

[72] Inventor **Philip R. Foti**
Kailua, Hawaii
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 [73] Assignee **Becton, Dickinson and Company**
East Rutherford, N.J.

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Primary Examiner—Dalton L. Truluck
 Attorney—Kane, Dalsimer, Kane, Sullivan and Kurvcz

[54] INDWELLING ARTERIAL CANNULA ASSEMBLY 10 Claims, 7 Drawing Figs.

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 128/221
 [51] Int. Cl. A61m 5/00
 [50] Field of Search 128/214.4,
 221, (I.C. Digest), 348

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ABSTRACT: An indwelling arterial cannula assembly includes a plastic catheter coaxially removably mounted on a blunt tipped cannula having a pointed stylet removably located in the bore thereof and extended beyond the blunt tip of the cannula; and a method is provided for positioning a portion of the plastic catheter of the assembly into an artery. The method includes the steps of projecting the assembly into the artery by piercing both the inner and outer walls of the artery with the point of the stylet and extending a portion of the assembly through the openings in both of the walls. Then the stylet is removed from the assembly and the remainder of the assembly is retracted until its forward tip reenters the artery and fluid from the artery flows through the cannula. The remainder of the assembly is then advanced into the lumen of the vessel to the desired position with the blunt tip of the cannula alleviating the danger of repuncture of the inner wall of the artery. Finally, the plastic catheter is slid forward while the cannula is removed therefrom which thereby locates a portion of the catheter in the desired position in the artery.

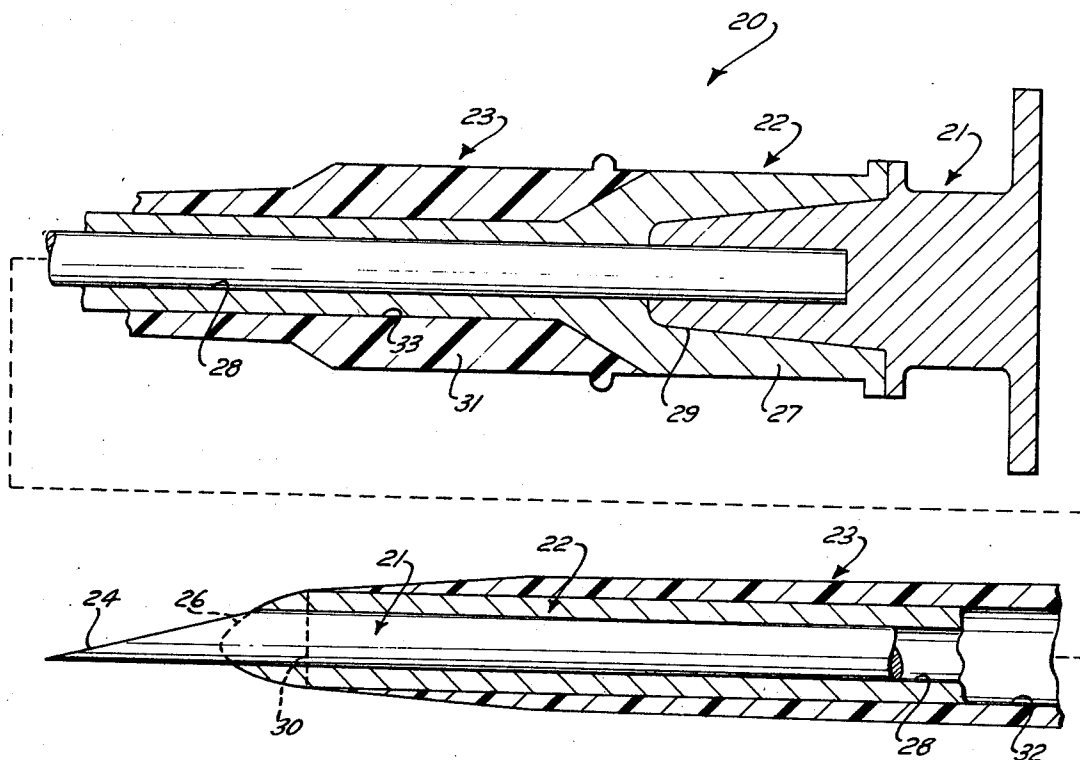


FIG. 1

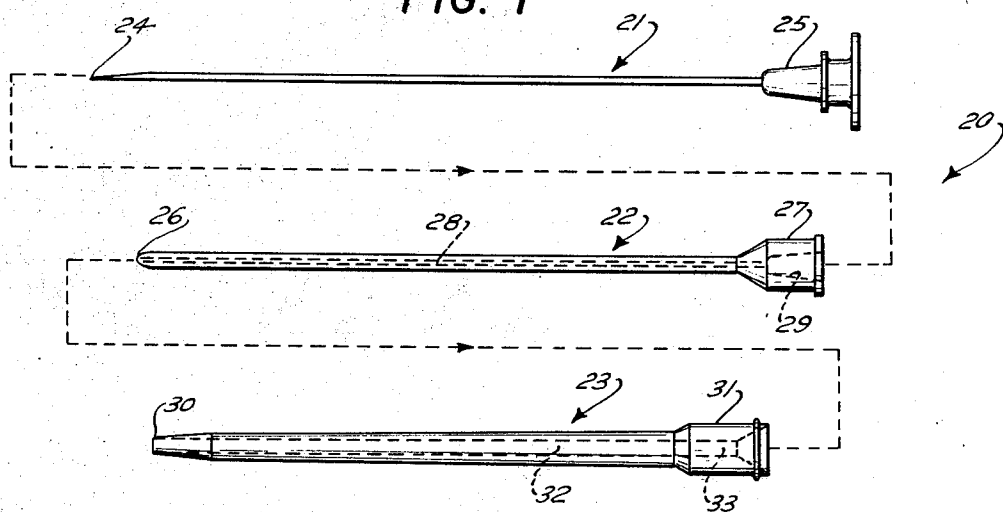
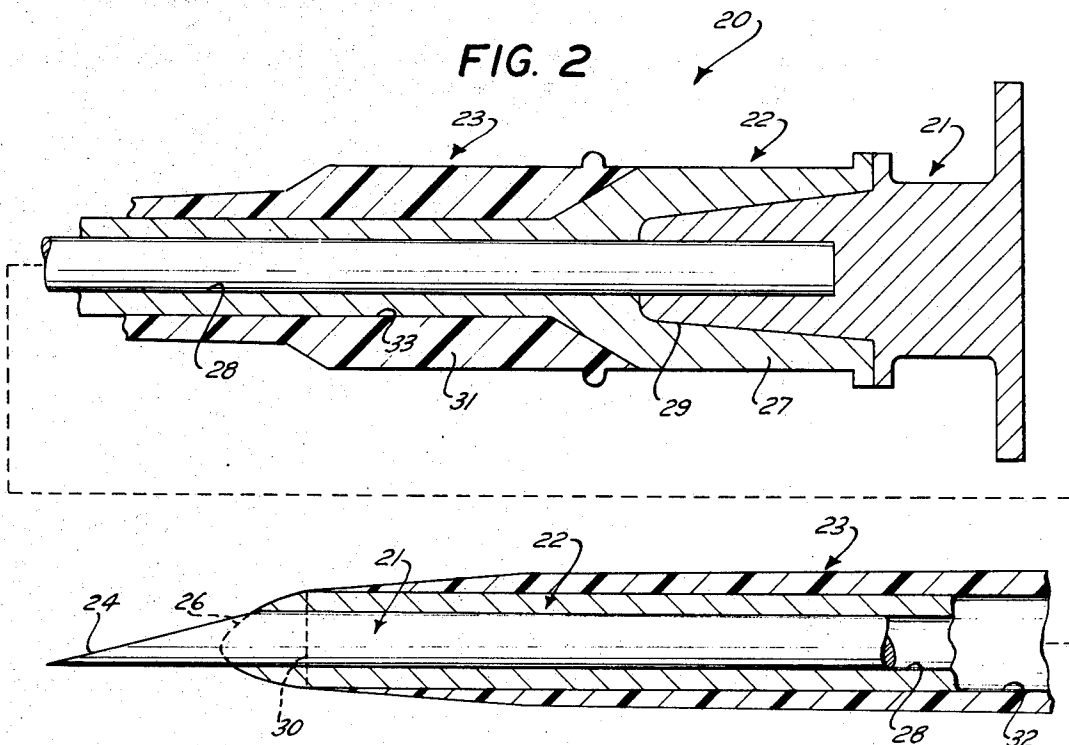


FIG. 2



INVENTOR
PHILIP R. FOTI

BY

Kane, Delamater, Kane, Sullivan & Smith
ATTORNEYS

FIG. 3

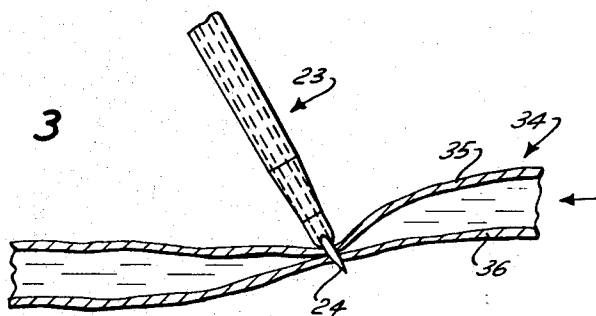


FIG. 4

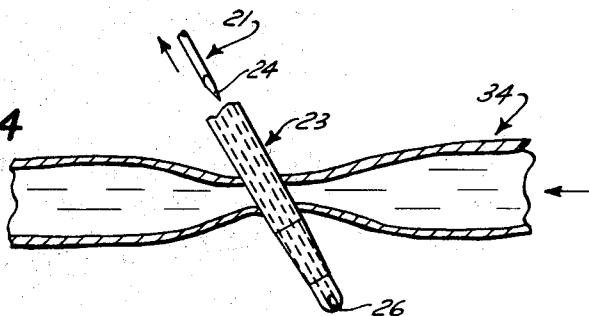


FIG. 5

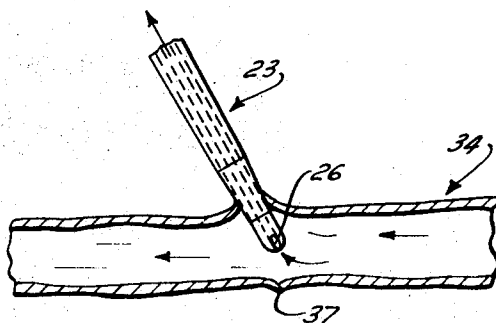


FIG. 6

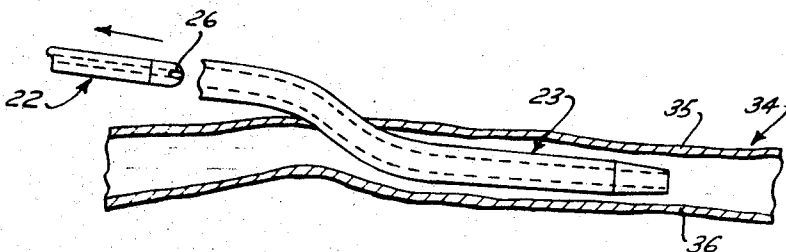
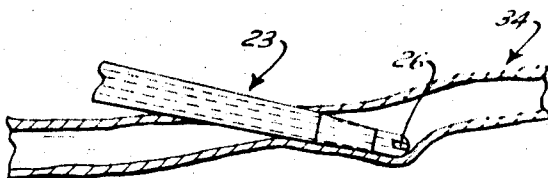


FIG. 7

INVENTOR
PHILIP R. FOTI

BY

Karl Q. Valenier, Karl, Sullivan, Smith
ATTORNEYS

INDWELLING ARTERIAL CANNULA ASSEMBLY

BACKGROUND OF THE INVENTION

There are several different types of arterial indwelling needles in use today. However, these needles produce various shortcomings when in use which demand the development of an improved indwelling arterial cannula assembly for application to a patient.

For example, one type of needle in use is a well-known Courmand needle. This type of needle is generally considered as the original arterial indwelling needle and it is constructed of all steel materials. Therefore, when it is placed within the lumen of a vessel which is located in a portion of the body where considerable movement occurs which is often the case, extensive damage to the vessel could occur. This happens quite often since this type of needle is generally placed in an area where considerable flexing by the patient would normally occur such as adjacent the elbow. Consequently, this type of needle is difficult to leave in place for many hours or days as is often necessary.

Several other attempts have been made to produce a needle which will satisfy the requirements for providing an indwelling catheter for an artery located in a difficult position such as discussed above. For example, one combination employs a plastic catheter positioned on a pointed needle which contains a pointed stylet within its opening with the solid pointed end of the stylet being aligned with the pointed end of the needle. The difficulty with this type of arrangement is that it is very difficult to get into an artery because of the pointed cannula or needle that remains when the stylet is removed. Trying to slide the plastic catheter and needle combination along the interior walls of the vessel particularly if the vessel is located in a difficult position such as an elbow joint will often cause repeated punctures of the vessel and considerable damage.

Another problem with this type of needle is that the stylet and the pointed cannula are generally beveled and have a common type of needle tapered point. This presents a problem in the instance of small and thin artery walls where it is preferable to have a cleaner puncture to alleviate the danger of tearing the artery wall which of course causes unwanted damage and also discomfort to the patient. Of course the one feature that this type of needle assembly has that the Courmand assembly does not have is the fact that it leaves a flexible catheter in the artery instead of a stiff steel needle as in the instance of the Courmand.

A further problem which often appears with existing needle assemblies is that often the assembly does not slip easily into place within the artery once the initial puncture is made. Furthermore, there is often difficulty in sliding an obturator in and out of the plastic catheter when it is in position within the artery each time it is desired to pass fluid through the catheter. A catheter material which will facilitate this particular step would also be advantageous in construction of the needle assembly. Once again this also provides a catheter arrangement which is less traumatic and discomforting to patients.

Other features which would be advantageous in an assembly of this type would be to have the outer catheter arranged so that it has a smooth taper from its forward point to its extreme diameter to facilitate entrance within the artery. Furthermore, an assembly of smaller gauges than previously utilized would facilitate use in smaller more difficult arteries within the patient. Furthermore, a tip on the assembly which is hard as well as having the above advantages would be helpful in that it will not hang up on the artery wall when entering. This is often the problem with previously discussed assemblies of this type. Finally, a catheter should be constructed of a material, if possible, which will lend itself to disposability after single use. Therefore, it should be of relatively low cost and relatively easy to manufacture.

SUMMARY OF THE INVENTION

Principally it is an objective of this invention to alleviate the above discussed problems existent with presently used needles and to provide a needle assembly which will achieve the above mentioned advantageous features as well as satisfying the above discussed requirements. The present indwelling arterial cannula assembly is capable of easier placement thereby providing a higher success rates in any user's hands. The resultant catheter is designed so as to be more comfortable in place because of flexibility thereby avoiding patient immobilization. This allows one to leave such a catheter in place for comparatively long periods of time, for example, in an intensive care unit. The introduction of the assembly and catheter in its proper location is significantly less traumatic to the patient and the assembly is readily adaptable for use in routine pulmonary physiological studies, cardiac output determinations and monitoring, indwelling arterial electrode use for monitoring partial pressure of oxygen, and any procedure requiring easy access to intermittent arterial blood samples over an extended period of time. The technique and method of use of the assembly is easily taught and the assembly is applicable to children as well as adults.

A brief description of the structural features of the indwelling arterial cannula assembly disclosed herein and its method of application is now in order to generally point out how the above mentioned features and objectives are obtained. An indwelling arterial cannula assembly is provided for the positioning of a portion of a plastic catheter into an artery wherein the assembly includes a plastic catheter coaxially removably mounted on a blunt tipped cannula having a pointed stylet removably located in the bore thereof and extending beyond the blunt tip of the cannula. The method of use of this assembly includes projecting the assembly into the artery by piercing both the outer and inner walls of the artery with the point of the stylet and extending a portion of the assembly through the openings in both walls of the artery. The stylet is then removed from the assembly and the remainder of the assembly is retracted until the forward tip thereof reenters the artery and fluid from the artery flows through the cannula. The remainder of the assembly is then advanced into the lumen of the artery to the desired position with the blunt tip of the cannula alleviating the danger of repuncture of the inner wall of the artery. Finally, the plastic catheter is slid forward while removing the cannula therefrom which thereby locates a portion of the catheter in the desired position within the artery.

With the above objectives in mind, reference is had to the attached drawing for a more detailed description.

BRIEF DESCRIPTION OF THE DRAWINGS

In the drawing:

FIG. 1 is an exploded view of an indwelling arterial cannula assembly of the invention;

FIG. 2 is a sectional elevational view of an indwelling arterial cannula assembly of the invention;

FIGS. 3-7 illustrate in perspective a sequential series of steps utilized in positioning the indwelling arterial catheter of the assembly in proper position within an artery with arrows showing the direction of flow of fluid within the artery and the direction of the assembly and its elements during the sequential series of steps.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Initially, discussion will be directed toward the cannula assembly 20 itself as attention is directed to FIGS. 1 and 2 of the drawings. Assembly 20 is composed of three basic elements, a stylet 21, a cannula 22 and a catheter 23.

Stylet 21 may be constructed of any well-known material to give it its solid properties such as a rigid metallic wire material. The forward end of the stylet 21 has a sharp pointed tip 24 to facilitate the assurance that only tiny pin holes are made in the

vessel or artery of the patient during the puncture procedure. The rear end of stylet 21 has affixed thereto a hub 25 generally constructed of any common rigid material.

Cannula 22 is also a rigid member and may be constructed of any common type of rigid material, for example a metallic material such as stainless steel. The forward tip 26 of the cannula 22 is blunted and has a somewhat rounded configuration so that cannula 22 will follow stylet 21 through a puncture hole in an artery but which is not sharp enough to readily create a new puncture by itself. Mounted on the rear end of the cannula 22 by any common means or integral therewith is a hub 27. An axial bore 28 extends from the forward tip 26 of the cannula 22 to the rear end thereof and communicates with an opening 29 within hub 27 to provide a continuous passage through cannula 22. Bore 28 is designed to accommodate in close fitting relationship stylet 21 with the forward portion of hub 25 positioned within opening 29 in hub 27. When stylet 21 is thus positioned within cannula 22 the forward tip 24 thereof will extend beyond tip 26 of cannula 22 a predetermined distance. Satisfactory results have been obtained with such as assembly when stylet 21 extends approximately 4 mm. beyond the blunt tip 26 of the cannula 22. However, this is not necessarily required and this distance may be varied depending upon the individual circumstances of use for the assembly 20.

The third principal element of assembly 20 is catheter 23 which generally has a taper from its rear end to its forward tip 30. This taper is to facilitate entrance of the catheter 23 through the puncture created in an artery when assembly 20 is introduced therein as will be readily apparent below. At the rear end of catheter 23 either attached thereto by common means or integral therewith is a hub 31. An axial bore 32 extends from the tip 30 of catheter 23 rearwardly into communication with an opening 33 in hub 31 to combine therewith to form a continuous passage from one end of catheter 23 to the other. Bore 32 and catheter 23 is of a sufficient size to snugly accommodate cannula 22 when assembly 20 is formed and opening 33 in hub 31 is designed to accommodate the forward portion of hub 27 of cannula 22. In this manner, stylet 21, cannula 22 and catheter 23 may be assembled in coaxial relationship to form indwelling arterial cannula assembly 20. The configuration of each hub and bore of each element contribute to an interlocking relationship between the elements in assembled form as is readily apparent from FIG. 2.

Cannula 23 is generally constructed of a plastic material, preferably flexible, which will be inert with the portions of the body with which it comes in contact and which will readily accommodate itself to the arterial configuration into which it must extend. It also must be of a material which will readily permit it to be introduced through the opening provided by tip 24 and tip 26 in the arterial walls with the minimum amount of resistance. A material which has been found to be particularly effective for use as catheter 23 is polytetrafluoroethylene which is commonly known as Teflon. As is well known in the art, Teflon is inert to the portions of the body with which it will come in contact as well as the fluids with which it will come in contact. Furthermore, Teflon being a natural lubricating material will easily follow its predecessor needle portions of the assembly into the arterial opening. Other plastic materials have been found to operate successfully, but not as successful as Teflon when formed as catheter 23 such as polyvinyl chloride with a silicone lubricated inner bore and which is welded to hub 31. Several important features of the catheter 23 which contribute to the ease with which the assembly may be operated, is the fact that the catheter should contain a smooth taper from its rear end to its forward tip, should fit tightly on cannula 22 yet still be easily removable therefrom and the plastic employed should be such that the tip may be electromagnetically buffed, if desired, to increase hardness and to alleviate the danger of "hang up" of the artery wall when it enters the artery. Previously known cannula assemblies of this type have produced this problem.

The term "hang up" refers to a catching of the forward edge of the catheter on some portion of the artery as it is moved with respect thereto which could cause tearing of the artery structure itself in resultant damage and discomfort to the patient. Furthermore, the material used for catheter 23 should be a disposable type of material so that the assembly may be economically and easily manufactured at low cost. The above discussed materials satisfy these requirements as well as other materials which are known in the art.

It should be noted as can be readily seen from FIG. 2 that the smooth rather continuous engagement formed by tip 24 of stylet 21, tip 26 of cannula 22 and tip 30 of catheter 23 facilitates the entrance and movement of the assembly within the arterial area during operation. In this regard it should be pointed out that tip 30 does not extend into coincidence with tip 26 of cannula 22 but terminates a somewhat short distance therefrom. This contributes to lessening the danger of "hang up" as well as limiting the extent of tolerances required during manufacture and thereby facilitating the production of an economic cannula assembly.

Turning to the operation and use of the assembly itself, reference should be made to FIGS. 3-7 which shows the sequence of steps employed in positioning catheter 23 properly within an artery 34. A recommended technique for insertion would be as follows: Initially, the vessel to be entered should be locally anesthetized. Then if desired, scalpel blade puncture of the skin is useful to avoid resistance to easy manipulation while transfixing the underlying vessel or artery.

If palpating fingers are placed above and below the site of arterial puncture, the following procedure aids in accurate, atraumatic cannulation of the vessel, that is, to advance the long needle stylet 21 through both walls somewhat tangentially. If it is placed nearly square through the center of the lumen, slight pressure will cause the blunt metallic cannula 22 to compress the arterial wall, compromise the lumen and the distal pulse will disappear or become markedly attenuated. A release of slight pressure will bring back the pulse. This is a sure sign of proper placement and the assembly 20 may then be advanced through both the outer wall 35 and the inner wall 36 of vessel 34. If the described sign is not obtained, it is best to withdraw completely, to begin again, and only pin holes are left in vessel 34 principally due to the sharp point 24 on stylet 21.

Once vessel 34 is transfixed and the entire assembly 20 has extended through both walls of vessel 34, then stylet 21 may be removed from the assembly. The remainder of assembly 20 should then be retracted until the tip 26 of cannula 22 has reentered the vessel which will be indicated by flow of fluid being established so that it issues from hub 27 of cannula 22. This position is indicated by FIG. 5 of the drawing. It should be noted at this point that inner wall 36 of artery 34 will tend to close and seal once again at the original point of puncture 37.

The next step is to advance the remainder of assembly 20 into the lumen of artery 34 to the desired degree. As illustrated in FIG. 6, the blunt tip 26 on cannula 22 will facilitate this movement in the sense that it will allow the assembly to move through the vessel without danger of tearing or repuncturing the inner wall of vessel 34.

The final step as illustrated in FIG. 7 is to simply slide the plastic catheter 23 forward and remove blunt cannula 22 rearwardly at the same time to properly locate catheter 23 within the lumen of the artery 34 where it will assume the natural configuration of the artery and may be kept in that position for a considerable length of time. A plastic stylet or obturator may be placed into the lumen of the needle to keep it from clotting between blood samples or if the catheter's course is too tortuous, a syringe with anticoagulant may be attached thereto. A common type of Teflon or obturator may be used to occlude the Teflon catheter lumen since it will not clot and flow will be maintained well. It is further recommended that a sterile glove be used for intermittent sampling, especially with smaller needles, to avoid contamination of the obturator shaft.

Obturator of this type are common as well as the use of a syringe with an anticoagulant which may be attached to the hub of the catheter. Therefore, since these items are not part of the assembly itself they are not shown in the drawings for simplicity purposes. Assemblies of this type may remain in place for a considerable length of time without thromboembolic or other problems and with a minimum of patient discomfort.

The advantages of such an assembly as disclosed herein are readily apparent and include easier placement of an indwelling arterial catheter and higher success rates in any hands. Furthermore, they are more comfortable when placed in a difficult position because of the flexible features possible thereby avoiding patient immobilization. This allows one to leave such a catheter in place for comparatively long periods of time, for example, in an intensive care unit. It is readily apparent that from the ease of and simplicity of construction, the utilization of the assembly is significantly less traumatic for the patient and the assembly is readily adaptable for use in routine pulmonary physiological studies, cardiac output determinations and monitoring, indwelling arterial electrode use for monitoring partial pressure of oxygen, on-line arterial pressure monitoring, and any procedure requiring easy access to intermittent arterial blood samples over an extended period of time. As discussed above, the technique of use is easily taught and the assembly is equally applicable to children as well as adults.

Thus, the above mentioned objects of the invention, among others, are achieved.

I claim:

1. An indwelling arterial cannula assembly comprising:
 - a rigid cannula having a blunted forward tip, a hub connected to its rear end and a passage therethrough;
 - a plastic catheter having a passage therethrough, a hub connected to its rear end and being coaxially removably mounted on said cannula said catheter being shorter in length than said cannula; and
 - a stylet having a pointed forward end, a hub attached to its rear end and being removably positioned within the passage of said cannula with its forward end portion extending beyond the blunted tip of said cannula thereby facilitating the positioning of a portion of said assembly into an artery and the subsequent removal of said cannula and stylet from said catheter to leave a portion of said plastic catheter in the desired position within said artery.
2. The invention in accordance with claim 1 wherein the forward portion of said catheter tapers inwardly toward the forward end thereof and terminates to the rear of the blunt tip

of said cannula to facilitate entrance of said assembly into said artery.

3. The invention in accordance with claim 1 wherein said cannula is composed of a metallic material.

4. The invention in accordance with claim 1 wherein said pointed stylet is composed of a metallic material.

5. The invention in accordance with claim 1 wherein said catheter is composed of polytetrafluoroethylene.

6. The invention in accordance with claim 1 wherein said cannula is rounded at its blunted tip end.

7. The invention in accordance with claim 1 wherein said printed stylet extends 4 mm. beyond the blunted tip of said cannula.

8. A method of positioning into an artery a portion of a plastic catheter of an indwelling arterial cannula assembly including a plastic catheter coaxially removably mounted on a blunt tipped, rigid cannula having a pointed stylet removably located in the bore thereof and extending beyond the blunt tip of the cannula said catheter being shorter in length than said cannula comprising;

projecting said assembly into the artery by piercing both the outer and inner walls of the artery with the point of said stylet and extending a portion of said assembly through the openings in the walls of said artery;

removing the stylet from said assembly;

retracting the remainder of said assembly until the forward tip thereof reenters the artery and fluid from said artery flows through said cannula;

advancing the remainder of said assembly into the lumen of the artery to the desired position with the blunt tip of said cannula alleviating the danger of repuncture of the inner wall of the artery; and

sliding the plastic catheter forward while removing the cannula therefrom thereby locating a portion of the catheter in the desired position in the artery.

9. The invention in accordance with claim 8 wherein after said cannula is removed from said catheter a plastic obturator is placed into the lumen of the catheter to alleviate the danger of clotting between the taking of samples of fluid from the artery.

10. The invention in accordance with claim 8 after said cannula is removed from said catheter a syringe containing an anticoagulant substance may be attached to the rear end of the catheter to alleviate the danger of clotting between the taking of samples of fluid from the artery.

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