

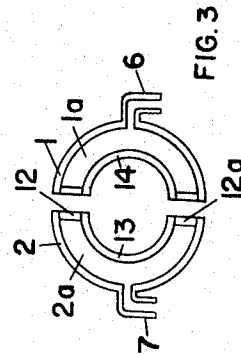
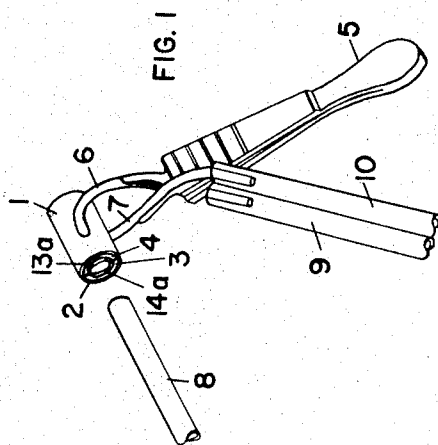
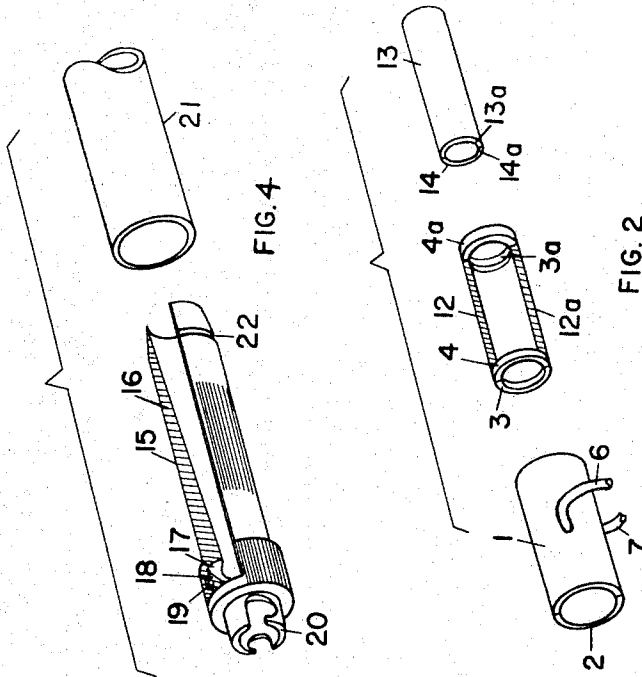
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VACUUM ARTERY CLAMP

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## VACUUM ARTERY CLAMP

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## ABSTRACT OF THE DISCLOSURE

A blood vessel clamping device consisting of a cylindrical housing, longitudinally split to form two half-cylinder assemblies, a similarly split cylindrical liner of solid, porous material positioned inside the housing such as to form vacuum chambers between housing and liner, connections from the vacuum chambers to an external source of vacuum, and operable handles connected to the two half-cylinder assemblies to swing the assemblies from an open position which allows positioning over a blood vessel to a closed, clamping position where the assemblies completely encircle a length of the blood vessel and hold it from collapse or longitudinal movement.

This invention relates to a vacuum artery clamp and more particularly to a device for holding an artery supplying blood to the brain or other organ of a human such that a rapid connection can be made with an extracorporeal blood circuit.

At the present time, connection to arteries is accomplished by making a longitudinal slit in the vessel wall, introducing a hollow tube into the vessel lumen (central passageway), and tying in place in with suture silk. This method does not permit rapid connections and generally is only satisfactory with arteries other than those supplying blood to the brain because of the time required to effect the connection to the external blood circuit. The introduction of a cannula (hollow tube) can cause damage to the highly sensitive artery intima (inside lining). It causes a reduction in blood flow because of the restriction and possible turbulence may damage the blood.

It is an object of the present invention to provide a clamp that will firmly hold the end of a severed blood vessel in position while a mechanical connection to an external blood circuit can be quickly and readily accomplished and thereafter maintained.

It is another object of the invention to provide a blood vessel clamping and positioning device that will cause little or no damage to the blood vessel surfaces.

These and other objects of the invention are achieved by providing a blood vessel clamping device that holds the vessel in the open (uncollapsed) state and maintains its relative longitudinal position such that the blood vessel may be transected and an external circuit quickly connected comprising a longitudinally split cylindrical housing of greater inside diameter than the blood vessel to be clamped, a cylindrical liner made of solid porous material adapted to fit inside said cylindrical housing, said liner having an inside diameter of approximately equal diameter to that of the blood vessel to be clamped, means for positioning said liner inside said housing, handle means attached to said housing vacuum lead lines leading from the interior of said cylindrical housing and adapted for connection to a vacuum source.

In drawings which illustrate an embodiment of the invention,

FIGURE 1 is a three-quarter view of the clamp device in relation to a blood vessel,

FIGURE 2 is a detail view of the vacuum clamping portion of the device of FIGURE 1, before assembly,

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FIGURE 3 is a cross-section of the clamping head of the device of FIGURE 1, and

FIGURE 4 shows a standard connector adapted to connect the blood vessel to a tube leading to an extracorporeal blood circuit.

Referring to FIGURE 1, a solid, metal cylindrical housing is split into two identical halves 1 and 2. A split end sealing ring made up of two halves 3 and 4 is positioned in the end of the housing halves 1 and 2. An inner sleeve, the ends of which appear in this figure as split rings 13a and 14a, is positioned inside the end sealing ring. A handle 5 is fixed to each housing half by means of swingable arms 6 and 7 and is operable to swing the two housing halves from the closed position illustrated to an open position which would allow the ready insertion of a blood vessel 8 into an interior position. In a device built and tested, the handle employed has been a modified bulldog clamp but other forms of handle might be used e.g. scissor, tong, or forcep type handles. It is preferable however that the handle have a spring bias urging the two housing halves to the closed position. Arms 6 and 7 are in the form of hollow tubes which not only hold the housing halves in relative position but also afford air lead entrance to the interior. Tubes 6 and 7 are connected to air-line tubes 9 and 10 which, in practice, would be connected to a vacuum pump.

FIGURE 2 shows the vacuum head portion of the device in detail. An adapter shown generally as 11 is made up of split end sealing half-rings 3 and 4 connected by arms 12 and 12a to similar split half-rings 3a and 4a. Adapter 11 fits snugly inside housing halves 1 and 2. An inner sleeve of porous material in the form of split cylindrical halves 13 and 14 fits inside the adapter 11. When assembled, the device has a central bore which has the same diameter as the outer surface of the blood vessel and which has a surface the major portion of which is formed by the porous material. The kinds of porous material that may be used are porous stainless steel, fine mesh screens, and porous plastics such as tetrafluoroethylene. Metals such as nickel, platinum, and others suitable for biological use could be used in either porous, fine screen, perforated, or expanded form. These materials, of course must be able to withstand sterilization. The various components are assembled by soldering although other methods might be used.

FIGURE 3 is a cross-section of the clamping head of FIGURE 1. It will be seen that plenum chambers 1a and 2a are found between outer housing halves 1 and 2 and the porous sleeve halves 13 and 14. These chambers are connected via tubes 6 and 7 to an external vacuum source. The ends of sleeve halves 13 and 14 (shown as 13a and 14a in FIGURE 1) are soldered such that there will be no leakage of air from the ends into the plenum chambers.

FIGURE 4 shows a form of quick connecting device that can be used to connect the clamped blood vessel to the extracorporeal circuit. The connector has a barrel 15 with a tapering inner bore 16 which terminates in a shoulder 17 which carries an O ring in a suitable groove. The device is fitted on the end with a bayonet type twist lock connector 18 which engages with appropriately positioned projections on the outer surface of the clamp housing halves. In the case of the device illustrated (see FIGURE 1) the tubes 6 and 7 are used. The other end of the connector is adapted for fitting into the end of a tube 21 leading to the extracorporeal blood apparatus. A groove 21 is provided in case a clamp is required.

After the apparatus has been assembled and connected to the vacuum pump, to operate the surgeon has only to compress the handles swinging the clamping head halves to the open position. The blood vessel is positioned inside the bore and the handles are released allowing the clamping head halves to return to the closed position. Because

of the vacuum induced in the porous metal sleeve which makes contact with the outer surface of the blood vessel, the blood vessel is clamped or held firmly in the open state against the walls of the porous metal sleeve and is prevented from collapsing or moving longitudinally. The blood vessel is then transected so that its end is flush with the end of the clamping head. The quick connector is then locked into position with the end of the clamping head engaging the O ring seal. The tube leading from the extracorporeal circuit is then connected to the quick connector.

The complete connection operation can be carried out in a few seconds using the described apparatus. It will be appreciated that the surgeon is strictly limited because of physiological considerations in the time that he has at his disposal in carrying out these operations. Blood supply to vital organs of the human body, especially the brain, cannot be suspended for longer than a few seconds.

Several advantages accrue from the use of this apparatus. Not only is the time required for making connections very short but it has been found that the device causes little or no physical damage to the blood vessel. In addition, blood vessels normally are difficult to work with not only being "slippery" but having a propensity to collapse when not filled with blood and creep in the longitudinal direction. The simple operation required in using this apparatus and its strong clamping action overcomes much of this difficulty.

What is claimed is:

1. A blood vessel clamping device comprising:

- (a) a cylindrical housing,
- (b) a cylindrical porous rigid sleeve having a central bore whose diameter is substantially equal to the outside diameter of the blood vessel to be clamped mounted inside said housing such as to form a chamber therebetween,
- (c) said cylindrical housing and said porous sleeve being split longitudinally to form two half-cylinder assemblies each with its own chamber,
- (d) operable arm members connected to said assemblies and adapted to swing the said half-cylinder as-

semblies from a closed position to an open position, (e) end sealing means at each end of said housing and sleeve such as to minimize air flow from the exterior into the chamber when a blood vessel is positioned in the central bore, and

(f) an air lead line from the said chamber to the exterior, said line being adapted for connection to a vacuum source.

2. A blood vessel clamping device comprising:

- (a) first and second matching half-cylindrical housings,
- (b) a half-cylindrical porous rigid sleeve mounted coaxially inside each of said first and second cylindrical housings in spaced relation therewith,
- (c) sealing means around the edges of said housing and sleeve assemblies such as to form closed chambers between the said housings and said sleeves,
- (d) manually operable pivotably mounted handles attached to said first and second cylindrical housings capable of swinging the said housings from an open position allowing insertion of a blood vessel to a closed position wherein the half-cylindrical housings and porous sleeves form a unitary cylinder completely surrounding the blood vessel,
- (e) said handles being spring-biased to the closed position, and
- (f) air lead lines leading to the said closed chambers, said lines being adapted for connection to a vacuum pump.

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