vascular access infection prevention

By Nancy Moureau, RN, PhD, CRNI, CPUI, VA–BC

Reducing Catheter Occlusions and Failure

Catheter occlusion and related complications are estimated to affect nearly 80 percent of peripheral and central vascular access catheters (Steere, 2018). Obstruction complications include loss of patency, phlebitis, and infiltration in PIV catheters. Blood is the first body fluid which touches vascular access catheter materials, such as urethane and Teflon. When the synthetic catheter material meets blood, a layer of plasma proteins absorbs onto the catheter surface and triggers a complex series of biological responses including protein absorption, platelet adhesion, coagulation and thrombosis.

The thrombotic deposits of platelets and fibrin mesh that develop within and around catheters are the result of a natural process that impact catheters upon insertion and throughout treatment as the catheter is used for infusions and blood draws. When blood is pulled back into the catheter, intentionally or functionally, during syringe connection/disconnection, patient movement, or pressure changes, red blood cells adhere to the inside of the catheter creating suboptimal flow. Such occlusions can lead to patency loss and device replacement or removal, all of which can negatively impact therapeutic outcomes. Blood coagulation and platelet adhesion to intraluminal catheter surfaces remain one of the largest contributors to vascular access catheter dysfunction by producing partial and total IV catheter occlusion.

Other complications associated with build-up within a catheter include vein thrombosis, venous inflammation, and catheter-related bloodstream infections (CRBSIs). Reflux of blood into the catheter, especially small diameter catheters, contributes to partial and complete occlusions, has a relationship to catheter associated infection, and may be a contributing factor in venous thrombosis development. Preventing occlusions, then, becomes a chain of events that presents an opportunity for improving both patient outcomes and catheter function that impacts healthcare facilities' bottom line.

The literature contains studies that have examined various methods to reduce catheter failure caused by blood reflux including the use of thrombolytics (Dillon, et al. 2008; Ernst, et al. 2014; Helm, 2015 and 2019). Other studies have sought to evaluate the impact of blood reflux-controlling valves on occlusions and infiltrate complications (Jasinsky, 2009; Johnston, et al. 2014; Steere, et al. 2018). Still others have examined the various design features of how valves function to limit or eliminate blood reflux into catheters (Steere, 2016; Schilling, et al. 2006). A Cochrane Protocol published in 2019 established reflux-controlling valve function by outlining a systematic review process for validating catheter materials and reduced complications (Schults, et al. 2019).

According to Rosenthal, in 2020, anti-reflux needlefree connector designs incorporate a bidirectional fluid-control valve designed to restrict fluid movement on connection and prevent unplanned reflux into the intravascular catheter during infusion, connection, disconnection and patient changes in intra-thoracic pressure. A reflux-controlling valve is an internal mechanism engineered into catheters and/or needleless connectors; these valves are designed to control fluid movement, most notably to prevent backwards flow. Design and performance vary by device type. Whether the valve technology is integrated into the catheter, or integrated into the needleless connector technology, these devices reduce clinician dependency on proper clamping sequence that blocks reflux and greatly reduces the blood movement from physiological pressure changes that naturally occur inside the patient's vasculature. More research is needed to establish more substantial conclusions on occlusion causation, the

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impact of reflux on occlusion, and the prevention of reflux-related occlusion.

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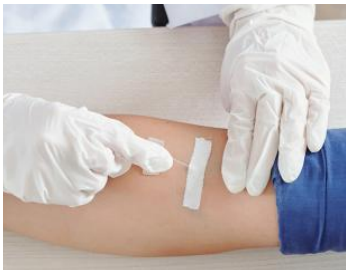

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