A NEW TYPE OF ALL-SILICONE RUBBER ARTERIO-VENOUS SHUNT

J. HOELTZENBEIN

Department of Surgery, St. Franziskus-Hospital, Münster/Westf., German Federal Republic

Cannula survival is just as important as efficient and clinically suitable dialysis apparatus. Forced by repeated and frequent failure of a forearm teflon-silastic shunt in a patient, we have devised a new shunt.

The new shunt taps the deep femoral artery and vein (Fig. 1). Access to these vessels

![Angiogram of the new deep femoral artery shunt.](image)

*Fig. 1. Angiogram of the new deep femoral artery shunt.*
is gained through the lateral femoral circumflex artery and the corresponding vein. Into these sufficiently large vessels a silastic tubing of $2 \times 4$ or $3 \times 5$ mm diameter is introduced and advanced till the square cut end of the silicone rubber tube just enters the lumen of the deep femoral artery and vein. The tubing is fixed by one or two slightly constricting ligatures. The distal ends of the tubings are brought out laterally at the upper thigh through stab incisions and an anastomosing loop is formed outside the body by inserting both ends into a tightly fitting sleeve of silicone rubber tubing (Fig. 2). The square ends abut against each other and are secured in the sleeve by constricting ligatures which would at the same time give a complete seal and prevent slipping out. The ends are thus perfectly aligned and transition from one tube to the other is smooth. There is no change in diameter in the whole cannula circuit. The loop is taped to the skin of the lateral thigh and protected by the under- wear. Details of the surgical technique are described separately (Hoeltzenbein, 1967).

The longest time a shunt of this kind has been in place is 20 weeks until the death of the patient due to another cause. At autopsy, there appeared almost no reaction macroscopically to the indwelling silicone rubber tubes, either in the soft tissue or in the vessels. After seven weeks, the arterial tube was accidentally pulled out a bit. The end slipped back into the lumen of the lateral circumflex artery. The shunt was still running, though blood flow velocity decreased slowly, leading to two clotting episodes after eight weeks. The clots, however, could easily be sucked out with a syringe. With the shunt still running after nine weeks, therefore, the vessels were exposed and new catheters, this time $3 \times 5$ mm, were advanced through the lateral circumflex vessels slightly into the lumen of the deep femoral artery and vein. Some fibrous deposits were removed which had formed near the tip of the tubing when it had slipped back in the lateral circumflex artery. This time, small wings made of the next larger size of silicone rubber tubing were glued to the silicone rubber tubes in order to prevent slipping out and moreover to stabilize against rotation (Fig. 3). Spontaneous flow through the $3 \times 5$ mm shunt was estimated by the bubble method to amount up to 500 ml/min. When using a blood-pump, however, a very much larger amount of blood could be drawn and returned through the shunt.

Discussion

It was felt that the teflon vessel tip had to be eliminated to minimize mechanical damage to the vessel wall. Moreover, connections in the shunt were reduced to only one smooth transition in the outside loop. Only one inert material, i.e., silicone rubber (Braley, 1964), would be in contact with blood, thus interference phenomena by differing electrical surface charges could be avoided. There should be no change of diameter to minimize formation of eddies (Fig. 4). The end of the silicone tubing should be flush with the wall of a larger vessel so that only a small portion, i.e., the cut square end of the tubing, would be in contact with a large pool of streaming blood. Arterial spasm in large vessels would not impede flow to such an extent as would be the case in the radial artery. The same would hold for large veins. There would be not as much change in pressure on addition of a relatively small amount of blood from the shunt to the large flow in the vein. Thus thickening of the vessel wall frequently observed in the forearm near the vessel tip (Pendras et al., 1966), could possibly be avoided. Moreover, venous spasm of a large vein would not as easily occur and would not impede the venous return to a great extent. Declotting, if necessary, would simply be reduced to sucking out a thrombus, usually not adhering firmly to the wall of the silicone tubing while fresh blood would follow from the large pool available at the tip. The danger of formation of a growing thrombus, unlikely in the artery, conceivable, however, in the vein, would not be as high with the small surface of foreign material exposed to the blood stream as would be the case with an indwelling catheter which might impede flow and thus promote thrombus formation.

Experience is still very limited with this shunt. It may be of value, however, to demonstrate
Fig. 2. View of the shunt at the upper lateral thigh.

Fig. 3. Close view of glued-on stabilizing wings.

Fig. 4. Arterial and venous silicone rubber tube with glued-on stabilizing wings are the only components of the shunt. Also shown is the connecting sleeve.
that in the body there is an ample resource of vessels still available when conventional cannulation sites are exhausted. The closer one gets to the body core, the easier would be the access to larger vessels. It is conceivable, for instance, to use the renal arteries and veins after nephrectomy with tubes extending extraperitoneally to the abdominal wall. Improvements in this type of shunt which we have also placed in the radial artery and cephalic vein in some cases, might be derived from making the vessel end of the silicone tubing thin-walled. Also the tubing could be made essentially kink-free by incorporating a rigid spiral or rings in the wall, thus adding safety to the cannula system.

Summary

An all-silicone rubber shunt positioned laterally at the upper thigh is described. Since the deep femoral artery and vein are tapped, the shunt might be called a deep femoral shunt. The shunt is made of silicone rubber only and has no change in diameter of the blood path. Inside the body, the shunt is stabilized by small glued-on wings to prevent pulling out and rotation. Outside the body, there is only one extremely smooth transition. Especially appreciated by the patients is the fact, that their arms are free and since the shunt is located at the lateral upper thigh, it is not visible ordinarily like shunts in the lower leg. It can, however, be cared for by the patient himself.

REFERENCES

