Since its inception, hemodialysis has been bedeviled by problems of vascular access. Access, from the time of creation and throughout a patient’s dialysis life, consumes significant time, effort, and expense and creates much anxiety and risk for patient and family. Vascular access complications remain the single leading cause of hospitalization and expense for dialysis patients. Some, such as infected access sites, are potentially life threatening. It is common for an access problem to precipitate a crisis related to the end of a patient’s dialysis life. Despite the advances made in hemodialysis technology, the same vascular access problems that plagued dialysis pioneers continue today to confound patient care teams.
Dialysis as Treatment of End-Stage Renal Disease

Arteriovenous Dialysis Access: Evaluation and Placement

### FIGURE 5-1
Evaluation for hemodialysis access. The creation of optimal vascular access requires an integrated approach among patient, nephrologist, and surgeon. The preoperative evaluation includes a thorough history and physical examination. A history of arterial and venous line placements should be sought. The upper extremities are examined for edema and asymmetry of pulse and blood pressure. Access should be placed at the wrist only after it is verified that the radial artery is not the dominant arterial conduit to the hand. The classic study is the Allen test, in which an observer compresses both the radial and ulnar arteries, has the patient exercise the hand by opening and closing to cause blanching, then releases one vessel to be certain that the fingers become perfused. An alternative, and perhaps more precise, test is to verify by Doppler imaging that flow to all digits is maintained despite occlusion of the radial artery. If indicated, vascular imaging studies should be used to delineate the vascular anatomy and rule out arterial or venous disease. Clinically silent stenosis involving the central veins is becoming increasingly common with the improved survival of critically ill patients for whom central vein catheters are commonplace.

### FIGURE 5-2
Creation of a Brescia-Cimino (radial-cephalic) fistula. The native vein arteriovenous fistula is the preferred choice for hemodialysis access. This simple and effective procedure, in which an artery is connected to an adjacent vein to provide a large volume of blood flow into the superficial venous system, has become less common in recent years. The ideal artery has minimal wall calcification, so that dilation can occur with time and allow unimpeded flow. In addition, the artery should not be affected by proximal stenosis, the most common site being an ostial lesion in the subclavian artery. Ideally, the outflow vein is subjected to minimal dissection or manipulation during the surgical procedure. Forcible distension of veins and rough handling of arteries leads to formation of neointimal fibrous hyperplasia and localized stenosis.

The first autogenous access site described was radial-cephalic at the level of the radial styloid process. These can be constructed end-to-side, A and B, or side-to-side, C, between the two vessels. The exposure is conveniently obtained using a transverse incision at the wrist, just proximal to the radial styloid process, where the artery and cephalic vein lie close to one another. In general, the two vessels are just far enough apart so that an end-to-side technique is best. When the vessels overlie each other, some surgeons prefer the side-to-side technique, which allows reversal of blood flow into the dorsum of the hand and then via collaterals into the forearm, theoretically leading to better flow volume over time.
incidence of steal is likely the result of the lower flow rate associated with these accesses. Additionally, such accesses have low rates of thrombosis and infection. The photograph shows a mature Brescia-Cimino fistula in a patient with longstanding diabetes. The fistula outflow vein has numerous aneurysmal segments, and, although they are associated with some tendency toward flow stagnation, they are of no harm to the patient’s dialysis life. They do, however, become obvious targets for the dialysis technical staff, who have a tendency to puncture them repeatedly rather than to utilize new needle insertion sites. The patient’s arm also demonstrates marked muscle atrophy secondary to advanced diabetic neuropathy, which particularly involves the thenar eminence and the interosseus muscle groups. Complaints of weakness and loss of grip strength in the arm are common and may represent symptoms of steal. In this case, however, the symptoms are due to the intrinsic loss of muscle mass, rather than to steal.

The brachial-cephalic vein fistula. If a radial-cephalic vein fistula cannot be constructed, the next best choice for vascular access is the brachial-cephalic vein fistula. Accesses that utilize the brachial artery have the advantage of higher blood flow rates than those that use the radial artery. Although this may improve the efficiency of hemodialysis, it is also associated with increased risk of arm edema and steal. A. The native anatomy of the ante-cubital veins somewhat resembles the letter M. A more complete depiction is seen in B. The medial volar venous flow enters the basilic system; lateral volar flow enters the cephalic system; and the central connector, which includes a deep tributary, connects the brachial (venae comitantes) system at the brachial artery bifurcation. To create an antecubital autogenous site, there are two general approaches; the surgeon either mobilizes the cephalic vein directly into the brachial artery (C) or “anastomoses” the deep connector between the median antecubital vein and the brachial veins directly to the adjacent artery. It is also possible to prepare a native vein arteriovenous fistula in the antecubital fossa by transposing brachial or basilic veins from the deeper compartment of the brachium to the subcutaneous tissue.