

SYSTEM AND METHOD FOR PREPARING A CATHETER BEFORE USE

FIELD OF THE INVENTION

[0001] This invention relates to a method of preparing a catheter for use in a patient, in particular purging and de-airing, and further relates to a respective system including the catheter. The catheter may be part of an intravascular blood pump for percutaneous insertion into a patient's blood vessel.

BACKGROUND OF THE INVENTION

10 [0002] Before using a catheter in a patient, more specifically before inserting the catheter into a patient's blood vessel, the catheter must be properly prepared. In particular, the catheter must be purged and de-aired to prevent air or other gas bubbles from being introduced into the patient, which could cause severe complications, such as an infarct. Typically, a catheter comprises an elongate tubular body having a proximal end and a distal end, with the distal end being the leading end upon insertion into the patient. The tubular body has a lumen which extends through the catheter from the proximal end to the distal end for receiving functional structures, lines or the like, depending on the application or for supplying fluids, e.g. including pharmaceuticals, to the patient. The lumen includes air before use and shall be completely de-aired before
15 the catheter is inserted into the patient. For de-airing and purging, a fluid may be pumped through the catheter with a certain pressure.

[0003] De-airing the lumen of the elongate tubular body of the catheter usually is not a problem because of its smooth geometry and small diameter. The lumen typically does not have any convexities, and the small diameter causes capillary forces
25 that draw the purge fluid through the lumen to eliminate any air bubbles or other gas bubbles. However, the catheter may be in fluid communication to at least one connected device, e.g. a pump unit or a handle portion, which can be held by a user to maneuver or otherwise control the function of the catheter. Depending on the application, a connected device may have at least one cavity which is in fluid communication with the

lumen of the catheter and which has a fluid inlet for receiving the purge fluid. The cavity of a connected device may have a complex geometry and may accommodate functional and possibly movable parts, such that air bubbles may still be trapped in the cavity although the purge fluid already exits the catheter at the distal end. In particular, if a user does not correctly hold the connected device, for instance not in a correct de-airing orientation which may be on an upright and vertical orientation, air bubbles may be trapped inside the cavity. According to the state of the art, it highly depends on the experience of the user, who may be for instance a surgeon, cardiologist, general practitioner, or other medical staff, to determine when the catheter and connected devices are completely de-aired.

[0004] The aforementioned problem of de-airing the catheter, in particular a connected device, may be particularly relevant to intravascular blood pumps. An intravascular blood pump is configured for percutaneous insertion into a patient's blood vessel and comprises a pump unit with a rotatable impeller for conveying blood from a blood flow inlet to a blood flow outlet of the pump unit. A drive unit is provided to cause rotation of the impeller.

[0005] In one type of intravascular blood pumps the pump unit comprises a drive unit which is directly coupled to the impeller and is included in a common pump casing together with the pump unit. The common pump casing may be arranged at the distal end of the catheter. De-airing of the catheter may be required before insertion into a patient.

[0006] In another type of intravascular blood pumps, the drive unit may be coupled to the impeller by means of a flexible drive shaft which extends through the lumen of the elongate tubular portion of the catheter, wherein the drive unit may be disposed in a cavity of a handle portion. In this type of intravascular blood pump, the pump unit with the impeller may be expandable. The drive unit may comprise an electric motor including a stator and a rotor and further electronic parts to control rotation of the drive unit, which may create convexities, undercuts or other cavities in which air bubbles might be trapped. Since the drive unit, such as the moving parts of an electric motor, may be immersed in the purge fluid, it is even more difficult to properly

eliminate all air bubbles from the cavity in the handle portion. Thus, it is important that a user holds the catheter, in particular the handle portion, in a de-airing orientation during purging and de-airing to avoid causing harm to the patient.

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SUMMARY OF THE INVENTION

[0007] It is therefore an object of the present invention to provide a method of preparing, in particular purging, a catheter for use in a patient and a respective system including the catheter, which allows securely de-airing the catheter, particularly before insertion into a patient. In particular, the catheter may be part of an intravascular blood
10 pump.

[0008] This object is achieved according to the present invention by a system and a method having the features of the independent claims. Preferred embodiments and further developments of the invention are specified in the claims dependent thereon.

[0009] According to a first aspect of the invention, a system is provided which
15 comprises a catheter as described above, in particular comprising an elongated tubular portion and a connected device which is connected to the catheter. The elongate tubular portion has a lumen. The connected device has at least one cavity. As explained above, before the catheter is used in a patient, the lumen and the cavity should be de-aired, i.e. air bubbles should be completely removed. In order to monitor the orientation of at least
20 one connected device and for the elongate tubular portion, preferably a connected device as is described in more detail below, the system further comprises at least one sensor for detecting said orientation.

[0010] According to a second aspect of the invention, a method of preparing a catheter for use in the patient is provided. In particular, the catheter is constructed as
25 explained above having an elongated tubular portion and a connected device. In the method of preparing the catheter, in particular purging the catheter, a fluid is supplied through a fluid inlet into the at least one cavity of the connected device and thereby into the lumen of the elongate tubular portion to purge said cavity and lumen. The method

further comprises the step of detecting the orientation of at least one connected device and of the elongate tubular portion, preferably during the fluid supply.

[0011] In the system and method of the present invention, an orientation of at least one connected device and/or the elongate tubular portion, preferably a connected
5 device, can be detected. Thus, the system and the method of the present invention do not rely on the experience of the user to correctly orient the catheter, especially of a connected device, but provide means to monitor the orientation of at least a portion of the catheter, in particular during the purging process. It will be appreciated that the term
10 “connected device” may refer to any structure connected to the elongate tubular body which can be manipulated by a user, in particular holding it by a user in his hands or turning it together with the patient, and which has a cavity in fluid communication with the lumen of the elongate tubular body.

[0012] The term “orientation” particularly refers to the orientation of the respective portion of the catheter in three-dimensional space relative to a fixed reference
15 system such as gravity. In particular, the orientation does not necessarily include an absolute position of the respective portion of the catheter in three-dimensional space, but may rather be regarded as a “relative position”, for instance relative to a vertical or horizontal axis or plane in three-dimensional space or any other suitable reference point or system. For instance, the orientation may refer to a tilt of the respective portion of the
20 catheter and may be indicated as an angle in degrees, e.g. relative to a vertical axis or horizontal plane. A vertical axis can be oriented in direction of gravity.

[0013] A control unit may be provided, which may receive data from the at least one sensor, the data particularly including the detected orientation, i.e. data representing the actual or current orientation of the respective portion of the catheter. The data may
25 be transmitted by wire or wirelessly. It may be determined whether the detected orientation matches an orientation in which a cavity can be de-aired. This may be the cavity of which the orientation is detected. A difference between the detected orientation and a predetermined orientation, i.e. a predefined orientation which should be achieved by a user orienting the catheter, may be calculated. The predetermined

target orientation is not necessarily a unique orientation but may include a range of orientations suitable for proper purging as will be explained in more detail below.

[0014] Based on said difference between the detected orientation and the predetermined orientation, a user may be guided to change, i.e. to correct, the orientation of the respective portion of the catheter to approach the predetermined orientation. The respective portion of the catheter can be moved such that it matches the predetermined orientation or at least lies within a range defined by the predetermined orientation. It will be appreciated that a tolerance may be allowed. For instance, a user interface, such as a display or the like, may be provided in the control unit, which may display the detected orientation or a representation indicating the difference between the detected orientation and the predetermined orientation or both. Alternatively or additionally, it may display the matching of the detected orientation with an orientation in which a cavity may be de-aired, which may be a predetermined orientation. For instance, an image of the respective portion of the catheter indicating its orientation in real time may be displayed, or a simple graphic, such as a line or the like, may be displayed indicating the tilt angle. Additionally or alternatively, the difference between the detected orientation and the predetermined target orientation can be displayed. For instance, any suitable graphic, such as a symbol, color scale (e.g. red-yellow-green) or the like may be displayed. Alternatively or additionally, the difference may also be indicated by means of any suitable acoustic signal, which enables the user to change the orientation to approach the predetermined target orientation.

[0015] Guiding the user to correct the orientation of the respective portion of the catheter can improve the purging process and can reduce or eliminate the risk of air bubbles being trapped inside the cavity or lumen. In particular, a complex geometry inside the cavity or lumen, e.g. comprising convexities, undercuts or the like, may require the user to hold the respective portion of the catheter in the predetermined orientation such that air bubbles can exit.

[0016] Since air bubbles move in the purge fluid in a vertically upward direction, the predetermined orientation is preferably a vertical or substantially vertical orientation or a conical range defined by a vertical axis and a predetermined angle. It

will be appreciated that any other orientation may be possible, depending on the geometry of the cavity or lumen to be de-aired. For instance, depending on the interior geometry, an angle of 45 degrees or any other angle could be necessary or suitable to completely de-air the cavity. As mentioned above, the "predetermined orientation" may include a range of orientations, e.g. range of angles, within which it is possible to completely de-air the cavity and lumen of the catheter. For instance, if the cavity has a smooth and regular geometry, it may be sufficient if the user holds the respective portion of the catheter, in particular the connected device, within a range of 45 or 30 degrees in any direction with respect to a vertical axis. Preferably, the orientation can be detected in the range of 0 to 180 degrees, e.g. to determine which end of the handle portion faces upward and which end faces downward. Generally, in order to ensure proper de-airing, the fluid inlet of the handle portion should be located below an exit to the lumen of the elongate tubular portion, with respect to a vertical direction. For example, an orientation angle can refer to a longitudinal main direction of the catheter or a connected device.

[0017] It will be appreciated that the predetermined orientation, regardless of whether it refers to a single orientation or a range of orientations, may not only refer to the tilt, i.e. angle relative to an external reference system, of the respective portion of the catheter, but may also refer to any other degree of freedom, such as rotation about a longitudinal axis of the respective portion of the catheter. For instance, in particular if the predetermined orientation is other than a vertical orientation, it might be necessary to rotate e.g. the connected device about its longitudinal axis to a predetermined orientation to remove all air bubbles from the cavity.

[0018] In one embodiment, a user may start the purge process and a fluid, i.e. any suitable purge fluid, will be supplied to the cavity of the connected device and thereby into the lumen of the tubular portion of the catheter. The purge fluid may be continuously supplied to the cavity and lumen of the catheter while the user is continuously guided to hold the respective portion of the catheter in the correct orientation, i.e. to change the orientation if necessary.

[0019] In a preferred embodiment, however, the fluid supply may be activated, in particularly activated only, if the detected orientation matches the predetermined target orientation, i.e. if the user correctly orients the catheter and/or a connected device the respective portion of the catheter. Similarly, the fluid supply may be deactivated, i.e. stopped or paused, if the detected orientation differs from the predetermined target orientation, i.e. when the user does not correctly orient the respective portion of the catheter. Particularly in this embodiment, it may be advantageous to measure the volume of the supplied fluid. Thus, if the measured volume of the supplied fluid reaches a known volume of the cavity and the lumen to be purged, and due to the fact that air bubbles are able to exit the cavity and lumen at all times because of the correct orientation, a conclusion can be drawn that de-airing is complete. The system may then notify the user that purging is complete. It will be appreciated that a certain safety margin, i.e. additional purge fluid volume can be added until the system indicates a successful completion of the purging process. In addition, the user may be requested to confirm that the purge fluid exits the catheter at the distal end to complete the purging process.

[0020] As explained above, there may be no problems of purging the lumen of the elongate tubular portion of the catheter, while purging the at least one cavity of a connected device may be difficult.

20 In another preferred embodiment, the at least one sensor is arranged in the connected device of the catheter in order to detect its orientation. It may not be necessary to detect the orientation of the elongate tubular portion of the catheter.

[0021] The at least one sensor to detect the orientation of the respective portion of the catheter, in particular the orientation of at least one connected device, may be at least one of a gravity sensor, an accelerometer and a gyroscope. For the sake of convenience, any of these terms may refer to all of these terms. However, the term "sensor" in the sense of the present disclosure may include any other type of active or passive sensor, means or system which is able to detect an orientation of the respective portion of the catheter in three-dimensional space. These may include sensors which are based on a magnetic or electromagnetic field, optical sensors or the like.

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For instance in another embodiment, the at least one sensor may be arranged at a distance to the catheter. The sensor may be formed by a camera system which records the respective portion of the catheter, in particular the orientation of at least one connected device, and detects the orientation from the recorded image.

5 [0022] However, a sensor is preferred which is easy to implement in existing systems and which provides reliable results. For instance, the advantage of a gravity sensor or accelerometer is that it does not require any external infrastructure, like external sensors or external field generators. In addition, an accelerometer is robust against external perturbations, such as a magnetic field, which may be caused for
10 instance by an electric motoric of an intravascular blood pump. An accelerometer may be designed as a MEMS device or nanodevice and can be arranged on a printed circuit board (PCB) or printed circuit assembly (PCA) which already exists for example in a drive unit of an intravascular blood pump.

[0023] A gravity sensor or accelerometer may detect a “downward” direction,
15 more specifically in a vertical direction. This “downward” direction, which represents the detected orientation, may be transferred to the control unit using memory-mapped register technique. That means, the sensor data, i.e. the detected orientation (downward direction) is stored in a memory, e.g. a memory of the blood pump. Every time the control unit reads a specific byte of the pump memory, the control unit gets the detected
20 orientation, e.g. the tilt in degrees, instead of the memory content. That means, the accelerometer does not need an additional connection, e.g. wires, to the control unit to transfer the data of the sensor but uses the existing communication connection that reads the memory.

[0024] As mentioned above, the system and method according to the present
25 invention may be particularly advantageous when used in connection with an intravascular blood pump, in particular an intravascular blood pump with a pump unit connected to an elongate body of the catheter. In this type of intravascular blood pumps, the interior of the catheter is in fluid communication with the environment and is purged during operation of the pump and has to be completely de-aired before use in order to
30 avoid introducing air bubbles into the patient's vascularity. By detecting the orientation

of the at least one connected device and guiding a user to correctly orient the catheter, especially at least one of the connected devices, the respective cavities can be securely de-aired. The pump unit may be expandable, i.e. it may be compressed into a compressed configuration for insertion into the blood vessel, and may be released and
5 expanded once placed at the target position as will be appreciated by a person skilled in the art.

BRIEF DESCRIPTION OF THE DRAWINGS

[0025] The foregoing summary, as well as the following detailed description of
10 preferred embodiments, will be better understood if read in conjunction with the appended drawings. For the purpose of illustrating the present disclosure, reference is made to the drawings, which are to be understood as schematic and may not be true to scale. The drawings are exemplary for illustrating the present invention, and the scope of the disclosure is not limited to the specific embodiments disclosed in the drawings. In
15 the drawings:

FIG. 1 shows a system in accordance with an embodiment of the present invention, including an intravascular blood pump connected to a control unit.

FIG. 2 shows the blood pump of FIG. 1 in more detail.

FIG. 3a to FIG. 3c schematically illustrate a handle portion or a pump unit of a catheter
20 at different orientations during the purging process.

DETAILED DESCRIPTION

[0026] FIG. 1 shows a system 100 in accordance with an embodiment of the present invention. In particular, the system 100 comprises an intravascular blood pump
25 10 connected to a control unit 5. The intravascular blood pump 10 comprises a catheter 1 with a pump unit 2 connected to the distal end 22 of the catheter 1, more specifically to an elongate tubular portion 11 of the catheter 1 (see FIG. 2). The pump unit 2 is also

called a connected device 230. A handle portion 3 is connected to a proximal end 21 of the elongate tubular portion 11. The handle portion 11 is also called a connected device 230. The handle portion 3 can be grabbed by a user for handling the catheter 1 and will not be inserted into the patient. The intravascular blood pump 10 may be designed to act
5 as a left ventricular assist device and may be inserted into a patient's aorta toward the heart, more specifically the left ventricle of the patient's heart. In this case, the pump unit 2 will be placed through the aortic valve to convey blood from the left ventricle into the aorta. However, it will be appreciated that the blood pump 10 may be designed for a different application, such as to act as a right ventricular assist device, or the
10 catheter may be designed for a different field than intravascular blood pumps.

[0027] Still referring to FIG. 1, the handle portion 3 accommodates a drive unit 4 of the blood pump 10, which will be explained in more detail below. In order to control the drive unit 4, an electric connecting cable 7 is provided connecting the intravascular blood pump 10 to the control unit 5. The control unit 5 has a user interface
15 comprising a display 6. It will be appreciated that the control unit 5 may comprise various further control elements, such as a touch screen, control dials, buttons or the like. The display 6 may be configured to display various operation parameters of the blood pump 10, such as pump flow rate, pump speed, motor current, etc. In particular, in view of the present invention, the display 6 may display during an initial purging
20 process a representation of the orientation of a connected device 230, for example the handle portion 3, which is detected by a sensor 15. As indicated in FIG. 1, the current orientation 27 of the connected device 230 may be displayed relative to a predetermined target orientation 28 of the connected device (indicated in dashed lines in FIG. 1). Any other display options suitable to guide a user may be implemented. Further, or in an
25 alternative example, the orientation 27 of the pump unit 2 may be displayed.

[0028] Besides the electrical connection, the blood pump 10 is further connected to a purge line 8 which is provided for supplying a purge fluid to the blood pump 10 for an initial purging and de-airing process as well as during operation of the blood pump 10. The purge line 8 may be connected to a purge cassette 9, which may be provided for
30 generating a certain purge pressure, which may be for instance 500 mmHg. A purge fluid, which may be any suitable fluid, such as water, or preferably a dextrose solution,

may be provided in a container or bag 17 and supplied to the purge cassette 9 and further, via the purge line 8, to the blood pump 10. Details of the method of preparing the blood pump 10 will be described in more detail below with respect to FIG. 3a to FIG. 3c.

5 [0029] Referring now to FIG. 2, the intravascular blood pump 10 of the system 100 of FIG. 1 is described in more detail. The blood pump 10 comprises two connected devices 230 which are the handle portion 3 and the pump unit 2. Each of the connected devices 230 comprises a cavity 13. Each of these cavities 13 is in fluid communication with a lumen 12 of the elongate tubular body 11. The blood pump 10 of the embodiment
10 shown is an expandable catheter pump, in other words, the pump unit 2 is expandable from a compressed configuration (not shown) to an expanded configuration. More specifically, in order to insert the blood pump 10 through a small access into a patient's blood vessel, the pump unit 2 will be compressed to the compressed configuration to reduce its diameter. Once placed at a target location, for instance the left ventricle and
15 the aorta, the pump unit 2 may expand. For this purpose, the pump unit 2 may comprise an expandable pump casing 23, which may be in the form of a cannula and may be formed of a mesh-like support structure covered by a thin polymer membrane. The support structure may be made of a shape memory material, such as nitinol. The pump unit 2 may have at its distal end an atraumatic tip 24, also known as J-tip or pig tail. An
20 impeller 18, which may be expandable and compressible, respectively, as well, is disposed inside the pump casing 23. In particular in the aforementioned application for left ventricular support, a blood flow inlet 19 may be formed in a distal portion of the pump casing 23, for instance in an enlarged diameter portion. Blood enters the pump casing 23 and is conveyed by means of an impeller 18 rotating about an axis of rotation
25 through the pump casing 23, and out of a blood flow outlet 20 (indicated by arrows B).

[0030] The impeller 18 is coupled to a flexible drive shaft 16, which extends through the catheter 1, more specifically through the lumen 12 of the elongate tubular body 11 of the catheter 1. The flexible drive shaft 16 is coupled to a drive unit 4 which is located inside the cavity 13 of the handle portion 3. The drive unit 4, which is only
30 schematically illustrated in FIG. 2, may comprise an electric motor. Further electronic

parts of the drive unit 4, such as a PCB 26, are connected to the cable 7, which in turn is connected to the control unit 5 as explained above with respect to FIG. 1.

[0031] A sensor 15 for detecting the orientation of the handle portion 3 is placed on the PCB 26 to be able to transmit data relating to the current orientation to the control unit 4. Before use in the patient, in particular the cavity 13 of the handle portion 3 and the lumen 12 of the elongated tubular portion 11 of the catheter 1, and also the pump unit 2, have to be completely de-aired, that means air bubbles have to be completely removed from all cavities of the blood pump 10 to prevent air from being introduced into the patient's vascularity, which may cause severe complications, such as an infarct. In order to supply a purge fluid to the blood pump 10, the purge line 8 is connected to a purge fluid inlet 25 of the handle portion 3. A person skilled in the art will understand that various connectors, such as Y-connectors, Luer-connectors or the like may be used to connect the various lines and cables. Further or in the alternative, a sensor may be placed in the pump unit, additionally or alone.

[0032] Referring now to FIG. 3a to FIG. 3c, a method of preparing a catheter in accordance with an embodiment of the present invention is described. In particular, as explained above, during the preparation of catheter 1 before it can be used in a patient, air bubbles shall be completely removed. While there is substantially no risk that air bubbles are trapped in the lumen 12 of the elongate tubular body 11 of the catheter 1, air bubbles might be trapped inside the cavity 13 of connected devices as the handle portion 3 and/or the pump unit 2. In particular, there is a risk that purge fluid exiting the catheter 1 at the distal end 22 (i.e. exiting the pump unit 2) may erroneously imply that the catheter 1 has been successfully de-aired. This is because the cavity 13 of the handle portion 3 (or the pump unit – not shown) may have recesses or other geometrical structures of the inner wall or of built-in components which may still be filled with air while the purge fluid already flows through the lumen 12 of the elongate tubular portion 11 of the catheter 1. In particular, the lumen 12 may have a very small diameter such that capillary forces may draw the purge fluid into the lumen 12 although there still is air in the cavity 13 of the handle portion 3 and/or the pump unit. Furthermore, the cavities or built-in components may have irregular structures that further increase the risk of entrapped air bubbles.

[0033] The risk of air bubbles being trapped inside the handle portion 3 and/or the pump unit 2 can be substantially reduced or eliminated if the handle portion 3 and/or the pump unit 2 is held in a correct orientation during the initial purge process for de-airing the catheter 1. Therefore, the system 100 of the present invention includes a sensor 15 for detecting the orientation of the handle portion 3 and/or the pump unit 2. In other words, the current orientation of the handle portion 3 and/or the pump unit 2 can be detected while supplying the purge fluid through the line 8 (see arrow P) into the handle portion 3 or into the pump unit via the tubular portion 11. In particular, the current orientation may be detected continuously or at certain time intervals, preferably very short time intervals, such that the orientation can be properly monitored.

[0034] The sensor 15 may be a gravity sensor, accelerometer, gyroscope or any other sensor, which is able to detect an orientation. In particular, it is sufficient to detect the orientation, and it may not be necessary to detect the absolute position of the handle portion 3 and/or the pump unit 2 in three-dimensional space, particularly in relation to gravity. Especially an accelerometer does not require any external infrastructure, like external field generators or the like, and is robust against a magnetic field, which may be caused by the drive unit 4. Thus, an accelerometer may provide an exact orientation.

[0035] In particular, the orientation may be represented by a tilt angle α enclosed by a general longitudinal axis L and/or the pump unit 2 and a vertical axis V, preferably along gravity. As indicated by the arrows in FIG. 3a to FIG. 3c, an accelerometer 15 typically detects a vertically downward direction. The sensor data can then be used to calculate the tilt angle α relative to the particular downward direction. The detected orientation may be transmitted to the control unit 5. Preferably, the sensor data obtained by the sensor 15 are transmitted using memory mapping, which eliminates the need for further connection wires, and the existing connecting cable 7 can also be used for transmitting the sensor data. The control unit 5 can display the detected orientation calculated from the sensor data on a display 6 as illustrated in FIG. 1. Further, the control unit 5 may be configured to guide the user to change the orientation of the handle portion 3 or the pump unit 2 toward a predetermined target orientation. As illustrated in FIG. 3a to FIG. 3c, the display 6 may also give a positive and negative

indication 29 whether the current orientation matches the predetermined target orientation or not, respectively.

[0036] A de-airing process will be described with the handle in FIG. 3a-3c as an example that can also be applied to the pump unit 2 analogously: The predetermined target orientation may be chosen depending on the interior geometry of the handle portion 3, to be the orientation in which air bubbles can securely exit the cavity 13 of the handle portion 3 into the lumen 12 of the elongated tubular portion 11 of the catheter 1. The predetermined target orientation may be a vertical orientation as shown in FIG. 3a, in which further a purge fluid line 8 is located vertically below the proximal end 21 of the tubular portion 11, i.e. at an angle α of 0 degrees, or, in other words, in which the vertical axis V is coincident with the longitudinal axis L. In this orientation, the purge fluid 30 is introduced from below and can securely push any air 31 in a vertically upward direction such that the cavity 13 and that the lumen 12 can be securely de-aired. It will be appreciated that any angle α greater than 0 or any range of angles may be selected to define the predetermined target orientation.

[0037] As shown in FIG. 3b, if the handle portion 3 is held at an oblique angle, for instance an angle α greater than 0 degree and below 90 degrees, such as 45 degrees, air 31 may be trapped in a corner of the cavity 13 of the handle portion 3 while the purge fluid 30 already is present in lumen 12. Likewise, as shown in FIG. 3c, if the handle portion 3 is held in an orientation in which the fluid inlet into the handle portion 3 is located vertically above the exit into the lumen 12, i.e. for instance at an angle α greater than 90 degrees up to 180 degrees, air 31 may be trapped in a corner of the cavity 13 of the handle portion 3. Nevertheless, purge fluid may continuously exit the catheter 1 at the distal end 22, thereby making the user erroneously believe that he has successfully de-aired the catheter 1.

[0038] Therefore, the user is guided how to hold the handle portion 3, in other words how to change the orientation of the handle portion 3 such that it matches the predetermined target orientation. The detected orientation, that means the current orientation detected by the sensor 15 is compared to the predetermined target orientation and a suitable indication is displayed on the display 6, e.g. at least one of the indications

27, 28 and 29 as described above. It will be appreciated that any indication representing the difference between the current detected orientation and the predetermined target orientation suitable to guide a user to choose the correct orientation may be envisioned, such as graphic illustrations, color scales, arrows or the like. Likewise, in addition or
5 alternatively, an acoustic signal may be used to guide the user to change the correct orientation to approach and match the predetermined target orientation, which is necessary for completely de-airing the system.

[0039] While the purge fluid may be continuously supplied by the fluid line 8 to the cavity 13 and to the lumen 12 during the aforementioned purging and de-airing
10 process, it may be advantageous to activate the flow of purge fluid only if the user holds the handle portion 3 in the correct orientation. Vice versa, the flow of purge fluid may be stopped or paused if the user does not correctly hold the handle portion 3. This may reduce or eliminate the risk that the purge fluid is drawn into the lumen 12 too early although air is still present in the handle portion 3. The volume of supplied purge fluid
15 may be measured such that based on the known volume of all cavities in the catheter 1, an indication may be displayed once the purging and de-airing process is completed. For safety reasons, the control unit 5 may prompt the user to confirm that the purge fluid exits the blood pump 10 at the distal end, and a safety margin for the amount of purge fluid may be added.

20 [0040] The disclosed method and system allow for proper and secure preparation of a catheter for use in a patient, in particular proper purging and de-airing the catheter in order to prevent air bubbles from being introduced into the patient's vascularity. It will be appreciated that the invention is particularly useful in the field of intravascular blood pumps but may be implemented in any catheter which requires
25 proper de-airing before used in a patient.