

[54] METHOD AND APPARATUS FOR
OCCLUDING FLUID FLOW THROUGH
VESSELS

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[51] Int. Cl. A61b 17/12, A61b 17/10

[58] Field of Search 128/325, 346, 320, 326, 227

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[57] ABSTRACT

A vascular conduit tourniquet including a sleeve having a bore defined by a wall formed of a resilient material and a spring clip fixed over the sleeve, preferably at the end of the sleeve opposite from the vessel which is to be occluded. Umbilical tape is passed under the vessel, the ends of the tape threaded through the sleeve bore and, while holding the ends of the tape, the sleeve is advanced against the vessel, thereby occluding the blood flow therein. The spring clip is then pinched forcing the sleeve walls together capturing the tape therein and maintaining the sleeve against the vessel in occluding relationship therewith.

7 Claims, 5 Drawing Figures

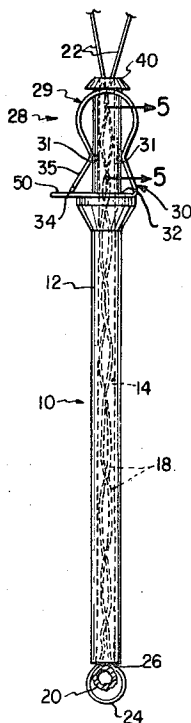


FIG. 1

FIG. 2

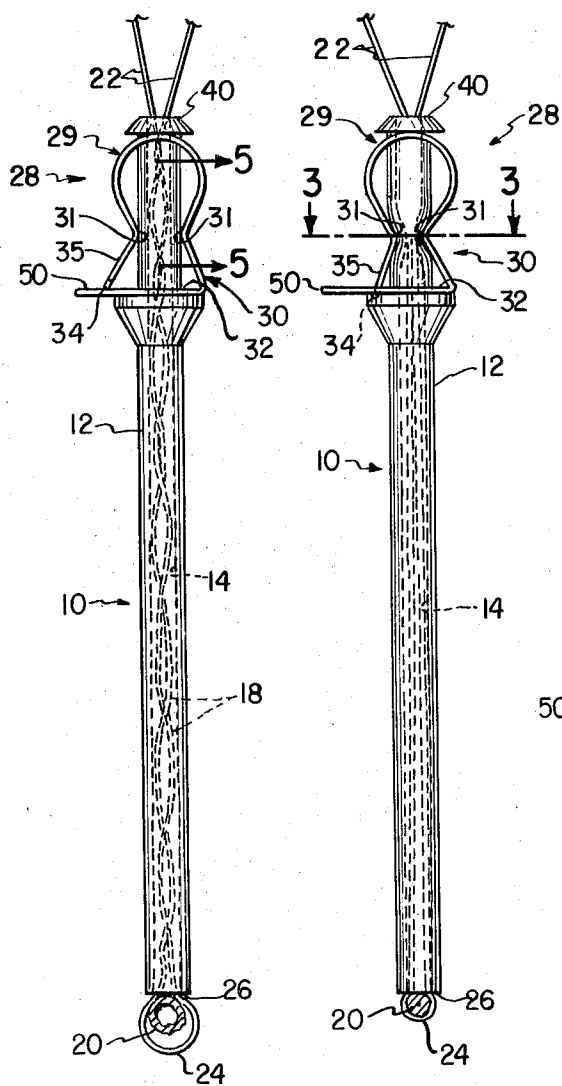


FIG. 3

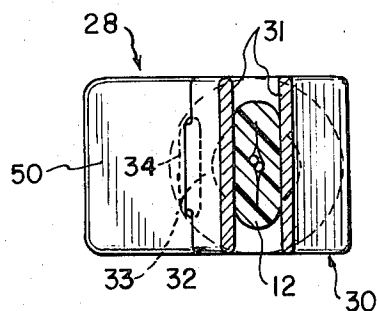


FIG. 4

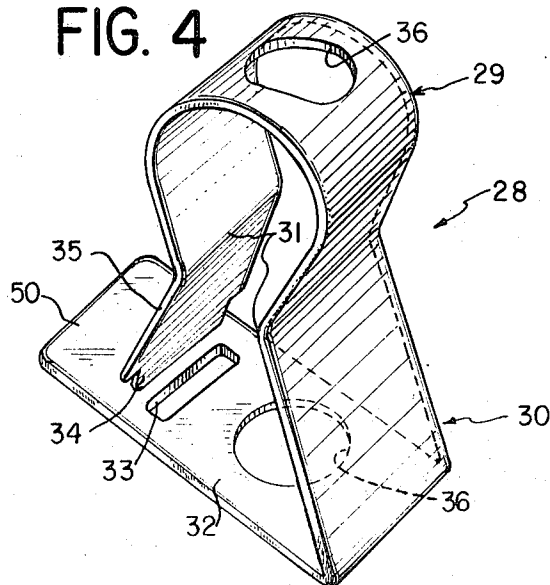
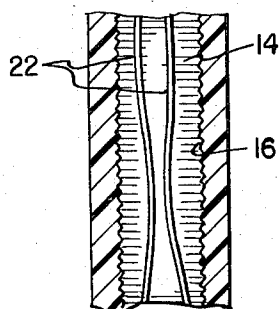


FIG. 5



METHOD AND APPARATUS FOR OCCLUDING FLUID FLOW THROUGH VESSELS

BACKGROUND OF THE INVENTION

During surgery, it often becomes necessary to control the bleeding from or the course of blood flow in a blood vessel without permanently ligating it, i.e. when it is necessary to occlude a blood vessel temporarily. It may also be necessary to hold a cannula captured within a vessel by partially occluding it around the cannula. In the past, such temporary occlusions have been accomplished in various ways. A widely used procedure has been to first free that portion of the blood vessel to be occluded from its connective tissue. Umbilical tape or a length of suture is then looped under the vessel by a pair of right-angled forceps. Both ends of the tape or suture are then threaded into a large needle-like device which draws both tape ends through a sleeve or length of tubing. Holding the tape ends, the tube is then pushed against the vessel thereby occluding the blood flow. At this point, a clamp, usually a hemostat, is attached to the tape adjacent the end of the tubing farthest from the vessel. This retains the tape compressed against the vessel which thereby maintains the occlusion.

In various types of surgical operations, such as in cardiac operations, it is not unusual in the use of the above-described method and apparatus to have six or more of these tube ends and associated clamps extending from the incision. Clearly, the presence of the tubes and clamps renders the operative procedure even more difficult than normal. Further, there is always a danger of the hemostat inadvertently opening or jamming during the operation which may prove detrimental to the outcome of the operation.

Several attempts have been made to deal with the above-mentioned problem. By way of example, a vascular occluder has been designed wherein a cap is threadably provided on one end of a rigid tube or sleeve, the cap having openings formed therein. The ends of umbilical tape after having been looped around the blood vessel are threaded through the sleeve bore through the openings in the cap and then knotted. The cap is rotated moving it outwardly relative to the sleeve thereby tightening the loop occluding the blood flow through the vessel. These devices are not only relatively complicated in structure but are quite time-consuming in their use. Additionally physicians tend to prefer using apparatus of which they are familiar with the "feel" and the complicated nature of the prior devices have prevented widespread acceptance by the medical field.

Thus, there is a need for a vascular tourniquet which will not unduly obstruct the already limited working area of a surface during an operation and which may be applied in a quick and uncomplicated manner.

SUMMARY OF THE INVENTION

Accordingly, an object of this invention is to provide a new and improved vascular tourniquet.

Another object is the provision of a new and improved vascular tourniquet which will not unnecessarily physically obstruct the working area of a surgeon during an operation.

An additional object is to provide a vascular tourniquet which can be applied relatively quickly, removed

easily, and with which there is no undue danger of jamming or inadvertent release.

In accordance with a preferred embodiment of this invention, these and other objects are attained by providing a vascular tourniquet including a resilient sleeve having a bore formed therethrough defined by the sleeve wall receivable of the ends of an elongate, flexible ligating member, such as umbilical tape. A clamp is provided over a portion of the sleeve which, subsequent to the sleeve being moved against the blood vessel occluding the blood flow therein, moves a pair of opposed sections of the sleeve wall toward each other to engage and lock the tape within the sleeve.

DESCRIPTION OF THE DRAWINGS

A more complete appreciation of the invention and many of the attendant advantages thereof will be readily appreciated as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings wherein:

FIG. 1 is an elevational view of the vascular conduit tourniquet of the present invention;

FIG. 2 is a view similar to FIG. 1 but showing the tourniquet after occlusion of blood flow through a vessel;

FIG. 3 is a top view taken in cross-section along line 3—3 of FIG. 2;

FIG. 4 is a perspective view of a clip which forms a part of the tourniquet; and

FIG. 5 is an elevational sectional view of a portion of the tube taken along line 5—5 of FIG. 1.

DESCRIPTION OF A PREFERRED EMBODIMENT

Referring to the drawings the vascular tourniquet 10 includes an elongate tubular member, or sleeve, 12 formed of a resilient material, such as rubber, having a bore 14 extending through its entire length. It is understood that in this context, resilient indicates that a force applied in a direction substantially perpendicular to the longitudinal axis of the sleeve will cause the sleeve wall to deform in that direction and, upon removal of the force, the sleeve wall will return to its original shape. The sleeve may be rigid or only slightly compressible in the longitudinal direction. The interior wall of the tubing defining bore 14 preferably, but not necessarily, has ridges or serrations 16 (FIG. 5) formed on its surface substantially perpendicular to the longitudinal axis of the sleeve for purposes which will become clearer hereinafter.

In the embodiment of the invention illustrated in the drawings, a spring clip type clamp 28 is positioned at the end of sleeve 12 opposite the base surface 26. Referring to FIG. 4, the clip 28 is formed preferably of a strip of spring steel or molded plastic so as to be radiopaque formed to include an upper curvilinear spring portion 29 integrally connected to a triangular clip portion 30 along a pair of inwardly positioned edges 31 which edges, after assembly of the occluder, will lie adjacent to opposed wall sections of sleeve 12. The base leg 32 of the spring portion has a slot 33 formed therein which is adapted to receive the end 34 of leg 35 when the latter is pinched inwardly. In order for the leg end 34 to be locked within slot 33, leg 35 is sufficiently long so as to interfere with base 32 prior to its end reaching the slot. Thus, base 32 is urged downwardly under the

force of leg 35 until end 34 reaches a position opposite slot 33 at which time the base snaps upwardly capturing the leg end and locking the clip into a configuration wherein the edges 31 are closer together than before. To open the spring clip, it is only necessary to depress base extension 50 thereby freeing the leg end 34 from slot 33 at which time the resiliency of the spring portion 29 causes leg 35 to move outwardly. In order to receive sleeve 12, aligned openings 36 are provided in the spring and clip portions. This spring clip design has certain advantages when used in the present invention which will be described in greater detail below.

Spaced, opposed shoulders 38, 40 are formed such as by molding or attached separately on the outer surface of sleeve 12. Upper shoulder 40 is preferably formed with beveled edges. Clip 28 is assembled onto the sleeve by forcing upper shoulder 40 through openings 36, the positioning being made easier by the beveled shoulder 40 until the clip base 32 abuts shoulder 38. The spring clip is retained on the sleeve by upper shoulder 40. Of course, the clip may be retained on the sleeve in various other ways than as just discussed. For example, the upper shoulder 40 need not be provided until after the spring clip has been positioned onto the sleeve at which time it may be molded or similarly provided on the sleeve to permanently capture clip 28.

The tourniquet is intended to constrict a blood vessel 20 so as to occlude the flow of blood therethrough. To do this an elongate flexible ligating member 18, such as conventional umbilical tape or thread made from standard suture material such as nylon, silk, cotton or surgical gut, is passed beneath blood vessel 20. The free ends 22 of tape 18 are threaded through bore 14 so that a noose or loop 24 is formed around the vessel. With the free ends 22 of the thread 18 held taut, the physician urges sleeve 12 towards vessel 20 so that its base surface 26 contacts the vessel with sufficient force to occlude the blood flow therethrough.

According to the present invention the wall of the sleeve 12 is itself then crimped so that the surface of bore 14 engages and locks the thread 18 thereby maintaining the relative positions of the sleeve against the vessel 24. The serrations 16 formed on bore 14 facilitate the grasp of the crimped sleeve on tape 18. It is seen that although the sleeve may be formed with serrations 16 extending along the entire length of bore 14, the serrations, if provided at all, may only be present in the vicinity of the portion of sleeve 12 where the crimping occurs.

In operation, thread 18 is looped about a vessel 24 as shown in FIG. 1. The physician, while holding the free ends 22 of the thread in one hand grasps clip 28 and without exerting any inward pressure on the clamp to crimp sleeve 12, pushes the clip against sleeve shoulder 38 with sufficient force to cause the base surface 26 of sleeve 12 to crimp vessel 24 occluding the blood flow therethrough. It is desirable for the sleeve to be relatively rigid longitudinally so that it does not become compressed during this procedure. When the blood flow has been sufficiently occluded due to moving the sleeve to the proper position, the physician merely pinches side 35 of clip 28 until the leg end 34 of leg 35 is captured in slot 33. During this procedure, inner edges 31 crimp the adjacent sleeve wall sections together (see FIG. 2) engaging and locking the tape therein. As mentioned above, the serrations 16 serve to facilitate the grip of the surface of bore 14 on thread

18. When it is desired to allow blood to begin to flow again, the clip 28 is opened by depressing clip base extension 50 freeing leg end 34.

It should be noted that the entire occluding procedure may be accomplished using only a single hand to move sleeve 12 against vessel 24 and clamping it in position. This feature enables a relatively quick occlusion of the blood flow through the vessel and, in addition, maintains the physical bulk of surgical apparatus extending from the incision at a minimum. The particular design of spring clip 28 is particularly suited for its use. More particularly, the positioning of the physician's fingers on the clip while urging it against the blood vessel to occlude the blood flow facilitates an immediate locking of the clip after occlusion, i.e., the fingers are in appropriate position to pinch the clip even while the sleeve is being urged against the blood vessel. Hemostats are now unnecessary and thus, the problems associated therewith, are obviated. For example, there is relatively little danger of clip 28 inadvertently opening or jamming during the surgical operation. Further, all the edges of the clip are rounded to discourage entanglement of suture material present in the surgical procedure, such as during the sewing of an incision. To further prevent suture entanglement, the clip base is recessed so as not to extend beyond shoulder 38 (except at extension 50).

By way of example, a typical vascular tourniquet according to the present invention may comprise a sleeve of about 6 inches in length having a wall of about 1/16th inch thickness and a 5/32nd bore diameter. The clip may be positioned on the upper 1 1/8 inch portion of the sleeve. Of course, other dimensions may be used in accordance with the present invention as determined by the particular surgical use to which the device will be put. Of course, the length of the sleeve may be shortened prior to or during the operation as desired by merely cutting off an appropriate length of the sleeve end with scissors.

Other clamping apparatus than the clip 28 may be used within the scope of the present invention. For example, the clip may be shaped otherwise than as shown. One alternative includes having opposed sides extending transversely to the sleeve which are movable towards each other to crimp the sleeve. As discussed above, other means may be used to retain the clip on the sleeve. Other variations and modifications of the invention may be made within the scope of the appended claims.

What is claimed is:

1. A vascular tourniquet for occluding fluid flow within a vascular conduit vessel comprising:

a resilient sleeve having a bore defined by an interior wall, said bore comprising a means for receiving the ends of an elongate flexible ligating member, which member forms a loop around the vessel portion to be occluded; and

clamping means mounted on said sleeve intermediate the end for releasably urging opposed sections of said wall towards each other into locking engagement with said ligating member to maintain said tourniquet in occluding relationship with said vessel said clamping means comprising a clip member having a pair of opposed sides having opposed inwardly facing protuberances, each protuberance providing means for urging said opposed wall sec-

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tions towards each other to selectively lock said ligating member therebetween

2. A vascular tourniquet as recited in claim 1 wherein said urging means includes a spring means comprising a pair of opposed sides resiliently spaced from each other, said clip sides adapted to be selectively moved from a first position wherein said ligating member is free within said sleeve bore to a second position wherein said ligating member is in locked engagement with said wall sections and back to said first position.

3. A vascular tourniquet as recited in claim 1 wherein said spring clip member has a spring portion and a clip portion integrally connected thereto, said clip portion including a first leg having a free end movable from a first position to a second position, and a second leg having a slot formed therein adapted to capture said first leg free end when in said second position, said second leg being movable to release said first leg free end.

4. A vascular tourniquet as recited in claim 1 wherein said clamping means for releasably urging said opposed flexible wall sections is restrained to a portion of said sleeve.

5. A vascular tourniquet as recited in claim 1 wherein the interior surface of said sleeve has means formed

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thereon for positively gripping said ligating member.

6. A vascular tourniquet as recited in claim 7 wherein said positive gripping means includes serrations formed on said interior surface substantially perpendicular to the longitudinal axis of said sleeve.

7. A method of temporarily occluding the flow of blood through a blood vessel comprising the steps of: passing an elongate flexible ligating member under said blood vessel;

directing the ends of said ligating member through a bore in a resilient sleeve;

advancing said sleeve against said blood vessel to exert upon it by tensioning the ligating member until the flow of blood therethrough is occluded; and providing a means for

forcing opposed wall sections of said sleeve together to lock said ligating member therebetween to cause said sleeve to remain in position wherein said blood vessel is occluded; and

allowing said opposed wall sections to free said ligating member to permit the flow of blood to resume in said vessel.

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