ULTRA-THIN-WALLED SILICONE VESSEL TIP

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Access to the circulation is recognized to be the main problem in regular dialysis treatment. While teflon has a rather smooth and inert surface with distinct anti-adhesive properties, its rigidity favours mechanical irritation with subsequent reaction and proliferation of the vessel wall leading to slowing of blood flow, platelet deposition, and finally thrombosis. Also penetration of the vessel wall may occur if the cannula is not properly aligned with the vessel. Moreover, to be of sufficient rigidity, teflon cannulas are made with a wall thickness ranging from 0.3 to 0.5 mm. This gives a marked step and consequent eddy formation and fibrin deposition at the transition from the vessel into the cannula. Another step is inevitably formed at the junction between the teflon vessel tip and the silicone rubber shunt body. Existing vessel tips made of silicone have a stepless transition to the shunt body, but are relatively thick-walled and are still prone to kinking and collapsing at the site of the ligature placed around the vessel.

In order to obviate these shortcomings, we have constructed a new shunt which has a flexible and ultra-thin-walled vessel tip still possessing sufficient rigidity. This was made possible by an entirely new procedure. Microscopically thin glass fibres having a diameter of a few microns only are incorporated into the vessel for reinforcement of the silicone rubber. By variation of the number of layers and the pitch of the thread, almost any desired degree of flexibility or rigidity can be obtained. In order to make the transition to the vessel intima as

Fig. 1. Front view of vessel tips. Conventional vessel tip to the left (0.4 mm wall thickness), glass fibre reinforced vessel tip to the right (wall thickness less than 0.1 mm).
Fig. 2. Complete shunt system consisting of 2 shunt tubes and centring sleeve (bottom). Ultra-thin-walled, flexible, glass fibre reinforced silicone rubber vessel tip and glued-on dacron felt ring for stabilization of the vessel tip (right hand side). Movable dacron ring with friction-fit for internal stabilization of the skin exit (centre).

soft as possible, we have found it practical to have the extreme end of the vessel tip formed of a very short length of unarmed, thin-walled silicone rubber followed immediately by a section armed with one layer of glass fibres only, adding more layers the closer one gets to the shunt body tube. The vessel tip can thus be made to a wall thickness of 0.1 mm or even less (Fig. 1). The vessel tip forms one piece with the shunt body, so there is no step. While the vessel cannulas could be made to any desired taper, a uniform diameter throughout the whole shunt is presently preferred in order to reduce change of velocity and eddy formation in the blood stream. Inside diameters of the shunts so far implanted have ranged between 2 and 3 mm. Insertion of the shunts into the vessel is greatly facilitated by a mandril armed with a tapered silicone rubber tip which is withdrawn after insertion. The shunt body tube near the vessel tip is surrounded by a permanently glued-on ring of dacron felt. This ring anchors the vessel tip by tissue ingrowth (Fig. 2). A second ring of dacron felt which is internally covered by silicone rubber is fixed to the shunt tube by friction. It can be moved, however, to any desired position close to the skin exit of the silicone rubber tube. Thus, internal rather than external stabilization prevents movement of the silastic tube at the skin exit and should reduce one source of infection at this site. Outside the body, the tubes are connected to form a loop. This connection is brought about by placing the two ends into a centring sleeve. Thus, the two tubes abut against each other and again a smooth transition is obtained.

Although the first experiences with this new type of shunt are encouraging, it is too early to give comparative results. Shunts have been implanted for periods up to 12 weeks so far.