

CARDIAC ASSIST PUMP INLET PROTECTION

FIELD OF INVENTION

[0001] The present invention relates to a percutaneous implantable heart assist device.

5 BACKGROUND OF INVENTION

[0002] Heart failure remains a major health problem, with an estimated prevalence of 1-2% in the adult population of developed countries increasing to 10% from the age of 70 years.

10 [0003] Today, the reference treatment for irreversible bi-ventricular dysfunctions remains heart transplantation. However, the criteria for eligibility for the transplant (selection of candidates) and the shortage of grafts make this therapy available for only a few selected patients. In addition, the waiting lists are very long, leading thus to long waiting times, which incompatible with the precarious health of some candidates.

15 [0004] One way of overcoming this lack of grafts, some systems have been developed based on the combination of Left Ventricular Assis Device (LVAD) and Right Ventricular Assis Device (RVAD) leaving in place the native heart and assisting the two ventricles by two external chambers. Although it is the most usable device in clinical practice, it remains subject to a major risk of complication (infectious, thromboembolic) and the complexity of the installation will increase the mortality risk during surgery.

20 [0005] As an alternative treatment, the development of total artificial hearts has gradually emerged, with the issue of allowing a return home under the cover of a good quality of life. However, there are many drawbacks that limit their development, including ergonomic limitations, heavy surgery, and the instantaneous death of the patient in the event of a pump stops.

[0006] In addition, most of those patients having bi-ventricular dysfunctions are aged patients and have severe comorbidities and/or diseases, and in this case, no reasonable therapeutic solution is available, as heavy open-heart surgery is excluded.

5 [0007] In the absence of a satisfying solution to treat terminal bi-ventricular dysfunctions, the future directions include the miniaturization of LVADs allowing their implantation by percutaneous or mini-invasive access and the development of a right cardiac assistance fully implantable percutaneously to limit the surgical and infectious risk could be the solution to many patients without therapeutic project.

10 [0008] The development of a miniaturized RVAD used as a destination therapy combine or not with LVAD, implanted without heavy surgery is the solution aimed at to increase the number of patients to be treated, especially patients who are not eligible for heart transplant. A further benefit is to avoid a re-intervention in case of complication or pump malfunction and the possibility to replace it percutaneously, especially in frail elderly patients. However, delivering an assist device percutaneously inside the right
15 ventricle presents some issues like the sizing of its constitutive elements, and the positioning and securing of said elements inside the patient's heart.

[0009] Regarding human anatomy, the best location for the assist device is inside the ventricle or atrium of the heart. However, a ventricle is a small chamber and it is possible that the elastic walls of said ventricle could be impacted by the depression induced by the
20 assist device pumping the blood of the patient through the patient's heart. It is therefore necessary to prevent the natural anatomical walls of the ventricle or atrium to be suck up towards or into the cardiac assist device.

[0010] The technical problem to be solved by the present invention is thus to propose an assist device which can be safely implanted and maintained inside the ventricle or atrium
25 of the human heart, without damaging neither the device nor the patient's heart.

SUMMARY

[0011] The present invention aims at solving this problem and thus relates to a cardiac assisting device configured to be implanted inside a patient's heart, and configured to

drive a blood flow from a first chamber of the patient's heart towards a reception conduct of the patient's heart by bypassing at least one second chamber of the patient's heart, the second chamber putting the reception conduct and the first chamber in fluidic communication, said assisting device comprising:

- 5 - a device inlet configured to open in the first chamber,
- a device outlet configured to open in the reception conduct,
- a rotary pump connecting the device inlet to the device outlet, the rotary pump comprising a pump body with a pump inflow in fluidic communication with the device inlet and a pump outflow in fluidic communication with the device outlet,
- 10 the pump body extending at least partially along an elongation axis and presenting an external surface, the rotary pump further comprising an impeller placed in the pump body between the pump inflow and the pump outflow.

[0012] The device inlet is coaxially arranged at an upstream portion of the pump body, and the pump body further comprises a spacing organ extending at least partially radially from the external surface of the pump body, the spacing organ being configured to maintain a predefined space between any anatomical wall of the patient's heart and the device inlet.

[0013] Thus, this solution achieves the above objective. In particular, it allows the obtaining of a cardiac assisting device which can be safely implanted in any chamber of a patient's heart without the risk of damaging the anatomical walls of said chamber or the device itself, due to the depression generated by the pump of the device. It also avoids the obstruction of the device inlet and thus prevents any malfunctioning of said device.

[0014] The device according to the invention may include one or more of the following characteristics, taken in isolation from one another or in combination with one another:

- 25 - the device inlet has at least one inlet opening that opens transversally with regards to the elongation axis, and wherein the spacing organ comprises at least one remote portion facing the inlet opening at a distance,
- the spacing organ comprises at least one radial portion extending along a secondary elongation axis, said secondary elongation axis extending radially with regards to the elongation axis,
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- the spacing organ may be configured to be free to move with regards of any of the anatomical walls of the patient's heart,
- the predefined space may range from 15 to 30mm,
- the spacing organ may be radially elastically deformable,
- 5 - the spacing organ may extend at least partially along the elongation axis, may present a distal extremity and a proximal extremity with regards to the elongation axis, each extremity being secured to the pump body,
- the spacing organ may extend at least partially along the elongation axis and may present a distal extremity and a proximal extremity with regards to the elongation axis,
- 10 the proximal extremity being secured to the pump body and the distal extremity being free,
- the spacing organ may be secured to the pump body by means of a securing ring strapping the pump body,
- the spacing organ may at least partially surround the device inlet,
- 15 - the device inlet may present at least one inlet opening configured to enable a blood flow to pass through the pump body, the spacing organ surrounding the at least one inlet opening,
- the spacing organ may at least partially surround the pump body,
- the spacing organ may comprise several distinct spacing elements distributed around
- 20 the external surface,
- the spacing organ may comprise several spacing elements connected to each other in order to form a spacing structure at least partially surrounding the pump body,
- the spacing structure may be a radially expandable structure, with regards to the elongation axis,
- 25 - the spacing structure may be an expandable mesh,
- the spacing organ may be at least partially made of a nitinol material.

BRIEF DESCRIPTION OF THE DRAWINGS

[0015] The invention will be better understood, and other aims, details, characteristics and advantages thereof will emerge more clearly on reading the detailed description
30 which follows, of one or several embodiments of the invention given by way of

illustration. Those are purely illustrative and non-limiting examples, with reference to the accompanying schematic drawings. On these drawings:

- **Figure 1** is a schematic longitudinal section view of a patient's heart,
- **Figure 2** is the same schematic view as figure 1, in which a cardiac assisting device has been inserted inside the patient's heart,
- **Figure 3** is a perspective view of a first embodiment of an assisting device according to the present invention,
- **Figure 4a** is a side view of a second embodiment of an assisting device according to the present invention,
- **Figure 4b** is a perspective view of the embodiment of figure 4a,
- **Figure 5** is a perspective view of a further assisting device according to the present invention,
- **Figure 6** is a perspective view of a preferred embodiment of the present invention,
- **Figure 7** is an embodiment of the outflow cannula of the embodiment of figure 6.

15 DETAILED DESCRIPTION

[0016] Classically, as can be seen on figure 1, the oxygen-poor blood flow coming from a patient's body is led to the patient's heart 100 by the inferior/superior vena cava 101 and enters the patient's heart 100 through the right atrium 102. The oxygen-poor blood flow then crosses the tricuspid valve and enters the right ventricle 104. The oxygen-poor blood flow then leaves the right ventricle 104 by crossing the pulmonary valve and flows towards the lungs through the pulmonary artery 106. The blood flow is oxygenated in the lungs and is fled once again towards the heart 100 by the pulmonary veins and reenters the heart 100 through the mitral valve inside the left atrium 108 and then into the left ventricle 110. The oxygen-rich blood flow then crosses the aortic valve and leaves the heart 100 through the aorta towards the patient's body. For a purpose of simplification, in the present invention, it is considered that the vena cava 101 is part of the human heart 100, in a broad interpretation of the human heart 100.

[0017] The present invention is about a cardiac assisting device 10 configured to be implanted inside a patient's heart 100. The cardiac assisting device 10 can be implanted in any chamber of the patient's heart 100. The cardiac assisting device 10 is classically

configured to circulate a blood flow from a first chamber C_1 of the patient's heart 100 towards a reception conduct C_R by bypassing a second chamber of the patient's heart 100 through which the blood would naturally flow.

[0018] The term "bypassing" means that, with regards to the natural circuit of the blood flow inside a patient's heart 100, at least one of the chambers of this natural circuit (right atrium 102, right ventricle 104, left atrium 108, left ventricle 110), is bypassed by the blood flow once the cardiac assisting device 10 is implanted and functioning.

[0019] Each chamber of the patient's heart 100 is delimited by at least one anatomical wall presenting some natural elasticity.

[0020] Regardless of the embodiment and implantation place, said assisting device 10 comprises:

- a device inlet 12 configured to enable the blood flow to enter the assisting device 10 from the first chamber C_1 ,
- a device outlet 14 configured to enable the blood flow to exit the assisting device 10 inside the reception conduct C_R ,
- a rotary pump 16 connecting the device inlet 12 to the device outlet 14.

[0021] The device inlet 12, device outlet 14 and rotary pump 16 can be located, once implanted, either in the same chamber of the patient's heart 100 or in different chambers of the patient's hearts 100. Depending on the size of the patient's heart 100, the device inlet 12 might be located very close to an anatomical wall of the patient's heart 100. The rotary pump 16 comprises a pump body 18 with a pump inflow 18i and a pump outflow 18o. The pump body 18 extends at least partially along an elongation axis X. The pump body 18 presents an external surface S.

[0022] The rotary pump 16 is preferably an axial pump (see figure 6). The rotary pump 16 thus extends axially along the elongation axis X. The pump inflow 18i, any impeller 20 (see below) and the pump outflow 18o are thus all aligned along the elongation axis X. The device inlet 12 is thus aligned along the elongation axis X, in order to guide the blood flow inside the device 10 from the device inlet 12 to the pump outflow 18o along the elongation axis X. The assisting device 10 thus extends in a straight line along the

extension axis X from the pump inflow 18i to the pump outflow 18o, and preferably from the inlet inflow 12 to the pump outflow 18o. This particular straight-line shape enables the assisting device 10 to maintain a small diameter all over the length of the assisting device 10 and make it thus easily implantable via catheter, without any need of deforming the pump body 18 during (or after) implantation.

[0023] The device inlet 12 is coaxially arranged at an upstream portion of the device 10 and comprises at least one inlet opening 12o enabling blood to flow through the pump body 18. The at least one inlet opening 12o may open axially or radially with respect to the elongation axis X. The device inlet 12 presents at least one inlet opening 12o configured to enable a blood flow to pass through the pump body 18. Preferably, the at least one inlet opening 12o opens transversally with regards to the elongation axis X.

[0024] On the other side of the pump body 18, the device outlet 14 is coaxially arranged at a downstream portion of the device 10 and comprises at least one outlet opening O enabling blood to flow out the device 10 inside the reception conduct C_R.

[0025] As can be seen on figures 2 and 7, the device outlet 14 is configured to change an orientation of the outlet opening O with regards to the elongation axis X. In other words, the device outlet 14 extends at least partially along an outflow axis Y, different from the extension axis X. More precisely, the outflow axis Y and the elongation axis X intersect each other at an angle ranging from 1 to 189°. Preferably the outflow axis Y and the elongation axis X intersect each other at an angle ranging from 1 to 90°. This way the outlet opening O is not aligned with the pump outflow 18o. This variable unalignment of the outlet opening O with the pump outflow 18o, enables the device 10 to adapt to a higher variety of heart sizes and shapes without causing any damages.

[0026] The device outlet 14 is, contrary to the rotary pump 16, deformable. The device outlet 14 is preferably a bendable cylinder. The device outlet 14 is configured to adapt to the patient's heart 100 morphology. Preferably, the device outlet 14 is preferably made of flexible tube materials, and can for example be a coated meshed or braided or spiraled stent made of, for example, Nitinol, and/or stainless steel. Depending on the used materials, the device outlet 14 folds and unfolds, thus enabling an easy introduction and

it can further, once implanted, adapt the patient's heart shape depending on the position of the rotary pump 16 inside the patient's heart 100. This flexibility precisely offers the possibility to vary the angle between the pump outflow 18o and the device outlet O thus improving the adaptation of the device 10 to the natural shape of the patient's heart 100
5 without affecting the shape of the rotary pump 16.

[0027] In some specific embodiment illustrated on figures 6 and 7 the device outlet 14 comprises a deformable cannula 140. The deformable cannula 140 presents the general shape of a tube with a tapered end at a distal extremity. The deformable cannula 140 thus comprises a central part formed by a coil (made of, for example, Nitinol, and/or stainless
10 steel), a proximal extremity configured to secure the deformable cannula 140 to the pump outflow 18o and a distal extremity formed by a mesh and presenting a tapered shape with a small diameter at an upstream extremity and a large diameter at a downstream extremity. The tapered end can be crimped during implantation and expands after implantation. The deformable cannula 140 is further coated with, for example PU, PTFE, ePTFE. The
15 diameter of the coil ranges from 6 to 10mm, preferably 8mm and the larger diameter of the tapered extremity ranges from 18 to 21mm, preferably 20mm. The wall thickness of the coil and the tapered end ranges from 0,2 to 0,4mm. The coil is formed one single wounded wired (spiral), thus forming a structure of parallel filaments. This specific structure enables the deformable cannula 140 to be folded with a small bending radius
20 while presenting high radial forces (with regards to the state of the art) and avoiding the cannula to be kinked as a kink would block the blood flow circulation.

[0028] In order to put the blood flow in motion through the assisting device 10 once it is implanted inside the patient's heart 100, the rotary pump 16 comprises a motor and an impeller 20. More particularly, the pump body 18 surrounds the impeller 20 which
25 extends between the pump inflow 18i and the pump outflow 18o. The impeller 20 is preferably magnetically coupled to the motor.

[0029] The rotary pump 16 provides a fluidic pressure ranging from 70 to 130mmHg for a left-side implantation and ranging from 10 to 40mmHg for a right-side implantation. The rotary pump 16 further provides a fluidic debit ranging from 2 to 4L/min for a left-

side implantation and a fluidic debit ranging from 2 to 4 L/min for a right-side implantation.

[0030] The impeller 20 generates depression in order to drive the blood flow inside the assisting device 10. This negative pressure is thus exerted in the chamber of the patient's heart 100 in which the assisting device 10 is implanted (more particularly in which the device inlet 12 is located). Said negative pressure is therefore also exerted on the anatomical wall of the chamber of the patient's heart 100. If the device inlet 12 is located closely to the anatomical wall of the chamber, said anatomical wall could be deformed and drawn towards the device inlet 12. This deformation could lead to injuries and/or an obstruction of the device inlet 12.

[0031] In order to avoid such deformation and/or obstruction issues, the pump body 18 comprises a spacing organ 22, as can be seen on figures 3, 4a and 4b. The spacing organ 22 extends at least partially radially from the external surface S. More precisely, the spacing organ 22 extends at least partially away from the elongation axis X. This way, the spacing organ 22 is configured to maintain a predefined space E between any anatomical walls of the patient's heart 100 and the device inlet 12.

[0032] Preferably, the space E ranges from 15 mm to 30 mm.

[0033] The spacing organ 22 extends at least partially along the elongation axis X. It thus presents a longitudinally length ranging from 10 mm to 40 mm along the elongation axis X.

[0034] In the embodiment depicted on figures 3, 4a, 4b, the spacing organ 22 presents a distal extremity and a proximal extremity with regards to the elongation axis X, each extremity being secured to the pump body 18. In those embodiments, the spacing organ 22 surrounds at least partially the device inlet 12. More particularly, the spacing organ 22 surrounds the at least one inlet opening 12o.

[0035] Particularly in the embodiment depicted on figure 3, the spacing organ 22 comprises several distinct spacing elements 220 distributed around the external surface 6

of the pump body 18 and more particularly over the device inlet 12. Those spacing elements 220 could for example be arched or bent stent's struts.

[0036] In some alternative embodiments, the spacing organ 22 presents a distal extremity and a proximal extremity with regards to the elongation axis X, the distal extremity being a free extremity. The spacing organ 22 could comprise at least one spike at least partially extending along the elongation axis X. In those embodiments also, the spacing organ 22 could comprise several distinct spacing elements 220 distributed around the external surface 6 of the pump body 18 and more particularly over the device inlet 12, like a sort of crown.

[0037] As depicted in figures 4a and 4b the spacing organ 22 comprises several spacing elements 220 connected to each other in order to form a spacing structure at least partially surrounding the pump body 18. In the case of figures 4a and 4b, the spacing structure is at least partially made of mesh. More particularly, in the embodiments of figures 4a, 4b, the complete spacing structure is an expandable mesh. This mesh can be radially elastically deformable. In some embodiments, the spacing structure could be expandable struts.

[0038] Regardless of the detailed structure of the spacing elements 220 of the spacing organ, the spacing organ 22 comprises at least one radial portion extending along a secondary elongation axis X_2 . This secondary elongation axis X_2 extends radially with regards to the elongation axis X. This ensures that at least a part of the spacing organ is remote from the pump body 18 and particularly from the inlet opening 12o.

[0039] Regardless of the embodiment, the spacing organ 22 comprises a part at least partially surrounding the pump body 18. In a preferred embodiment, the spacing organ 22 comprises a part at least partially surrounding the device inlet 12. More particularly, the spacing organ 22 surrounds the at least one inlet opening 12o. Preferably, the spacing organ 22 comprises at least one remote portion facing the inlet opening 12o at a distance.

[0040] In some embodiments, for example the embodiment depicted on figures 4a, 4b, the spacing organ 22 is secured to the pump body 18 by means of a securing ring 24 strapping the pump body 18. In the embodiment of figure 3, the spacing organ 22 is

welded to the pump body 18. In some other embodiments, the spacing organ 22 forms one single piece with the pump body 18 and is part of the surface S.

[0041] In order to ease the adaptation of the assisting device 10 to the specific shape of the chamber of the patient's heart 10, the spacing organ 22 is radially elastically
5 deformable. For example, the spacing organ could be at least partially made of Nitinol material.

[0042] In order to avoid any tension on the anatomic walls of the patient's heart 100, the spacing organ 22 is configured to be free to move with regards of any of the anatomical walls of the patient's heart 100. This way, regardless of the movements of the implanted
10 assisting device 10, the spacing organ 22 does not pull or tear the anatomic walls and is not pulled or torn by an anatomical wall to which it would be attached, and remains thus entirely functional and able to generate the necessitated space E between any anatomical walls of the patient's heart 100 and the device inlet 12.

[0043] In order to ease the implantation of the assisting device 10, the spacing structure
15 is a radially expandable structure, with regards to the elongation axis X. The spacing organ 22 is thus inserted inside the patient's heart 100 in a folded configuration and, once the assisting device 10 is rightfully in place inside the patient's heart 100, the spacing organ 22 expands inside the chamber of the patient's heart, thus protecting the device inlet 12 once everything is in place. In its expanded configuration, the spacing organ 22
20 displays an extended diameter ranging from 15 to 30mm. In its expanded configuration, the spacing organ 22 is configured to maintain the predefined space E between the anatomical wall of the patient's heart 100 and the device inlet 12.

[0044] The assisting device 10 further comprises a support device configure to secure and stabilize the device 10 inside the patient's heart 100. Said support device comprises
25 at least one outlet support element 25 and, in some embodiments, a pump support element 26. In case the device 10 comprises a deformable cannula 140 as described here-above, the tapered end of the deformable cannula 140 forms an outlet support device 25. In those embodiments, the at least one outlet support device 25 is integral with the device outlet 14 thus forming the deformable cannula 140.

[0045] The at least one outlet support element 25 is configured to tightly cooperate with a membrane in order to immobilize the pump 16 and the device outlet 14 inside the patient's heart 100 (or vena cava 101) and enable the patient's blood flow to be driven from the device inlet 12 to the device outlet 14 through the at least one membrane of the patient's heart 100, more particularly through the conduct membrane M_1 of the reception conduct C_R .

[0046] When the assisting device 10 is implanted inside the patient's heart 100, the outlet support element 24 crosses the conduct membrane M_1 and leads the blood of the patient through the conduct membrane M_1 . The at least one outlet support element 25 crosses the conduct membrane M_1 by means of an artificial anastomosis created percutaneously by a surgeon or an interventional cardiologist. Said anastomosis presents an aperture with a diameter ranging from 5 to 15mm opening inside the reception conduct C_R . The aperture is also circumscribed by an edge presenting the regular elasticity and width of the membrane M of the patient's heart 100. The at least one outlet support element 25 thus presents a central hole presenting a diameter ranging from 5 to 15mm, corresponding to the diameter of the aperture of the anastomosis of the conduct membrane M_1 .

[0047] In a convenient embodiment, the device 10 is at least partly deployable from a retracted configuration to an expanded configuration in order to ease its implantation. Thus, more particularly, the at least one outlet support element 25 is deployable from a retracted configuration to an expanded configuration:

- the retracted configuration enables the at least one outlet support element 25 to be introduced through the conduct membrane M_1 of the reception conduct C_R , and
 - the expanded configuration enables the at least one outlet support element 25 to stay in place inside the conduct membrane M_1 .
- When expanded, the at least one outlet support element 25 presents an outer diameter ranging from 10mm to 30mm.

[0048] In order to securely drive the blood flow inside the reception conduct C_R , the outlet support element 25 is configured to extend, once the device 10 is installed inside the patient's heart 100, from an internal side and from the external side of the conduct membrane M_1 . The outlet support element 24 is thus configured to cooperate radially with

the edge of the aperture of the conduct membrane M_1 . This radial cooperation ensures a tight and strong cooperation between the conduct membrane M_1 and the outlet support element 25 (and therefore with the device outlet 14). This radial cooperation thus ensures that the blood flow driven by the assisting device 10 (around 30 to 70% of the complete patient's blood flow) flows through the conduct membrane M_1 , from the inside of the assisting device 10 inside the reception conduct C_R of the patient's heart 100.

[0049] In the embodiments in which the assisting device 10 is a right assisting device, the at least one outlet support element 25 is configured to be secured to the conduct membrane M_1 separating the right atrium 102 or the vena cava 101 from the pulmonary artery 106 as the reception conduct C_R of the patient's heart 100. In this particular embodiment, the outlet support element 25 is configured to be secured to a wall of the superior vena cava 101 or right atrium 102 as the conduct membrane M_1 .

[0050] Preferably, the support element 25 comprises a first and a second expandable flanges, the expanded configuration of each support element 25 enabling a pinching of the conduct or chamber membrane M_1 between the first and second expandable flanges.

[0051] As already mentioned, in some embodiments, the support device further comprises a pump support element 26 configured to secure the pump 16, and more particularly the pump body 18 of the pump 16 to a chamber membrane of the first chamber C_1 . More particularly, this chamber membrane is the wall of the right atrium 102 and/or vena cava inferior 101. Depending on the shape of the pump support element 26, it might also expand inside the vena cava inferior 101, be stuck like a spherical object inside a spherical conduct and secure the device 10 this way.

[0052] Each support element 25, 26 is preferably deployable from a retracted configuration to an expanded configuration. The retracted configuration enables each support element 25, 26 to be safely introduced through or in the conduct or chamber membrane M_1 , of the patient's heart 100. On the other hand, the expanded configuration enables each support element 25, 26 to be secured in position inside the conduct or chamber membrane M_1 . Preferably, the second support element 26 does not go through

any membrane, but is rather deployed inside the vena cava inferior 101 or right atrium 102.

CLAIMS

1. Cardiac assisting device (10) configured to be implanted inside a patient's heart (100), and configured to drive a blood flow from a first chamber of the patient's heart (100) towards a reception conduct (C_R) of the patient's heart (100) by
5 bypassing at least one second chamber of the patient's heart (100), the second chamber putting the reception conduct (C_R) and the first chamber in fluidic communication, said assisting device (10) comprising:
- a device inlet (12) configured to open in the first chamber (C_1),
 - a device outlet (14) configured to open in the reception conduct (C_R),
 - 10 - a rotary pump (16) connecting the device inlet (12) to the device outlet (14), the rotary pump (16) comprising a pump body (18) with a pump inflow (18i) in fluidic communication with the device inlet (12) and a pump outflow (18o) in fluidic communication with the device outlet (14), the pump body (18) presenting an external surface (S) extending at least partially along an elongation axis (X), the rotary pump
15 (16) further comprising an impeller (20) placed in the pump body (18) between the pump inflow (18i) and the pump outflow (18o),
- wherein** the device inlet (12) is coaxially arranged at an upstream portion of the pump body (18),
- wherein** the pump body (18) further comprises a spacing organ (22) extending from the
20 external surface (S) of the pump body (18) at least partially radially with regards to the elongation axis (X), the spacing organ (22) being configured to maintain a predefined space (E) between any anatomical wall of the patient's heart (100) and the device inlet (12).
2. Cardiac assisting device (10) according to the preceding claim, **wherein** the device
25 inlet (12) has at least one inlet opening (12o) opening transversally with regards to the elongation axis (X), and wherein the spacing organ (22) comprises at least one remote portion facing the inlet opening (12o) at a distance.
3. Cardiac assisting device (10) according to any one of the preceding claims, **wherein** the spacing organ (22) comprises at least one radial portion extending along a

secondary elongation axis (X_2), said secondary elongation axis (X_2) extending radially with regards to the elongation axis (X).

4. Cardiac assisting device (10) according to any one of the preceding claims, **wherein** the spacing organ (22) is configured to be free to move with regards of any of the anatomical walls of the patient's heart (100).
5. Cardiac assisting device (10) according to any of the preceding claims, **wherein** the predefined space (E) ranges from 15 to 30mm.
6. Cardiac assisting device (10) according to any one of the preceding claims, **wherein** the spacing organ (22) is radially elastically deformable.
- 10 7. Cardiac assisting device (10) according to any one of the preceding claims, **wherein** the spacing organ (22) extends at least partially along the elongation axis (X), presents a distal extremity and a proximal extremity with regards to the elongation axis (X), each extremity being secured to the pump body (18).
- 15 8. Cardiac assisting device (10) according to any one of claims 1 to 4, **wherein** the spacing organ (22) extends at least partially along the elongation axis (X) and presents a distal extremity and a proximal extremity with regards to the elongation axis (X), the proximal extremity being secured to the pump body (18) and the distal extremity being free.
- 20 9. Cardiac assisting device (10) according to any one of the preceding claims, **wherein** the spacing organ (22) is secured to the pump body (18) by means of a securing ring strapping the pump body.
10. Cardiac assisting device (10) according to the preceding claim, **wherein** the spacing organ (22) at least partially surrounds the device inlet (12).
- 25 11. Cardiac assisting device (10) according to the preceding claim, **wherein** the device inlet (12) presents at least one inlet opening (12o) configured to enable a blood flow to pass through the pump body (18), the spacing organ (22) surrounding the at least one inlet opening (12o).

12. Cardiac assisting device (10) according to any one of the preceding claims, **wherein** the spacing organ (22) at least partially surrounds the pump body (18).
13. Cardiac assisting device (10) according to any one of the preceding claims, **wherein** the spacing organ (22) comprises several distinct spacing elements (220) distributed
5 around the external surface (S).
14. Cardiac assisting device (10) according to any one of claim 1 to 11 **wherein** the spacing organ (22) comprises several spacing elements (220) connected to each other in order to form a spacing structure at least partially surrounding the pump body (18).
- 10 15. Cardiac assisting device (10) according to the preceding claim, **wherein** the spacing structure is a radially expandable structure, with regards to the elongation axis (X).