Turbulent Catheter Flushing Technique

Question:

I have been told that the stop-start method of flushing a catheter is required to reduce the incidence of catheter occlusion. What is the purpose of this technique and does it really work?

Answer:

For many years, nurse educators have endorsed the use of an alternating stop-start method to flush catheters. Numerous published articles also endorse this technique. This technique is purported to create turbulence inside the catheter lumen, causing any substances adhering to the catheter wall to be flushed out of the lumen. At the present time, this concept does not have any research-based evidence to support the theory.

Fluid, including blood, usually flows in a laminar manner. This means that the fluid flows in layers with the innermost layer moving at the fastest rate. The layers closest to the side of the tube, or vessel wall, will move more slowly. Turbulent flow is created when there is some type of obstruction that interferes with the laminar layers. Fluid flows in swirls and eddies due to these obstructions. Watching a river or creek flow will demonstrate this process. The tree stumps and rocks created obstructions along the riverbank, causing the water to flow in the swirls and eddies. The turbulence will often dislodge these obstructions.

Blood flow changes from laminar to turbulent in areas of vessel stenosis or due to the obstruction posed by the presence of a catheter. Areas of turbulent flow inside the vein increases the risk of vein thrombosis.

Theoretically flushing a catheter with uninterrupted force applied to the syringe plunger will create smooth layers of fluid flowing evenly with the fastest layer moving down the center of the catheter lumen. We have speculated that this technique leaves “residue” adherent to the catheter’s internal lumen, possibly causing lumen occlusions.

While the theory of turbulent flushing is based on general principles of fluid flow, I cannot locate any research to support this practice of pulsatile flushing technique and its impact on catheter lumen patency. There is no doubt that catheter lumen occlusion is a problem in clinical practice. Causes of the problem are numerous including biofilm/fibrin combinations, thrombosis, drug and mineral precipitate, and other mechanical problems such as pinch-off syndrome.

A layer of proteins and platelets adheres to all catheters placed in all patients. This layer begins during the insertion procedure when blood is aspirated to confirm placement in a blood vessel and quickly becomes a coating of fibrin. Hub manipulation can introduce microorganisms into the catheter lumen, resulting in biofilm formation. Fibrin and biofilm combine to form a complex matrix that can result in bloodstream infection. The

impact of flushing frequency and techniques on the formation of the biofilm-fibrin complex is unknown.

Shearing forces cause small parts of the biofilm to break loose and travel to distant locations in the catheter or vein. Blood flow and flushing can produce shearing forces. Does the turbulent flushing techniques actually increase the risk of producing these shearing forces? Again, research has not provided these answers yet, but this should be considered when the patient has a febrile episode. When catheter flushing produces fever, chills, and other symptoms of systemic illness, I would suspect that small amounts of bacteria-laden biofilm are being flushed into the bloodstream.

New technology addressed the problem of lumen thrombosis. Needleless injection systems designed with the positive fluid displacement feature prevents blood reflux into the catheter lumen at the end of the flushing procedure. Drug and mineral precipitate can be prevented by flushing with saline between the infusion or injection of two medications. Correction of mechanical problems requires catheter repositioning or removal and re-insertion at a different site.

Theory of pulsatile flushing is all we have at the present time. While nursing resources are so limited, it is difficult to justify investment in training and competency assessment on this technique in the absence of evidence. Will other strategies produce better results than this pulsatile flushing process? For instance, can we reduce the bacteria introduced into the catheter hub and the subsequent formation of biofilm by reducing the number of times the hub is manipulated? If your flush solution is withdrawn from multidose vials or bags, could this be a source of bacteria introduced into the catheter lumen? These are difficult questions to answer in the absence of evidence.

I would recommend that you collect data on the outcomes with catheters in your facility. Address your efforts to the problems you identify. Pulsatile flushing techniques may or may not be the answer.

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