PICC Occlusion Rates: Prospective Study Comparing Positive Pressure I.V. Connector versus Neutral Displacement I.V. Connector

Karen White RN, BSN, CCRN, CRNI
PICC Coordinator North Colorado Medical Center, Banner Health

Background

Catheter occlusion is the most common noninfectious complication associated with the use of venous access devices. (Klerk CP,2003) Persistent withdrawal occlusion is the inability to aspirate blood from a CVC. The CVC may or may not flush easily because a fibrin tail on the opening of the catheter or fibrin build-up on the lumen wall. Persistent withdrawal occlusion rates of occurrence reported in the literature is 62% to 100% (depending on VAD type). (Chernecky 2003) A complete intraluminal thrombotic occlusion occurs when a blood clot completely occludes the internal lumen of the catheter. This can occur over time as blood residue builds up on the intraluminal surface of the catheter as a result of blood reflux. There are two causes of reflux; physiological (internal) and mechanical (external). Physiological reflux occurs when negative pressure occurs in the thoracic cavity with respiration, coughing, or vomiting. Mechanical reflux is associated with repeated blood reflux episodes associated with connection to or disconnection from an IV connector. (Macklin 2006) Partial or complete thrombotic occlusions translate into increased costs and decreased patient quality of life. A projected annual cost for the treatment and troubleshooting intraluminal thrombotic catheter occlusions is $4.5 billion within the U.S. (Macklin,2006).

Key to the prevention of thrombotic occlusions is prevention of repeated mechanical reflux episodes. Clinical practice has evolved with connector technology to minimize the effects of blood reflux episodes related to I.V. connectors. With split septum designs and original Luer-activated IV connectors, positive pressure is applied to the syringe plunger and than the clamp closed prior to disconnection. With the current positive-push IV connectors the reflux episode occurs with connection. It is imperative that the clamp is not closed with disconnection when a positive push occurs to clear the catheter tip. A final heparin flush is common practice to help minimize fibrin aggregation.

Conceptual Frame work

The theory of practice based on Levine's conservation model in nursing practice (Faucett 1995) speaks to therapeutic regimens that provide treatments in medical surgical areas. This study begins to lend support for using neutral pressure I.V. connectors in specific nursing population as a intervention for reducing catheter occlusions and in improving quality patient care.

Purpose

The study purpose was to determine whether eliminating repeated reflux episodes by using a neutral displacement I.V. connector and saline only flush would lower PICC occlusion rates.

Methods

A prospective study (PS) with retrospective data for comparison was implemented on consecutive patients. During a ninety day period between August and October 2005, a neutral displacement I.V. connector (InVision-Plus® Neutral™ RyMed Technologies Inc. Franklin, TN) was placed on all new peripherally inserted central catheters (PICCs) inserted in intensive care unit (ICU), inpatient oncology (IPO) and outpatient oncology (OPO). During this time period 400 PICCs were inserted (table 1) using ultrasound. Total enrollment breakdown by unit: Intensive Care Unit (ICU) 180; Inpatient Oncology 109; Outpatient Oncology 111. These PICCs were flushed with 10 mL normal saline q12hr using a push-pause flushing technique.

The baseline data for occlusion rate comparison was compiled from retrospective chart review (RS) of 400 patients who had received PICCs in ICU, OPO and IPO during a ninety day period preceding the study between May and July 2005. (Table 1) Total patient enrollment breakdown by unit; ICU 169, IPO 126, and OPO 105. These PICCs were flushed with 10mL Normal saline followed by 3 mL 100 unit heparin flush q12hr.

Sample: Retrospective

A total of 244 males and 156 females were included in the three month baseline group. All were adults ranging in age from 20 -81. Diagnoses of ICU patients were trauma, cardiac, and multi-system failure. In inpatient oncology diagnoses were breast, acute and chronic lymphocytic leukemia, ovarian, non-hodgkins lymphoma, melanoma, lung, colon, bone, prostate, stomach, glioblastoma multiform, and lupus. In outpatient oncology diagnoses included osteomyelitis, polycythemia, cellulitis, wound infection, ovarian cancer, dog and cat bite. The PICC s were placed in the left upper basilica, left upper brachial, right upper basilica, right upper brachial and right upper cephalic. (Table 2)

Table 1

	ICU			IPO			OPO		
Number of Lumens	1	2	3	1	2	3	1	2	3
Prospective		57	123		109		69	42	
Retrospective		40	129		126		62	43	

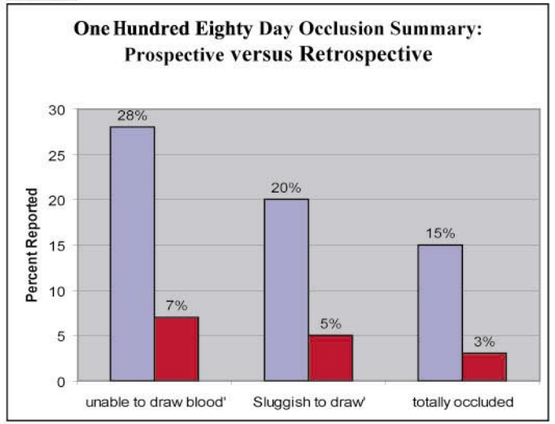
Table 2

Location	ICU		IPO		OPO	
	PS	RS	PS	RS	PS	RS
Left Upper Basilic	93	129	57	72	67	64
Left Upper Brachial	26	16	24	27	22	5
Right Upper Basilic	31	24	18	19	17	19
Right Upper Brachial			10	6	3	15
Right Upper Cephalic			2		2	2

Table 3

	ICU		IPO		OPO	
	PS	RS	PS	RS	PS	RS
Unable to draw but flushes	18	58	6	30	5	24
Sluggish to flush and draw	11	39	3	15	6	26
Total occlusion	10	38	4	9	3	13

Table 4



Blue – Retrospective
Red – Prospective

Sample: Prospective

All consecutive patients admitted to the ICU, IPO, and OPO who required a PICC were included in the study. A total of 277 males and 173 females were included in the three month study group. All were adults ranging in age from 23 – 83. Diagnoses were equivalent to the retrospective group but the samples were not matched. The PICC s were placed in the left upper basilica, left upper brachial, right upper basilica, right upper brachial and right upper cephalic. (Table 2) Totals for the study group: left upper basilic 217, left upper brachial 72, right upper basilic 66, right upper brachial 13, and right upper cephalic 4. For the baseline group: left upper basilic 265, left upper brachial 48, right basilic 62, right brachial 21, and right cephalic 2. Exclusion criteria included < than 19 years old and did not require a PICC.

Both the prospective study and the retrospective baseline samples were similar in size, gender, age, and PICC insertion site. The number of lumens were comparable in each group by location.(table 1) Patients in the ICU received mostly triple lumen catheters and some double lumens. In out patient oncology double lumen PICCs were exclusively used. While in outpatient oncology single lumen and double lumen PICCs were inserted.

Results

By unit there were reductions of: ICU 38% unable to draw but flushes, 28% sluggish to flush and draw, 26% total occlusion; IPO 20% unable to draw but flushes, 20% sluggish to flush and draw, 20% total occlusion; OPO 21% unable to draw but flushes, 23% sluggish to flush and draw, 23% total occlusion. (Table 3) Total occlusion rate summary prospective versus retrospective is reviewed in Table 4.

Conclusion

Using the neutral displacement valve and saline flush only resulted in 21% decrease "unable to draw blood"; 15% reduction "sluggish to draw "12% "totally occluded". Final heparin flushes were eliminated ($0.87 savings per flush). This study demonstrated that neutral displacement I.V. connectors hold promise in reducing occlusion related problems in patients requiring PICCs.

Discussion

Occlusions (partial or complete) can increase patient's hospital stay, disrupt their therapeutic regimen, may waste scheduled medication, interrupt healthcare providers work routine, and may result in catheter removal and if necessary replacement. Product design as well as patient factors and the care received impacts occlusion rate outcomes. It is therefore appropriate to focus on product design issues. The neutral displacement I.V. connector utilized in this study offers a design solution eliminating repeated reflux episodes and dead space (0.027 mL).

Limitations

Lack of randomization or matched samples

Site specific settings in one geographic location

Inclusion of patients on anticoagulant therapy

No data on co-morbidities.

Implications for Nursing

1. Neutral displacement I.V. connectors reduce repeated reflux episodes playing an important role in reducing occlusion rates in PICCs.
2. Streamlining flushing protocols improves protocol adherence and saves healthcare dollars.
3. Further robust methodological studies need to be implemented to determine the significance of neutral displacement IV connectors on occlusions in all VADs in order to affect evidenced based practice.

Awarded 1st place for the best clinical poster presentation at the 20th Annual Association for Vascular Access Conference, September 2006, Indianapolis, IN