Vascular Access for Extracorporeal Renal Replacement Therapy in Veterinary Patients

Serge Chalhoub, DVM, Cathy E. Langston, DVM*, Karen Poeppel, LVT

KEYWORDS

• Hemodialysis • CRRT • Catheter

Vascular access is the first and most basic requirement of successful extracorporeal renal replacement therapy (ERRT). An adequately functioning dialysis catheter allows for smooth and efficient patient management, whereas a poorly functioning catheter frustrates the technician, doctor, and patient. In veterinary medicine, central venous catheters are the predominant form of vascular access. Much thought and care should go into appropriate catheter selection, placement, and maintenance. In humans and animals, these catheters can be placed fairly quickly; however, they remain a major cause of morbidity for dialysis patients. Therefore, it is important to understand their limitations and to respect guidelines on proper placement techniques and care.

CATHETER COMPOSITION AND CHARACTERISTICS

Various materials can be used to make a catheter that is minimally thrombogenic, flexible, and nonirritating to the vessel wall. Synthetic polymers, such as polyurethane, polyethylene, polytetrafluoroethylene (PTFE), silicone, and carbothane, are suitable choices. Most of these materials are stiff (at least initially), which makes their percutaneous placement possible. Polyethylene is stiff and kinks when bent. These catheters can be used for temporary catheters but are not appropriate for long-term use.[1] Polyurethane has some rigidity at room temperature, which assists in placement, but it becomes softer and more flexible at body temperature. Alcohol-containing antibiotic ointments weaken the material.[1]

To allow simultaneous removal and return of blood, a dialysis catheter has 2 lumens. Although catheters are placed in a central vein, the lumen that provides blood egress

Renal Medicine Service, The Animal Medical Center, 510 East 62nd Street, New York, NY 10065, USA
* Corresponding author.
E-mail address: Cathy.langston@amcny.org

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from the body is generally referred to as the *arterial* port or access port, and the lumen that provides blood return to the body is termed the *venous* port or return port. The arterial lumen is usually shorter than the venous return lumen to avoid uptake of blood returning from the dialyzer (access recirculation), which would decrease the efficiency of treatment (**Fig. 1**). In some situations, 2 single-lumen catheters are placed in separate vessels or in the same vessel to provide blood egress and return.

In lumens with a single opening (at the tip or a side port), partial occlusion from thrombosis or a fibrin sheath can decrease catheter function to the point of it being unable to provide adequate dialysis. The risk of complete occlusion is lessened by having multiple ports (**Fig. 2**). If the ports are positioned circumferentially around the catheter, even if the vessel wall is drawn against the ports on one side of the catheter, blood flow can continue on the opposite side. If the side ports are small, blood preferentially flows through the tip, making the side ports superfluous. If the side ports are large, they weaken the catheter, and increase the amount of heparin that diffuses out of the catheter between dialysis treatments.[2]

A double-D configuration provides the highest lumen volume with the lowest surface area in contact with the blood to diminish shear stress while maintaining a modest outer circumference[1]; however, other configurations are commonly used, including round or C-shaped lumens (**Fig. 3**).[3]

TEMPORARY CATHETERS

Temporary catheters should more precisely be called nontunneled, noncuffed catheters (**Fig. 4**). Depending on the type, a temporary catheter may function for up to 4 weeks. In most cases, a temporary catheter is the appropriate choice unless there is suspicion of preexisting chronic kidney disease and the owners are interested in chronic dialysis. Temporary catheters are designed with a tapering tip to facilitate percutaneous placement and are placed via Seldinger technique (**Box 1**). Because these catheters may need to remain in place for weeks, strict attention to aseptic technique during placement is essential. Catheter placement must be done in a clean procedure room with restricted traffic, and all personnel involved in the procedure should wear caps and masks. A large barrier drape and sterile gloves are mandatory. Because of the springiness of the guidewire, a surgical gown is recommended to decrease the risk of contaminating the guidewire during placement. Sedation and/or local anesthetic may be necessary depending on the patient's clinical status and demeanor.

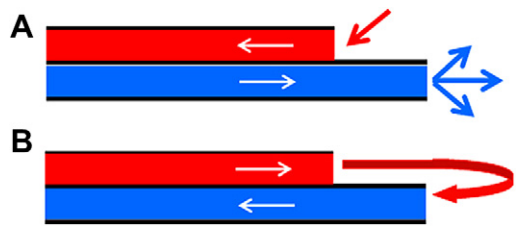

Fig. 1. In the correct configuration, blood enters the catheter through the proximal lumen and is returned via the distal lumen (*Panel A*). If the direction of flow is reversed (*Panel B*), blood returning via the proximal lumen is likely to be recirculated by reuptake at the distal lumen.