
Successful Long-Term Central Venous Access; Daily Home Hemodialysis Blood Access

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Successful long-term central venous access is a complex subject. The concept of "long term" implies that continued surveillance will be required. This also requires the catheter to be placed, initially, in its best configuration. To achieve long-term performance and durability, a thorough understanding of all aspects related to the catheter, catheter placement, and catheter maintenance is essential.

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Key words

Intravenous catheter, urokinase, exit-site infection

Introduction

The first step to achieving long-term success is patient selection. For the most part, any patient with end-stage renal disease can undergo placement of an access catheter. There are, however, two subgroups of patients who will not do well with central venous catheters. The first group includes immunocompromised patients. These patients will have continuing problems with recurrent infections, both at the exit-site area and systemically. Routine local care for the exit-site infection typically will not clear the problem, and removal of the offending catheter is usually required. Also, any patient with these recurrent types of infection should be evaluated for other underlying diseases.

The second group includes patients with superior vena cava occlusion. These patients have occlusion of the great venous vessels leading into the chest. Blood flow return is through engorged collateral vessels. The great venous vessels become occluded from previous catheter placement for the most part. Some patients may have occlusion from radiation damage

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or as a result of tumor growth infiltration. As a result of this occlusion, catheter placement in the chest or neck area is not possible.

Once the patient selection has been determined, the next step to consider is catheter placement. There are two areas of concern regarding catheter placement: the external exit site and the central tip location.

The internal portion (pickup, return lumens) of the catheter should lie in the region of the superior vena cava, the right atrial area. It is preferable that the catheter itself be centered in the middle of this vessel. Having the catheter enter this area of the vessel from the right internal jugular vein, thus on a straight path, ensures its position. If the catheter enters from the left or right subclavian vein, the catheter will tend to lie against the opposite wall of the vessel in a curved fashion, and if the catheter lumen lies against the vessel wall in this manner, the pickup area will be sucked against the wall during the dialysis run. Subclavian-placed access catheters also lead to subclavian vein occlusion and its associated morbidity (1,2).

The exit site should be placed in an area on the chest that is functionally acceptable for both the patient and for staff use. Preferably, it should be on the chest at a location that is comfortable for the patient, easy to manage, and unobtrusive during daily activity. It should be simple to care for and to clean (3). The catheter, at the exit site, should also be fashioned to allow only minimal catheter movement (4) to ensure lower infection rates and inflammatory problems.

Catheter maintenance is crucial to achieving long-term use of the catheter. One must understand and be able to identify all catheters used to ensure that proper protocols are followed for maintaining patency and for limiting infections. At several of our dialysis areas we have a board on which all catheters used at that facility are taped for identification purposes. We now use so many different types of catheters that it is overwhelming just to identify the catheter type. The

dialysis staff can now look at the external portion of the catheter on the patient and then go to the board to confirm the catheter type. The correct protocol technique for the catheter can then be ensured. Flushing and exit-site protocols should be followed, with reassessment of protocols performed routinely.

Infection remains one of the major reasons for catheter failure (4). There are three types of infection: exit-site, tunnel, and catheter. Exit-site infections relate to the site where the catheter exits from the body. Proper cleansing of this area will keep the infection rate low. Once an infection is identified, aggressive local care will resolve most of these types of problems (5). We find that many of these types of infection are related to an occlusive dressing that has been left in place for a prolonged period.

Tunnel infections are located in the subcutaneous tissue. The infection here usually involves the Dacron cuff of the catheter. In most cases, this requires removal of the catheter.

Catheter infection is more a general sepsis picture. The catheter itself may or may not be infected, but due to the severity of the infection, the catheter should be removed. In many of these cases, on removal we find an infected clot within the lumen of the catheter.

Flow problems usually occur with flow rates of less than 200 cm³/minute (6). This rate is below acceptable for efficient dialysis for most of our dialysis patients. Flow problems are usually related to either a clot within the lumen (7) or the catheter pickup lumen being sucked against the vessel wall (8). The catheter itself may also become entrapped within a clot and cause scarring along the intraluminal portion of the vessel. There are several methods to improve performance of the catheter related to clot and position.

Thrombolysis will dissolve most clots located within the lumen of the catheter (9,10). The first step in resolving flow problems is a trial urokinase infusion. Urokinase is a potent thrombolytic agent that will dissolve most clots and thrombi. Our typical urokinase infusion is 100 000 U instilled through the problem lumen over a 1- to 2-hour period. The half-life of urokinase is less than 15 minutes, so bleeding problems related to this short course are infrequent.

Catheter manipulation using intravascular guide wires and wire snares can both strip the clot from the catheter tip and move the tip to a better position. These

procedures are performed in the radiology catheter laboratory using fluoroscopy, usually with the manipulation catheters and wires being introduced through the femoral vein.

Catheter replacement involves removing the problem catheter and placing a new one. The replacement catheter can be inserted through the same path into the vein or into a new insertion area. If the catheter is having flow problems and not considered infected, it can easily be replaced through the same tract into the vein utilizing a new exit site on the chest. This is our first step after attempts at urokinase have failed. We prefer this approach because it does not expend an access site on the vein.

To replace a catheter in this manner, the patient is taken to the operating room and given light sedation. Local anesthesia is also used in the areas involved. The first step is to make a small cut down over the current catheter near its entrance into the vessel. (This area of the catheter will be between the Dacron cuff and the catheter's entrance into the vein.) The catheter is identified and controlled. A new exit site on the chest is selected, and the new catheter is tunneled from this new site up to the cut area. The controlled old catheter is now divided. The guide wire (from the kit) is threaded into either lumen and advanced into the central venous system. The old catheter is then removed over the guide wire. The guide wire is then threaded into the tip of the new catheter until it appears at the hub of the catheter. The new catheter is advanced with the guide wire into the central venous system. The new catheter will easily follow the tract into the vein without using dilators or peel-away sheaths. The guide wire is carefully removed. The catheter is flushed to confirm good blood flow and then capped. Fluoroscopy or chest x-ray can be used to confirm tip location. The remaining portion of the old catheter is then removed.

This same technique can be used for a problem exit-site infection if the infected exit site is carefully isolated from the operative field. It is important that no cross contamination of the catheters occur.

In summary, successful long-term central venous access requires all those involved with catheter placement, maintenance, and surveillance to have a good understanding of the catheter and potential problems. Once a problem is identified, corrective procedures can be undertaken. It is only through this group effort

Successful Long-Term Central Venous Access

that long-term survival of these catheters may be accomplished.

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