Keeping the Lines Open with Evidence-Based Practice and Advanced Technologies

A continuing educational activity for pharmacists and nurses

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Learning Objectives

- Explain the relationship between catheter-related bloodstream infections and thrombotic occlusions and why this is important
- Give examples of appropriate techniques and interventions to prevent blood reflux, thrombotic occlusions and CRBSIs
- Describe available technology to prevent intraluminal blood reflux and improve patient care

Designation Statements

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VHA Inc. is accredited as a provider of continuing nursing education by the American Nurses Credentialing Center's Commission on Accreditation.

This program is designated for 1.00 hours.

VHA Inc. is approved by the California Board of Registered Nursing, Provider Number CEP12580, for 1.20 contact hours.

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Universal Program Number: 546-000-11-029-H05-P – Home Study

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Intravascular catheters are indispensable in modern-day medical practice and are necessary to provide vascular access. They can, however, put patients at risk for complications from catheter-related bloodstream infections, or CRBSIs. CRBSIs are life-threatening infections and account for significant medical costs – about $2.3 billion annually in the United States.[1] This education program is designed to empower clinicians caring for these catheters with tools to prevent complications and promote positive outcomes for patients.

OVERVIEW OF CENTRAL ACCESS DEVICES

Central access devices have a variety of uses. The most common is to provide a reliable infusion route for medications of all types. The termination of the tip in the central circulation allows infusion of medications like total parenteral nutrition (TPN) that would cause damage to the peripheral veins which allow a much smaller volume of blood flow. Central catheters are also used to monitor central venous pressure, allow frequent blood draws, and provide a temporary access site for dialysis. The devices are generally categorized by use for short-term, long-term, or dialysis.

For short-term use (7 to ten days), a centrally placed catheter is generally used. These catheters can have single to quad lumen ports (Figures 1, 2).


Fig. 1


Fig. 2

These temporary catheters are often placed at the bedside using the subclavian, internal jugular, or femoral vein. Although there are conflicting studies regarding which site is preferred, the femoral approach is well documented to have the highest rate of infection and should only be used if the subclavian or internal jugular approach is not an option. One study shows that the subclavian insertion site has a lower incidence of infection than a femoral vein insertion site with statistics showing a rate of 1.2 infections per 1,000 catheter days for the subclavian versus 4.5 per 1,000 catheter days for the femoral.[2] The subclavian vein has a lower rate of thrombosis formation – 1.9% is generally presented in the literature – versus the femoral which has a thrombosis occurrence rate as high as 21.5%.[2] New studies directly comparing the internal jugular and subclavian approach in various settings would help to resolve the question of which of the two sites have fewer complications.

For long-term use (30 days to several months), either peripherally or centrally placed central catheters can be used. Centrally placed catheters in this category are generally tunneled catheters, totally implanted ports, and temporary dialysis or pheresis catheters (Figures 3, 4).


Fig. 3


Fig. 4

To prevent infection, these catheters are placed in the operating room or in the radiology suite under strict sterile technique. Available with up to three lumens, they are used for chemotherapy, blood products, long-term TPN, blood sampling, long-term antibiotic treatment and dialysis.

A peripherally inserted central catheter (PICC) is peripherally placed, but is considered a central catheter because its tip terminates in the central circulation. These venous catheters can also have single, double or triple lumens (Figures 5, 6) and are for intermediate to long-term therapy for blood draws or infusions. Newer power-injectable devices are capable of withstanding the high flow and pressure of power injection needed in many radiological tests and eliminate the need for placement of a large bore peripheral IV for these studies.

Fig. 5

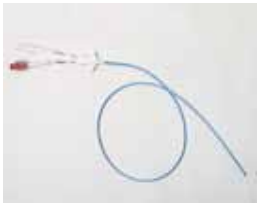

Fig. 6

Catheter complications

Many different types of central venous catheters are used in the hospital setting with more than 5 million central venous catheters being placed every year in the United States alone. The Centers for Disease Control and Prevention (CDC) reports 1.7 million healthcare-associated catheter infections per year resulting in 99,000 deaths per year.[3]

The three major types of complications most commonly associated with central venous catheters are mechanical, thrombotic, and infectious. Mechanical complications such as pneumothorax, hematoma, and accidental arterial puncture occur at a rate of 5 to 19%. Thrombotic occlusion, either partial or complete, occurs in 2% to 38% of catheterizations.[4] Infectious complication, either partial or complete, occurs at a rate of 5 to 26%. Infection is considered the most serious complication as it is accompanied by a mortality rate of 12-25%.[5]

Aside from the patient costs in terms of discomfort and the complications of having a bloodstream infection, the financial cost to the hospital is $28,000 per bloodstream infection.[6] Since October 2008, Medicare no longer reimburses for treatment of a hospital-acquired catheter-related bloodstream infections.[7]

THE CAUSES OF CATHETER-RELATED INFECTIONS

Catheter colonization is caused when organisms grow inside a portion of the catheter. A true bloodstream infection related to the central venous catheter occurs when the same organism is not only in the catheter segment but is also obtained from the blood culture with no other identifiable source of infection in the body.

Catheters become infected in several different ways. An infection at the exit site may occur when the site becomes colonized by bacteria that migrate along the external catheter surface. The site becomes erythematic and tender with purulent drainage within 2 centimeters of the exit site.[8] Bacterial contamination may also come through the catheter hub. If a lumen is accessed without properly disinfecting the hub, the bacteria present on the hub will enter the lumen and create potential for bacteria to intraluminally colonize the catheter.[8] The third way catheters become infected is through the hematogenous seeding of a catheter from another source in the body.[8]

The relationship between thrombosis and infection is also important. For example, when a thrombosis occurs in the catheter intraluminally, it provides a nidus for infection. This allows biofilm to develop. Biofilm has a very sticky surface, causing pathogens to migrate to the biofilm and adhere to it.

Reducing blood stream infections

There are several simple interventions that can reduce bloodstream infection rates. The two main interventions include utilization of targeted, evidence-based catheter insertion best practices. The Institute for Healthcare Improvement (IHI) and the Centers for Disease Control and Prevention (CDC) have established these best practices based on years of research. The 2001 report released by IHI introduced a group of practices commonly referred to as the IHI bundle. The second intervention is an educational model which focuses on best practices for all staff on insertion and maintenance of catheters to reduce catheter-related bloodstream infections.[9, 10] Facilities across the world are seeing dramatic decreases in infection rate by implementing these models.

The Central Line Bundle is a group of evidence-based interventions for patients with intravascular central catheters that, when implemented together, result in better outcomes than when implemented individually.

Care bundles, in general, are groupings of best practices with respect to a disease process that individually improve care, but when applied together result in substantially greater improvement.[11]

The key components of the Central Line Bundle are:

- Hand hygiene
- Maximal barrier precautions upon insertion
- Chlorhexidine skin antisepsis
- Optimal catheter site selection, with subclavian vein as the preferred site for non-tunneled catheters
- Daily review of line necessity with prompt removal of unnecessary lines[11]

Best practices – catheter insertion

All catheters should be inserted under strict sterile technique starting with performing proper hand hygiene prior to the procedure. Prior to insertion, a thorough check should be made to ensure that the correct patient is undergoing the correct procedure. In preparing the skin, a 2% aqueous chlorhexidine solution has been found to be more effective than alcohol-betadine in reducing infections introduced through the skin.[12] Because the antibacterial properties are activated by friction, the swab must be rubbed on the skin in a back-and-forth pattern (basket-weaving motion) for a full 30 seconds then allowed to dry for at least 30 seconds. If the skin was moist prior to scrub, the area must be allowed to dry for a full 2 minutes. It is crucial for the clinician to understand the difference in the techniques of chlorhexidine and the inside-out circular motion used with betadine in order to safely remove as many bacteria as possible.

The inserter and any person coming within 3 feet of the sterile field should wear a cap, mask, sterile gown, and sterile gloves. Any person outside the 3 foot area, yet still in the room, must wear a cap and mask. A large sterile drape covering the entire body of the patient is also very important as this will minimize the risk of contamination to any of the equipment being used (Figure 7).

Fig. 7

Another very important part of the procedure is to have a witness and an assistant remain in the room at all times during the insertion procedure so that they can monitor and ensure that sterile technique is being maintained. The witness and the assistant, as well as all those in the room, should be empowered to stop the procedure if at any time the sterile technique is broken. Empowering staff to stop a procedure has been shown to help significantly in preventing contamination and decreasing infection rates. Implementing a central venous catheter insertion checklist has also proven helpful to validate and educate everyone involved with insertion to follow best practice procedures.

Once the catheter is inserted, a transparent or gauze dressing is selected. This dressing should be secured occlusively on all 4 edges and dated so that the next nurse caring for the patient knows when to change the dressing (Figure 8).

Fig. 8

These guidelines should be followed in pediatric or neonatal units as well. Hospital specific procedures and policies regarding flushing frequency, volume and solution used to flush differ. Clinicians should be familiar with their facility's policies.

CENTRAL VENOUS CATHETER MAINTENANCE

Central venous catheters do not need to be changed on a routine basis. Rather, they should only be changed when there are clinical indications of a possible infection. If an infection is suspected, the catheter should be removed.

If a catheter infection is suspected, the patient should be given a "line holiday," meaning no central lines, if possible. Infectious disease physicians recommend treating the patient with antibiotics given peripherally for at least 24 hours before replacing a central line. If central access is imperative, the central line should be taken out and an entirely new one should be inserted. Remember that a PICC is a central line and should be given a line holiday in the same way temporary catheters are. Another option is to use a midline catheter because it does not enter the central circulation.

If a thrombus occurs, a thrombolytic agent can be used to dissolve it. The only FDA-approved product is a tissue plasminogen activator which can restore function to central venous catheters and can be used with both pediatric and adult catheters. It will not work, however, on medication precipitate occlusions. While Cathflo-Activase® and Alteplase® are two of the brands used; others are available for use as well and are similarly effective in removing partial or complete occlusions. Clinicians should be educated that all occlusions should be treated even if the lumen is not needed. A clotted lumen becomes a nidus for infection even if the lumen is not being used; therefore taping the end of the connector labeled with the word "clotted" is not an acceptable option. If the catheter is allowed to remain in place with a clot, biofilm will form, bacteria will grow and the line could become infected. If the lumen cannot be de-clotted, the catheter will need to be removed.

Every day the team of clinicians caring for the patient should ask, "Does this patient still need a central line? Why does this patient still need a central venous catheter?" If there is no reason for the catheter then it should be discontinued.

Nurses should take responsibility for maintenance for dead end caps on all ports. A dead end cap is the cap that is put on an arterial line, where there is an open end from which blood is drawn. It is an accepted practice to use central lines for blood draws and is one of the benefits of having a central line. This saves the patient from having to have peripheral sticks. However, it is imperative that the line be flushed correctly after the blood is drawn. If blood is drawn and the lumen is not flushed correctly there is a risk of occlusion. Additionally, needleless access devices and dead end caps should be changed at least every 72 hours with the tubing. When nothing is infusing, the needleless connector may be changed every 7 days according to CDC guidelines. One of the most important infection prevention strategies is to swab needleless connectors with alcohol for 10 to 15 seconds before accessing the line.

The type of dressing used on the catheter will determine how often the dressing should be changed. A transparent dressing can remain in place for 7 days as long as there is no visible soilage or dampness and if the dressing stays completely intact. After the dressing is applied, the insertion site should be evaluated with every shift change, looking for drainage, redness and making sure that the dressing is adhering well.

Gauze dressings are generally indicated for patients who are diaphoretic or where there is any bleeding present. A gauze dressing may be the first dressing applied after insertion because of possible bleeding at the site. The gauze dressing should remain in place for 24 to 48 hours, depending on hospital policy. However, if there is any visible soilage, any loosening of the tape, or if the dressing is not completely intact, the dressing should be changed. With gauze dressings, the site can only be assessed when the dressing is being changed. With every shift change, the dressing should be checked to verify that it is clean, dry and intact.

When the dressing is changed, it is recommended that 2% aqueous chlorhexidine is used to swab in a back and forth pattern for 30 seconds to make sure the skin is clean and disinfected.[12] The back and forth pattern is unique with chlorhexidine. If the person is diaphoretic with a great deal of fluid present on skin surface, the area should be scrubbed for 2 minutes to ensure bactericidal activity. When using Betadine, cleaning should start at the center and move outward in a circular motion. With both Betadine and 2% aqueous chlorhexidine, standard practice is to allow it to dry fully before applying the new dressing.

Antibiotic ointment should not be used at the insertion site with the exception of dialysis catheters since antibiotic ointment at the insertion site can actually lead to fungal infection. It is very important to add the date and time to the dressing no matter which type is placed to make sure that the dressing is changed at the correct time.

Although using a Biofilm patch or other chlorhexidine gluconate material on the dressing is not currently a CDC recommended practice, studies have shown that the chlorhexidine gluconate solution does prevent infection.[12] If a Biofilm patch is used, it should be changed with the seven-day dressing change.

Sutureless securing devices are being investigated as a way to help reduce needlestick injuries. The securing device should be changed with every dressing change. No matter which device is used, whether it is a securing device or a suture, there should be no catheter migration at the insertion site due to the risk of normal flora contaminating the vessel. When the catheter is not secured well, the tip of the catheter can erode the vessel and cause a clot. For example, when changing a PICC dressing, it should be temporarily secured to ensure that there is no movement of the catheter. A full cleansing and preparation should precede the replacement of the securing device.

PREVENTION OF THROMBOSIS

As discussed earlier, thrombosis is a complication that can have severe consequences as well as promoting infection of the catheter. Because various diseases such as cancer and hematologic disorders increase the risk for thrombosis,[8] an even higher vigilance with these patients is necessary. Additionally, larger catheters such as dialysis catheters have a higher risk of thrombosis.

Because catheters placed in the femoral site are associated with a higher incidence of thrombosis, insertion at that site should be avoided whenever possible. If a catheter is placed at a femoral site during an emergency, the catheter should be removed and a new one should be placed in the subclavian or internal jugular vein as soon as possible.

Some studies have investigated using systemic anticoagulation solutions to prevent thrombosis. A 2007 review by Chan and colleagues studied the practice of using a systemic anticoagulation solution for flushing lines in oncology patients. The anticoagulation options were warfarin, heparin and low-molecular-weight heparin. The study found that the routine use of systemic anticoagulation solutions was not warranted even though it was also noted that the results showed some inconsistencies.[13] This is an area where more randomized control studies are warranted.

However, it is proven that patency is maintained through flushing. Some institutions use heparin flush and others use normal saline. Knowledge of what solutions, medications and fluids are compatible with each other is critical. Good flushing to prevent biofilm from forming is also critical. Blood products and albumin have a higher viscosity. Infusion of these products will also lead to a higher incidence of thrombosis. Lines need to be flushed thoroughly after blood products and albumin are infused.[14]

Flushing techniques

As a general guideline, 10 to 20 milliliters (mL) of normal saline is used for the first flush, followed by 2 to 3 mL of heparin flush. The exact concentration will vary since there have not been a sufficient number of randomized controlled studies to indicate the exact concentration and volume. The size of the catheter lumen will determine the volume of flush solutions to be used. For example, an adult catheter will be much different than a pediatric catheter. Following the manufacturer's recommendation on flush volume is the best way to determine the amount.[15]

Large bore catheters should be flushed with a higher concentration of heparin, in the range of 1,000 units per mL or 5,000 units per mL. This volume is dependent on the catheter size. The manufacturer's recommendations should be followed to determine the volume to be infused. If heparin is used, ensure that single dose vials are used. To maintain volume control, many hospitals have switched to pre-filled heparin flush syringes.

In the surgical ICU at Barnes-Jewish Hospital in Missouri and at Riverside Methodist Hospital in Ohio, normal saline is used for flushing catheters. These institutions switched from using heparin due to a concern about heparin-induced thrombocytopenia, also known as HIT, and heparin-induced thrombocytopenia thrombosis syndrome (HITTS).

CASE STUDY: OHIO HEALTH, HEPARIN-INDUCED THROMBOCYTOPENIA (HIT) AND PATIENT SAFETY

At Riverside Hospital, part of the OhioHealth conglomerate, HIT became a serious issue. When the hospital converted to a saline-only flush policy using the positive displacement device for the entire institution, a significant increase in occlusion and infection rates was noted. These complications caused delays in the administration of medications and in treatment. Additionally, some catheters had to be discontinued and replaced, increasing the risk to patients of complications such as pneumothorax.

The Team Approach to Patient Safety

At OhioHealth the goal is patient safety. To address patient safety issues such as HIT and the central catheter complications noted above, a team approach is used. For over 2 years, a team has worked on central lines issues. The team consists of physicians, outcomes managers, infection control coordinators, clinical nurse specialists, staff nurses and IV specialists working collaboratively to come up with solutions.

The team begins by reviewing the literature available on the topic since evidence-based practice is needed to assess what is going on, what is being done correctly, what areas provide improvement opportunities and how this assessment applies to current practices. Once the improvement opportunities are clarified, the education process begins for staff, physicians, nurses and anyone else involved. By educating, implementing changes and monitoring results the team can apply the appropriate changes needed.

Training is an ongoing process. The key is awareness. For example, the more nurses are aware that something needs to change, such as cleaning caps, the more frequently the process will be put into practice. Using the term "Scrub the Hub" as a reminder to not simply swab the hub, is a good way to remember to clean the cap properly for 15 seconds every time.

The PICC Team

At Riverside, a 900 bed hospital, the vascular access team includes five full time IV Specialists. This team places all of the PICCs and performs the difficult IV starts as well as troubleshooting if there is a problem with any access device. The size of the team will vary from hospital to hospital and depends on what the team functions will be. Although having a dedicated team to perform central line care is expensive, research demonstrates that having an active team in charge of the care of the catheters and dressing changes causes infection rates to decrease.[16]

With the Medicare reimbursement criteria changing, hospitals are losing money because of infection rates. An infection can cost a hospital from $30,000 to $50,000.[15] Using specially-trained personnel for central line care is not only reducing the rate of infection but also helping with reimbursement rates. The cost of having an IV PICC team can be paid for in the long run by the prevention of infections.

Opportunities for Improvement

In every health care setting, opportunities for improvement are available. One opportunity is optimum performance of dressing changes. The standard dressing change is 24 to 48 hours for a gauze dressing and every 7 days for a transparent dressing. After a line is placed, the initial gauze dressing should be changed 24 hours after insertion due to drainage. Finding that a gauze dressing has been on a patient for 7 or 8 days would be a problem and an opportunity for improvement. Corrective measures should be implemented to prevent a future occurrence noting that awareness of the problem can be the key to changing practice.

Central lines can become contaminated during the insertion process. In 2001, the CDC sent out recommendations for improving the care of central catheters and decreasing infections. Part of these recommendations included an invasive line checklist. At OhioHealth, the outcomes manager has taken the charge on this initiative, starting in the intensive care unit and taking it hospital-wide. One RN is designated to keep the invasive line checklist which asks questions such as, "Does everybody have their mask on? Does everybody have their cap on? Is the sterile drape where it should be?" This nurse is empowered to say, "I need a moment. I have a question," or "I think we need to change our gloves. There might have been a contamination there." The invasive line checklist has become an invaluable tool for OhioHealth.

Policies on central catheter choices and dwell time may not be clear. OhioHealth has been looking at the forms and policies to update them so nurses know what they need to do. For example, if a catheter needs daily assessment, the nurse can see on the form when it is time to assess the catheter.

Central Catheter Device Algorithm

OhioHealth has developed an algorithm to determine which central catheter device is the appropriate one to place. Due to the fact that some physicians do not know the best line to place, or, as in the case of residents, haven't placed many lines, physician education has become very important. Residents wouldn't know, for example, if they should place a PICC or a triple lumen short-term catheter. With the algorithm, the physician can determine which type of line to place. If the patient needs long-term access, then the patient would need a PICC. If the patient needs short-term access, they would need a short-term catheter. Following this algorithm has been a very successful education tool for physicians.

Blood Reflux and Connectors

Blood reflux is a major problem. Since central catheter tips are deep in the body and blood reflux cannot be seen when it occurs, the blood is often not adequately flushed from the line. Also, increased intravascular pressure between flushes can cause reflux leading to biofilm formation and build-up, occlusion, and even infection. Because reflux can occur when you flush the catheter as well as between flushes, prevention strategies for both time frames should be addressed.

In order to prevent reflux, it is important to know what type of needleless connector is being used. The connector, often referred to as a valve, is the cap that is screwed on and is also where medication is administered.

There are 3 different types of needleless connectors: a negative displacement device, a neutral displacement device and a positive displacement device.

With a negative displacement device, the catheter must be clamped before the syringe is removed or there will be a backflow of fluid. The area that fills with blood from the backflow can cause blood to clot.

With the neutral displacement device, the fluid should remain neutral, meaning it should not go forward or backward. There are several different neutral devices and they can either be clamped before or after flushing. It is extremely important with these devices that the manufacturer recommendations are checked and followed. The manufacturer will state the type of device and when it should be clamped.

With a positive displacement device, it is important to clamp the catheter after the syringe is removed to get the displacement.

Because the flush protocol on each device is very different, it is critical that clinicians know what type of device is being used so that the proper flushing technique is implemented. When several different types of devices are used at one facility, standardizing the valves would be the best way to ensure that errors are not made with flushing techniques.

NEW VALVE TECHNOLOGY

To help decrease the incidence of reflux between flushes, some catheter manufacturers have developed new valve technology.

Bard Groshong™ PICC

The Bard Groshong PICC was developed in response to the need to reduce the amount of heparin flush used (Figure 9). The Bard Groshong valved catheter is a three-way valve. The three-way valve is in the distal tip of the catheter and is placed inside the body. The valve has a slit in the tip of the catheter so that when it is not being used or flushed, the slit remains closed. This catheter uses a saline-only flush with the recommendation to inject the last half mL of saline while removing the syringe. The flush procedure will depend on the valve that is being used and should be in line with the manufacturer's recommendations. The Bard Groshong catheter can be flushed with saline every 7 days when not in use and is very helpful for home care patients who are having a once-a-week blood draw. The Groshong gravity flow is around 193 to 266 mL per hour.

Fig. 9

The Bard PowerPICC Solo™

The Bard PowerPICC Solo is another valve device that was developed in response to the need for power injection (Figure 10). It has a three-slit valve in the hub of the catheter which remains outside of the body. The middle slit is for infusion so when the catheter is aspirated, the fluid comes through the top and bottom slits. Another difference in the PowerPICC Solo is that it is power injectable, up to 5 mLs per second and 300 psi. It can also be flushed with saline every seven days when not in use. The recommendation is to inject the last half mL of saline before removing the syringe. The Power PICC Solo has a flow rate around 498 to 1024 mL per hour.

Fig. 10

Boston Scientific Pressure Activated Safety Valve PASV®

Boston Scientific has a PICC called the Vaxcel (Figure 11). The Vaxcel has a pressure-activated safety valve, also known as PASV. The Boston Scientific Vaxcel PICC with the pressure-activated safety valve, PASV, is a three-way valve. The PASV is different because the valve is placed in the actual hub of the catheter outside the body and not inside the body like the Bard Groshong. The valve stays closed when it is not being used. Either saline or heparin can be used to flush and the manufacturer recommends a pulsatile or a stop/start technique while flushing. Like the Bard Groshong, this catheter can be flushed every 7 days when it is not in use, making this another good catheter for long-term use for infrequent blood draws or medications.

Fig. 11

The Hospira LifeShield® TKO™

Another device is the Hospira LifeShield TKO (Figure 12). This device was developed for use on the battlefield. When soldiers were injured and needed an IV, they needed technology that would allow for an IV without an IV pole. If the bag was on the shoulder or the body, blood reflux would result. This technology was developed to keep the IVs from forming clots. Initially introduced by Nexus, it also was developed with power injection capabilities and is injectable up to 300 psi.

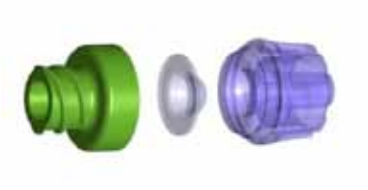

Fig. 12

The TKO valve looks like a dome making it a very stable, strong device (Figure 13). It takes a small amount of pressure to open it, but once it opens a very high flow rate can be administered. On aspiration, there is a high flow rate as well.

Fig. 13

The TKO is not bi-directional like other positive, negative and neutral connectors. As a result, the fluid does not move when the syringe is going in or out, and there is no backward reflux of blood. One unique property of the device is its protection from reflux between flushes.

As an example, if the normal central venous pressure is zero and the patient is coughing, the intrathoracic pressure goes up significantly, causing the blood to come back into the tip of the catheter and to potentially form a clot. The TKO senses the increased pressure and closes before the blood refluxes. When the pressure decreases and fluid begins to flow in the appropriate direction, the valve opens again to allow infusion to continue.

With the TKO, either a saline or heparin flush can be used depending on the facility's flush protocol. The TKO prevents reflux despite the flushing technique, making it a vast improvement for home care use. Home care patients also do not have to worry about clamping protocol when flushing with the TKO device because the device prevents reflux whether the device is clamped or not. The TKO has a volume rate of 4200 mL per hour.

Evidence-based Practice

Riverside Methodist Hospital conducted a three month study involving 189 patients. The occlusion rates using the CLAVE® device alone and a heparin flush were 30%. After adding the TKO to the CLAVE and using a heparin flush, the occlusion rates went down to 7.6% - a significant reduction in occlusion rates. Even when using a saline-only flush the occlusion rate decreased dramatically from 30% to 12.5%.[17]

A second phase of the study involved 399 patients and was conducted using peripheral catheters. This study investigated the current practice of starting a new IV every 72 hours. Originally, when the CLAVE needleless connector was used on peripheral catheters, only 24% of the catheters lasted 72 hours. The goal was to extend usage to 96 hours because the cost of IV starts and nursing time can be reduced which results in increased

patient satisfactionWith the TKO attached to the CLAVE device, 51% of the catheters lasted 96 hours. In addition to this benefit, phlebitis rates were monitored and found to have decreased from 10% to 4%.

The second phase of the TKO study will be published in the Infusion Nurses Society (journal), January-February 2009 edition.

The Impact of Changing to the TKO

At OhioHealth, the impact of changing to the TKO has made a significant improvement on the ICU infection rate. Since the TKO was introduced 16 months ago along with the IHI bundle, Riverside has not had an infection in their 32 bed ICU in 16 months.

The TKO can be used with any needleless connector. Facilities still need to determine whether a positive, neutral or negative connector device is best for their institution. One should note, however, that some negative displacement devices have such a strong negative pull to reflux fluid, those devices may negate the work of the TKO valve unless the line is clamped prior to disconnection.

IMPLEMENTING BEST PRACTICES AND NEW TECHNOLOGIES

Implementing best practice techniques is a process that can take several years. The greatest barrier to implementing new techniques is stopping the wrong processes that are currently in use. If several changes need to be implemented, the process can be overwhelming; however, starting the awareness and education process will begin a process in which changes can gradually be incorporated into daily practice.

There is no single technology or process that will answer all the questions that lead to success in reducing and eliminating bloodstream infections. However, by taking the first steps of reviewing current practices, using best practices, educating and involving the entire staff, and staying current with new technologies, catheter care can be improved with a corresponding decrease in complications like infection and occlusion that cause our patients harm.

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