This IV connector has been designed to help reduce occlusions and CRBSI due to its minimal reflux after syringe connection or disconnection.[8] This type of IV connector is relatively new to the Canadian market. There is no specific clamping sequence for this IV connector.

Background

The University Hospital of Northern British Columbia (UHNBC) utilized an opaque positive displacement IV connector in 2011 and for several years previously. With concerns generated in the United States surrounding positive displacement and the potential increased risk for infection, it was decided to evaluate a clear neutral displacement IV connector that was not associated with these risks. One of the criteria in selecting an IV connector was that it was clear/transparent and therefore the fluid pathway was visible to the clinician. A neutral displacement IV connector with this design feature was chosen and implemented during October 2011. The newly implemented IV connector was then evaluated for 4 months on all patients with peripherally inserted central catheters (PICCs).