A METHOD OF INTRODUCING THIN-WALLED POLYMER CANNULAS AND CATHETERS INTO BLOOD VESSELS UNDER 0.2 mm IN DIAMETER

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High hydraulic resistance of cannulas and catheters used to measure intravascular pressure and also for experimental perfusion of organs is undesirable. The resistance can be reduced by a decrease in the ratio of the thickness of the wall of the cannula (catheter) and its radius. However, if the diameter of the vessel is under 1 mm, thin-walled polyethylene catheters and cannulas will be extremely flexible, for if the linear dimensions of a tube are reduced by half, its flexural rigidity is reduced by 16 times [1], and the introduction of such tubes into vessels is difficult. That is why cannulas under 1 mm in diameter are usually made of hard materials (glass, metal, polycarbonate, fluoroplast), and catheters are made with thick walls. However, high flexibility of the hydraulic lead could substantially facilitate measurements on objects such as contracting skeletal muscles of the heart, and could also facilitate the passage of a catheter along vessels with sharp bends.

The writers have made a device facilitating the introduction of thin flexible catheters and cannulas (Fig. 1). The device consists of a cannula or catheter 1 made of thin-walled polyethylene, a fairly rigid tube 2 made of thick-walled polyethylene, a tube 3 made of silicone rubber or polyvinyl chloride, an airtight tube 4 made of polyethylene and a length of copper wire 5, tapering to a point at one end, and fitting tightly into the thin end of tubes 1 and 3 (Fig. 2).

Slightly conical thin-walled tubes for cannulas and catheters up to 150 μ in diameter, with a wall up to 15 μ in thickness, were drawn in a current of hot air (over heated nichrome wire) from polyethylene tube with an outer diameter of 2.00 mm and with a wall 0.25 mm in thickness.

Before introduction into the blood vessel the device is filled with physiological saline with heparin. Introduction (through an incision in the wall) of the pointed end of the wire into the vessel as a rule presents no difficulty (Fig. 3a). If there are no large rough areas at the end of the tube it also easily enters the vessel (Fig. 3b). The pointed end of the wire is drawn into the tube (Fig. 3c) and the latter is moved forward along the vessel. The cannula is fixed to the vessel by the ligature 2 (Fig. 3d), and at the level of the tube 2 (Fig. 1) it is fixed to the tissues or, if necessary, to a reinforcing device (not shown in Fig. 3). After this, the wire is withdrawn completely, a minature clip is applied, and

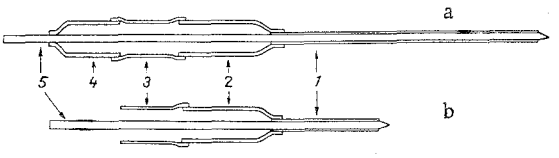

Fig. 1. Diagrams of devices for introducing catheter (A) and cannula (B). Explanation in text.

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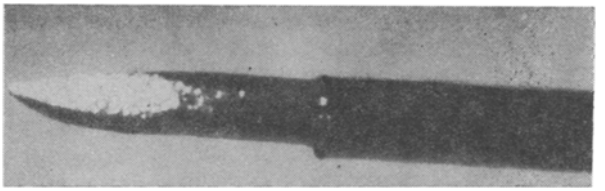

Fig. 2. Tip of cannula with wire *in situ*.

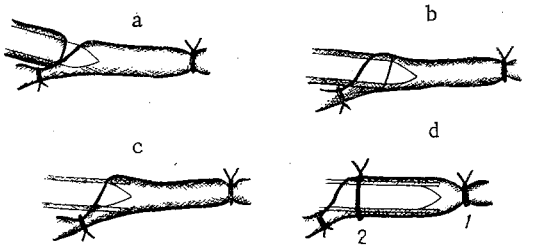

Fig. 3. Stages of introduction of cannula (catheter) into vessel. Expanation in text.

ligature 1 is untied (Fig. 3d). The ligature can be replaced by a miniature clamping device. The apparatus is ready for connecting to the measuring or perfusion system.

During introduction of the catheter ligature 2 (Fig. 3d) is not tied tightly, and after ligature 1 is untied the tube is carefully moved forward along the vessel. When a bend is approached the resistance to movement increases. From that moment, the catheter is advanced step by step: The wire is withdrawn by 2-3 mm, the catheter moved forward through 2-3 mm, the wire again withdrawn by 2-3 mm, and so on. After the advance of the catheter has ended, ligature 2 is tied, the wire is withdrawn as far as tube 4, tube 3 is clamped, tube 4 is withdrawn from it, and the catheter is ready for use.

The device described above enabled the writers to measure pressure in vessels such as branches of the saphenous and brachial arteries in rats. In the same animal catheters were introduced via the left brachial and right subclavian arteries to record pressure in the aorta, and blood was sampled from the saphenous artery through a cannula whose resistance amounts to only a small fraction of the resistance of this artery.

LITERATURE CITED

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