Claims

1. A cannula structure configured for cannulating an anatomical vessel through a vessel entry point with~~in which~~ a central axis ~~is~~ definable within the vessel, the cannula structure comprising:

a first tube having a lumen therethrough and an elongate length, the first tube having a proximal fluid input configured for receiving a fluid and a plurality of fluid outputs configured for outputting or discharging the fluid into the vessel, the proximal fluid input fluidically coupled to the plurality of fluid outputs, the plurality of fluid outputs comprising:

a set of fenestrations disposed along a portion of the elongate length of the first tube, the set of fenestrations configured for outputting or discharging fluid into the vessel in a set of flow directions including at least a first flow direction and a second flow direction which is counter to the first flow direction, wherein the first flow direction is away from the heart and the second flow direction is toward the heart; and

a ~~set of~~ distal opening~~s~~ disposed near or at a distal end of the first tube, the ~~set of~~ distal opening~~s~~ configured for outputting or discharging fluid into the vessel in ~~a~~ the second flow direction ~~counter to the first flow direction, concurrent with output of fluid in the first flow direction~~,

wherein a vector flow component along the central axis of the vessel corresponding to fluid output by at least some fenestrations within the set of fenestrations is antiparallel to a vector flow component along the central axis of the vessel corresponding to fluid output by the ~~set of~~ distal opening,

wherein the set of fenestrations is substantially located beneath the vessel entry point on an angulatable section of the first tube and the fluid is oxygenated blood.

2. The cannula structure of claim 1, wherein the set of fenestrations and the ~~set of~~ distal opening~~s~~ are configured to reside entirely within the vessel when the vessel is cannulated~~, and wherein the first flow direction is away from the heart and the second flow direction is toward the heart~~.

3. The cannula structure of claim 1, wherein the first tube comprises:

a first portion comprising:

a first segment comprising a lumen and including the set of fenestrations and the ~~set of~~ distal openings~~s~~, the first segment configured to entirely reside within the vessel when the vessel is cannulated; and

a second segment comprising a lumen aligned with the lumen of the first segment, the second segment proximal to the first segment, the second segment configured to essentially entirely reside external to the vessel when the vessel is cannulated; and

a second portion carrying the proximal opening of the first tube and comprising a hub structure.

4. The cannula structure of claim 3, wherein a ratio of a total fenestration area through which fluid can exit the set of fenestrations to a total distal opening area through which fluid can exit the ~~set of~~ distal openings~~s~~ is between 10% - 40%.

5. The cannula structure of claim 3, wherein the first segment further carries an expandable or inflatable cuff disposed around the first segment slightly proximal to the set of fenestrations such that the expanded or inflated cuff has a cross sectional area that is larger than a cross sectional area of the vessel entry point and the first segment at a location around the first segment at which the expandable or inflatable cuff is disposed, and the expanded or inflated cuff is positioned substantially beneath and immediate to the vessel entry point when the first tube is in a correct position within the vessel.

6. The cannula structure of claim ~~3~~5, wherein the expandable or inflatable cuff is configured to entirely reside within the vessel when the vessel is cannulated.

7. The cannula structure of claim 5, wherein the expandable or inflatable cuff comprises a set of flange members configured for expansion away from or contraction toward the lumen of the first segment.

8. The cannula structure of claim ~~7~~1, wherein the set of fenestrations is configured to output higher fluid flow towards the first flow direction in relation to the second flow direction~~expandable or inflatable cuff has a cross sectional area that is larger than a cross sectional area of the first segment at a location around the first segment at which the expandable or inflatable cuff is disposed~~.

9. The cannula structure of claim 7, wherein the expandable or inflatable cuff comprises:

a sleeve that carries the set of flange members, the sleeve prevents total blockage of blood flow distally should the first tube be advanced inadvertently, blood continue to flow distally between the deployed set of flange members; and

an activation member carried by the sleeve and configured for selectively expanding or contracting the set of flange members.

10. The cannula structure of claim 9, wherein the activation member comprises an activation port that is fluidically coupled to a hub corresponding to the hub structure.

11. The cannula structure of claim 3, wherein the first segment includes a blood / fluid indicator port formed therein, and wherein the blood / fluid indicator port is fluidically coupled to a hub corresponding to the hub structure.

12. The cannula structure of claim ~~3~~1, wherein the ~~set of fenestrations is disposed on an angulatable material~~ cannulating the anatomical vessel through the vessel entry point is at least part of an extra-corporeal membrane oxygenation (ECMO) procedure conducted to a subject.

13. The cannula structure of claim 1~~2~~, wherein the angulatable ~~material~~ section is structurally reinforced by way of at least one of material composition, material thickness, and incorporation of natural or synthetic fibres therein.

14. The cannula structure of claim 2, wherein the first tube includes at least one graduated scale disposed along the elongate length thereof.

15. The cannula structure of claim 1, further comprising a second tube that is configured for mating engagement with the first tube and which serves as a dilator relative to the first tube.

~~16. The cannula structure of claim 1, wherein the cannula structure greatly reduces the risk of limb ischemia during an extra-corporeal membrane oxygenation (ECMO) procedure by way of fluid flow in the first flow direction counter to fluid flow in the second direction.~~