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[21] Appl. No. **747,712**
[22] Filed **July 25, 1968**
[45] Patented **Aug. 10, 1971**
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[32] Priority **Apr. 30, 1968**
[33] **Germany**
[31] **H 62 605/30k Gbm**

[54] **VASCULAR CANULA FOR MEDICAL APPLICATIONS**
6 Claims, 5 Drawing Figs.

[52] U.S. Cl. **128/348,**
128/214.4, 138/118, 138/177
[51] Int. Cl. **A61m**
25/00
[50] Field of Search..... **128/214.4,**
348-351, 2; 138/118, 123-127, 129, 130, 177,
178; 264/173, 174, 209

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ABSTRACT: A vascular canula which is intended for inser-
tion into a blood vessel. The canula includes a thin-walled
tube made of silicone rubber. The tubing wall is reinforced
with thin fibers to provide a canula which combines softness
and flexibility with stability of shape.

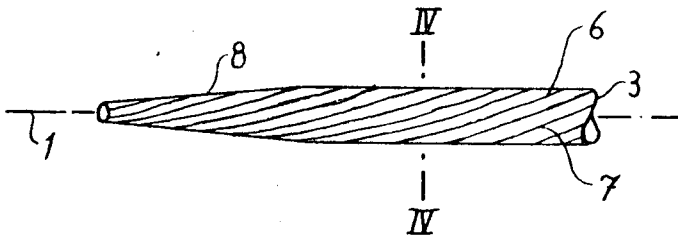


Fig. 1

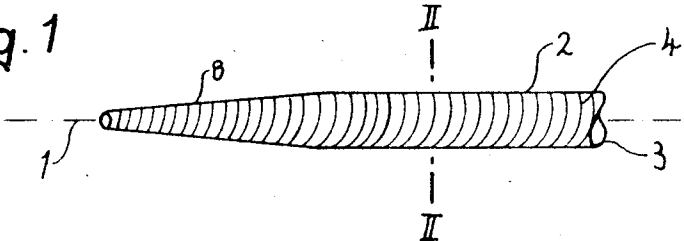


Fig. 2

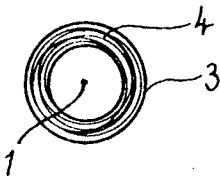


Fig. 3

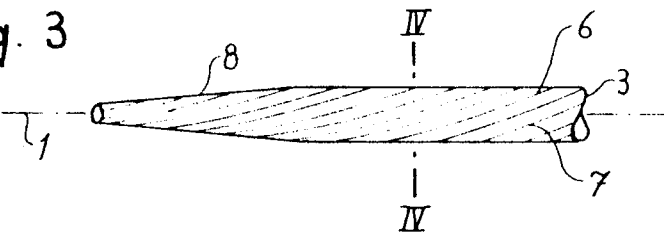


Fig. 4

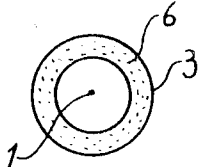
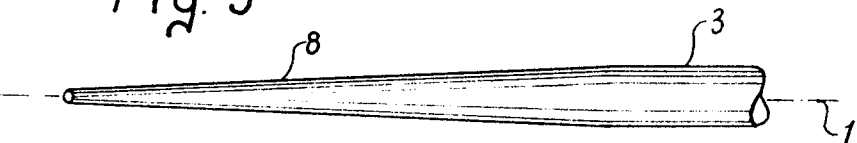


Fig. 5



VASCULAR CANULA FOR MEDICAL APPLICATIONS

BACKGROUND OF INVENTION

This invention relates to a vascular canula for medical applications. In particular the invention relates to a canula for insertion into a blood vessel wherein the canula is of the silicone rubber type.

In medical technique it is often necessary to insert a thin canula or tube into a vessel such as an artery. In doing so it is customary to place a ligature around the blood vessel so that blood cannot escape along the outside of the canula. In order to prevent bulging from developing between the exterior of the canula and the interior of the blood vessel, the ligature is usually placed as close as possible to the end of the canula. The remote end of the canula may be placed connected with a suitable tube to guide the blood externally of the patient for appropriate treatment. A similar arrangement may be made for returning blood to the body.

Canulae for this purpose are now often manufactured from silicone rubber as this material is tolerated particularly well by the human body. Moreover, canulae made of silicone rubber can be made with very thin walls relative to the diameter of the tubing.

However, certain considerations should be borne in mind in the use of silicone rubber canulae. For example, thin-walled canulae of this type are often so soft that they collapse easily, that is to say they lose their inside round cross section and it may therefore not be advisable to use these thin-walled canulae directly for introduction into the blood vessel.

Another consideration in the use of a vascular canula is that the transition from the inside wall of the blood vessel into the canula should be a continuous as possible in order to avoid the development of vortices in the blood flow which could lead to fibrinous deposits and finally to thrombosis.

Additionally, it is important that the inside skin of blood vessel should not be mechanically irritated.

Summarizing, certain forms of silicone rubber canula in present use may sometimes have certain disadvantages by being either too rigid or too soft, or by creating an undesirably abrupt transition between the blood vessel and the interior of the canula. Similar disadvantages may of course also occur in the transition from the canula to the connecting tube to the exterior.

OBJECTS AND SUMMARY OF THE INVENTION

It is therefore a general object of the invention to provide a canula which obviates or minimizes problems of the type generally noted above.

It is a particular object of the invention to provide a thin-walled canula formed of silicone rubber which combines very great mechanical strength and stability of shape with the customary surface smoothness of silicone rubber.

A canula constructed in accordance with a preferred embodiment of the invention, intended to accomplish at least some of the foregoing objects comprises a thin-walled silicone rubber tube reinforced by fibers extending along the tube.

In the preferred embodiment the fibers comprise glass fibers embedded into the wall of the silicone rubber canula. The fibers are statistically evenly embedded.

In further refinements of the invention, the fibers are embedded into the wall along the main axis and disposed helically therealong. In addition, the vascular canula may be axially tapered to provide a generally frustoconical leading end of the canula.

THE DRAWINGS

A canula according to certain preferred embodiments of the invention is illustrated in the accompanying drawings in which;

FIG. 1 is a side view of a canula according to one preferred embodiment of the invention;

FIG. 2 is a cross-sectional end view of the canula shown in FIG. 1 taken along lines II-II therein;

FIG. 3 is a side view of a second embodiment of a canula according to the present invention;

FIG. 4 is a cross-sectional end view of the canula shown in FIG. 3 taken along lines IV-IV therein; and

FIG. 5 is a side view of a third embodiment of a canula according to the present invention.

DETAILED DESCRIPTION

Referring to FIG. 1 of the drawings, a canula constructed in accordance with a preferred embodiment of the invention is there shown. The canula extends along a longitudinal axis 1 and comprises an axially extending tube 2 defined by a thin wall 3 which is of very much less thickness than the extent of the tube diameter. For example, the thickness of the wall 3 may be of the order of 0.2 mm. while the diameter of the tube is of the order of 6-10 mm.

Embedded in the wall 3 are a plurality of glass fibers 4. The fibers extend along the tube in a generally uniform helical configuration about the tube. Distribution of the fibers along the tube is made on a statistically even basis to maintain the strength and flexibility characteristics of the canula on an axially uniform basis. In the preferred embodiment the fibers 4 are embedded along the main axis in relatively steep helical pitch 7.

However, in the second alternative embodiment shown in FIG. 3, fibers 6 disposed in a less steep helical pitch are provided.

As disclosed in FIG. 1 the canula is provided with a tapering end portion 8 of generally frustoconical form.

Additionally, the fibers may be disposed in axially extending relation (FIG. 5) in the third alternative embodiment of the invention to provide an exceptionally elongated tapering point which nevertheless retains its stability of shape to the very tip.

Although glass fibers have thus far been disclosed, other types of fiber may be utilized under certain circumstances. In particular, embedded fibers formed of extremely fine quartz filaments of a few microns of thickness may be utilized, particularly as quartz fibers gain mechanical strength in an inverse ratio in their thickness so that they are very flexible. Quartz fibers of this type can therefore be bent without tension in exceedingly small radii especially in view of the support afforded by the surrounding silicone rubber. Other fibers include metal fibers formed of capillary sliver. If it is desired to provide magnetic or electric current conductivity properties steel or iron fibers may be used. In addition, mixtures of different fiber materials may be employed.

The embedded fibers provide the canula with a combination of high bending in elasticity and high mechanical strength. If extremely high elasticity of extension is required however, then the fibers are embedded in the tube wall at an increased pitch along the tube (as disclosed in the embodiment of FIG. 3) or else extending axially along the canula (as disclosed in the embodiment of FIG. 5).

Thus, one can produce canulae depending on the characteristics desired in the individual case, which canulae are very flexible or else which have great tensile strength. Also, the longitudinal elasticity of the canulae can be influenced through the type of development of fibers.

In cross section (FIG. 2) it will be seen that the fibers do not extend into the interior of the tube which thus retains its smooth interior wall characteristics. However, under certain circumstances, it is desirable to cause the embedded fibers to project with a noticeable roughness from the inside surface of the tube. This has the advantage that during use the fibrogerminal cells of the blood settle in the rough spots of the wall surfaces to create a vascular wall within the canula which corresponds to artificial live tissue.

SUMMARY OF ADVANTAGES

The fibers invention provides a canula having significant advantages. Even in the case of wall thickness of 0.2 mm. and less and with correspondingly very small diameters, silicone rubber canulae provided with embedded fibers as described, combine the advantage of optimum softness with pronounced stability of shape. The tubes and canulae furthermore have the desired smooth surfaces which are peculiar to silicone rubber. Furthermore, these canulae are of wide application because of their high elasticity.

A particular advantage is afforded by the ease with which the mechanical strength as well as the degree of elasticity may be regulated within wide limits. In some cases where a high bending elasticity and where a high mechanical strength are important, the canula contains the embedded fibers in a relatively close helical pitch. If, however, increased elasticity of extension is required, then the fibers are embedded in a helical disposition of considerably increased pitch, or extending axially along the canula.

It is furthermore an advantage that one can also produce canulae having elongated tapered extreme portions which are pliable to their extremities and yet which retain their rigidity.

Although certain embodiments have been described it will be appreciated by those skilled in the art that numerous additions, deletions, substitutions, modifications, and other

changes not specifically disclosed or described may be made which will fall within the purview of the appended claims.

I claim:

1. A vascular canula comprising a silicone rubber tube having a wall thickness of no more than about 0.2 mm., having a nonwoven, helical fiber disposition running in a single axial helical direction, embedded in said tube wall, and running substantially the length of the tube, the fiber material being selected from the group consisting of glass, quartz, silver, steel, and iron, whereby radial expansion of said tube under internal pressure is restricted without severe reduction of the axial extensibility of said tube.

2. A vascular canula as defined in claim 1 wherein, the fiber material is gloss.

3. A vascular canula as defined in claim 1 wherein, said fibers extend at least partially from said wall into the interior of said tube to make the interior of said tube noticeably rough.

4. A vascular canula as defined in claim 1 further including, a generally frustoconical, tapered portion of relatively reduced diameter positioned at one extremity of said tube.

5. The canula of claim 1 in which said fiber material is steel.

6. The canula of claim 1 in which said fiber material is quartz.

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