Central Venous Stenosis

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Over a billion dollars are spent annually to handle the complications related to dialysis access. Much of that cost is related to catheter-related complications. It is important to mention that central venous stenosis is a major problem from both patient and dialysis delivery standpoint. By occluding the flow of blood, it can lead to superior vena cava syndrome creating a catastrophe for the patient. On the other hand, by causing stenosis, it can reduce blood flow needed to successfully dialyze a patient. The concept of blood flow is critically important to understand. Dialysis access is a complete circuit. The circuit begins with the heart, the aorta, and then the artery that feeds that fistula/graft. The draining vein then takes the blood back to the central veins and to the heart. A stenosis anywhere in the system can cause a reduction in blood flow. A reduction in blood flow then leads to a reduction the quality of dialysis delivered to the patient.

In general, central veins are the veins that are located inside the thoracic cavity. These include subclavian veins, brachiocephalic veins, and the superior vena cava. Inferior vena cava and iliac veins are also called central veins. Occlusion of superior vena cava leads to swelling of the face, neck, breasts, and shoulders. The swelling extends to the upper extremity, and patients often present with upper extremity edema. If the edema is located to one side, the subclavian, brachiocephalic vein on that side is usually responsible. If bilateral upper extremity edema is observed, the lesion is usually located in the superior vena cava. On inspection, collateral veins can be seen in the upper extremity and the chest and back. Lower extremity edema can also be observed due to the occlusion of iliac vein.

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While the true incidence of central venous stenosis is not known, investigators have emphasized the nearly 40% of the patients with catheter develop central venous stenosis [1]. Subclavian vein stenosis is observed much more than internal jugular vein. As an example, nearly 40% of the patients with a subclavian catheter develop stenosis, while only 10% of the patients with an internal jugular catheter demonstrate central venous stenosis. Right internal jugular vein has much lower incidence of stenosis compared to the left internal jugular vein. This is due the fact that brachiocephalic vein makes multiple turns [2]. These angles provide a focal point for catheter-induced trauma to the venous endothelium.

While dialysis catheter is a common device that can lead to central stenosis, there are multiple other devices that can cause central stenosis. A peripherally inserted central line can also cause central venous stenosis. Also, a smaller caliber catheter is also capable of producing central venous stenosis. It is a known fact that stents can treat venous stenosis. However, once placed, they also can cause stenosis. Finally, a relatively new etiology (cardiac rhythm devices) for central venous stenosis has gained popularity among nephrologists [3]. Pacemakers and implantable cardiac defibrillators and cardiac resynchronization devices can cause major central venous stenosis. Such stenosis is difficult to treat as device wires traverse the central veins on their way to the endocardium.

A significant number of patients with a cardiac rhythm device develop central venous stenosis. However, they rarely demonstrate features of superior vena cava syndrome. In one study, central stenosis was documented in over 70% of the patients with cardiac rhythm devices, and only less than 2% showed evidence of superior vena cava syndrome [4]. This is due to the fact that these patients do not have an arteriovenous access in the upper extremity. With an arteriovenous access in the upper extremity, over 80% of the patients become symptomatic and demonstrate arm, shoulder, and facial swelling [5].

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Management of Central Venous Stenosis

The first step in the management of central venous stenosis is an accurate diagnosis of the condition. Simple physical examination can be very helpful in diagnosing central venous stenosis. Chest scars indicating old catheter insertion site should raise the suspicion of the etiology. While central venous stenosis can occur without a catheter (de novo), this is not common.

Angiography should be performed to locate the stenosis and to treat the lesion. Angiography is also recommended prior to the creation of an arteriovenous access in a patient who has had a dialysis or any catheter in the past. A problem that is common with catheters is the development of fibrin sheath [5]. Angiography should be performed to diagnose this problem before the catheter replacement. If a fibrin sheath is present, it is a good idea to treat it with an angioplasty balloon. Tunneled catheters that are replaced without the treatment of fibrin sheath do not work frequently. Treatment of fibrin sheath ensures optimal function of a catheter.

Asymptomatic central venous stenosis that does not reduce blood flow and does not produce major symptoms (due the development of collateral veins) may not require any treatment. It is important to monitor dialysis adequacy in these patients on a monthly basis and evaluate any progression of symptoms of central venous stenosis.

The NKF/KDOQI guidelines recommend percutaneous balloon angioplasty for central venous stenosis [6]. This treatment is safe, results in improvement, and can be employed on an outpatient basis. A stent may be needed for certain cases of central venous stenosis. The decision to place a stent should be based on a case-by-case basis. If angioplasty yields adequate results, then stent may not be needed. However, if the lesion recurs quickly after simple angioplasty, stent may be required. In addition, elastic recoil after angioplasty is another situation where stent insertion may be needed. There are some issues one must consider before a stent is placed. Stents can serve as a nidus for infection. An infected stent in a central vein may end up requiring a major surgical intervention to remove the infected foreign body. Stents can also cause stenosis (in-stent stenosis and stenosis at the ends of a stent). This complication should also be kept in mind when placing stents. Stents can also migrate and in doing so bring on problems related to their migration. Finally, these devices are expensive and add to the total cost of the procedure [7].

For patients with cardiac rhythm devices, an alternative is now available. A leadless pacemaker and an implantable cardiac defibrillator are now available and should be used in end-stage renal patients needing dialysis [8, 9]. Because chronic kidney disease is a progressive disease and patients may end up requiring dialysis therapy, leadless cardiac rhythm devices should be preferred in patients with chronic kidney disease.

Conclusion

Central venous stenosis has a major impact on morbidity and mortality. Prevention is of paramount importance. Whenever possible, central catheters should be avoided. Leadless cardiac rhythm devices should be preferred in patients with chronic kidney disease. Percutaneous balloon angioplasty is a minimally invasive therapy that can be employed to successfully manage central venous stenosis. Because of their associated complicated issues, stent placement should be carefully evaluated in patients with central venous stenosis.

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