DIRECT ARTERIOVENOUS FISTULA FOR HEMODIALYSIS


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Abstract. A direct end-to-side anastomosis between the radial artery and the cephalic vein on the forearm was created for hemodialysis in thirty cases. In the authors' experience this procedure makes a valuable contribution to the easier management of hemodialysis as the shunt is less liable to thrombosis and infection, less time is lost in controlling the shunt, and the arm can be used freely between dialyses. A local aneurysm in the anastomosis required reoperation in one case.

The arteriovenous fistula is an important requirement for chronic hemodialysis in terminal renal failure. Such a fistula was effectively tried and described by Quinton, Dillard, Cole & Scribner (1962). Since thrombosis and infections tend to develop in these shunts, their use has often been limited to a period of a few months. This has contributed to the high mortality rate carried by chronic hemodialysis.

Brescia, Cimino, Appel & Harwich (1966) described a side-to-side anastomosis between the radial artery and the cephalic vein as an alternative method to overcome these complications. Since November 1966 we have used a modified Brescia-Cimino technique in our hemodialysis-transplantation program. A preliminary report on the results of our first thirty fistulas is given in the following.

SURGICAL TECHNIQUE

A tourniquet is applied to the upper arm, allowing the cephalic vein to fill. The course of the vein in the operative field is marked with a contrasting dye and the tourniquet removed. The skin incision is made as shown in Fig. 1 under local infiltration anesthesia. It is important to make this incision 2 to 3 cm away from the site of the planned anastomosis, so as to eliminate the constricting effect that the scar tissue would have on the vascular suture. After ligating the small branches of the vein with 6-0 silk, the vein is dissected from the surrounding tissue for a length of several centimeters; the artery is also dissected away from the surrounding tissue. Prior to constructing the anastomosis, the ulnar arterial collateral circulation is tested by clamping the radial artery and observing the arterial filling of this vessel distal to the clamp. When the collateral blood flow is adequate, the artery is ligated.

The vessels are flushed with heparin and clamped. An oval-shaped incision is made on the radial side of the artery, using the scissors shown in Fig. 2. The anastomosis is completed end-to-side, using 6-0 Mersilene continuous everting suture. The back of the anastomosis can be stitched from the luminal side with continuous suture (Fig. 3). Special attention is paid to good hemostasis. After closing the skin incision, the wound is covered with a gauze compress and the forearm fixed with a dorsal splint and slightly elevated.

TECHNIQUE OF DIALYSIS

We usually wait for at least one week before using the anastomosis for dialysis. During this period the patient is treated by peritoneal dialysis, when necessary. Before venipuncture the vein is engorged by applying a tourniquet on the forearm (Fig. 4). The vein is punctured under local anes-
After dialysis the needles are removed and the puncture sites are compressed for a few minutes. The arm bearing the fistula can be used without restriction.

RESULTS

The results of our first thirty fistulas are shown in Fig. 5. The fistulas have been functioning for 94 patient months, during which time they have served for 750 dialyses. The patient with the fistula that has functioned for the longest time has been dialysed for 15 months (124 dialyses). Seven patients succumbed to their primary disease, although the shunts were still in working order. Thrombosis developed in three fistulas, and aneurysm in two (Fig. 6). The fistulas which became thrombosed did so during the early months.

DISCUSSION

We created an arteriovenous fistula between the radial artery and a vein of the forearm according to the method of Brescia et al., in this manner utilising a superficial vein as a source of arterial blood for use in hemodialysis. Our preliminary experience with the side-to-side anastomosis was that the blood flow necessary for dialysis with the twin coil kidney was obtained only when the artery and vein were ligated on the distal side of the anastomosis. Therefore, we prefer an end-to-side anastomosis between cephalic vein and radial artery, ligating the artery distal to the anastomosis. The swelling of the hand usually subsides within
Fig. 3. Arteriovenous fistula. End-to-side anastomosis between the cephalic vein and radial artery, the latter is ligated distal to the anastomosis.

Fig. 4. Left: Forearm vein filled with arterial blood. Right: Needles in place for blood outflow (left) and backflow (right).
a few days and the vein carrying the arterial blood is ready for use within a week of the operation. The fistulas we constructed served for hemodialysis for 94 patient months.

An important advantage over the Scribner shunt is the unrestricted use of the arm carrying the fistula. The time-consuming continuous control of the function of the Scribner shunt with accom-

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**Fig. 5.** Duration of fistula function (in months).

**Fig. 6.** Venous aneurysm of the arteriovenous fistula.
panying psychological stress is eliminated. Although we have no personal experience, it seems possible that this fistula could be used with the Kil type kidney if the vein were compressed.

None of the cardiovascular complications associated with traumatic fistulas were recorded in our series. We studied the cardiac output in a few patients several months after creating the fistula and observed no difference with the fistula open or closed. Nor did we note any decrease in heart rate or elevation in blood pressure after closing the fistula (Nicoladoni–Branham test). This may be attributable to the small calibre of the vessels, their site, and the short period during which the fistulas were under observation.

The subcutaneous arteriovenous fistula of iatrogenic derivation is in a special category of traumatic arteriovenous fistulas. Experience has shown that cardiovascular complications are related to the shunt volume and localisation of the fistula. Arteriovenous fistulas in the lower part of the body lead to cardiomegaly in 54 per cent of cases, those in the upper part of the body in only 25 per cent of cases. Vollmar (1967) attributed the repercussions on the circulation of the fistula in the lower part of the body to the larger capacity and capability of the inferior caval venous system. The process of adaptation, which is accompanied by an increase in circulating blood volume and circulation velocity, extends over several years.

With our modification of the Brescia–Cimino fistula the complication rate is much lower than that observed with the Quinton–Scribner shunt. Blood clots in the vein were noted only in those cases in which the veins available for anastomosis were small, as in a case of renal dwarfism. In patients with a transplanted kidney functioning well we have already noted that the fistula may close within a week, as does also the Scribner shunt. The causes of closure are as yet unknown, but certainly call for further investigation.

Neither thrombosis nor infection, the most frequent complications with the Quinton–Scribner shunt, were recorded in our cases. This might partly be due to careful and long compression of the puncture sites, preventing the formation of subcutaneous hematomas.

An aneurysm formed in the venous part of the fistula in two patients. In only one instance was excision and the creation of a new fistula proximal to the old one required. To prevent local aeurysmatic dilatation of this type in the vein close to the anastomosis, we believe it important to restrict the preparation of the adventitial layer of the vein to the few millimetres bordering on the anastomosis.

Our experience to date prompts us to claim that the Brescia–Cimino fistula may make a valuable contribution to the safe performance of long-term hemodialysis.

REFERENCES