

of a mitral and/or tricuspid valve from patient to patient make it difficult to have a solution that will work for all or at least a wide variety of patients.

SUMMARY

[0008a] An aspect of the invention provides a delivery device for delivering a docking device to a native valve annulus of a patient's heart, the delivery device comprising:

- a delivery catheter having a first lumen; and
- a pusher tool comprising:
 - a pusher slideably received within the first lumen, the pusher having a distal portion, and proximal portion, and a second lumen extending from the proximal portion to the distal portion;
 - a locking mechanism fixedly attached to the proximal portion of the pusher;
- and
 - a retrieval line extending through the second lumen from the locking mechanism to the docking device to connect the docking device to the pusher tool;
 - wherein the locking mechanism includes a rotatable member connected to the retrieval line, the rotatable member having a first position that locks the amount of retrieval line that extends from the locking mechanism and a second position that allows the amount of retrieval line that extends from the locking mechanism to be increased or decreased.

[0008b] Another aspect of the invention provides a pusher configured to extend through a delivery catheter, the pusher comprising:

- an elongated tube having a distal end, a proximal end, and a lumen extending from the distal end to the proximal end
 - a first section having a first stiffness;
 - a second section having a second stiffness;
 - a third section having a third stiffness;
- wherein the first section is closer to the proximal end than the third section;
- wherein the second section is between the first section and the third section;

wherein the second section has a stiffness that is higher than a stiffness of the first section; and

wherein the third section has a stiffness that is higher than the stiffness of the second section.

[0008c] Another aspect of the invention provides a locking mechanism for a line comprising:

- a body having a first portion;

- a second portion extending away from a central region of the first portion;

- a rotatable member connected to and rotatable relative to the first portion of the body;

- wherein the rotatable member has a first axial position that locks the rotatable member against rotation and a second axial position that allows rotation of the of the rotatable member;

- a biasing member that biases the rotatable member to the first axial position.

[0008d] Another aspect of the invention provides a delivery device for delivering an anchoring device to a native valve annulus of a patient's heart, where the anchoring device is usable to secure a prosthetic heart valve at the native valve annulus, the delivery device comprising:

- a delivery catheter having a distal region configured such that it can transition from a first shape to a second shape different from the first shape, the second shape being curved; and

- a pusher tool, the pusher tool comprising:

- a body rotationally fixable relative to the delivery catheter;

- a control connected to the body; and

- a pusher connected to the control;

wherein the pusher is configured to extend through the body to the delivery catheter, and to move translationally in the delivery catheter when the knob is actuated, to move the anchoring device within and/or out of the delivery catheter.

[0009] This summary is meant to provide some examples and is not intended to be limiting of the scope of the invention in any way. For example, any feature included in an example of this summary is not required by the claims, unless the claims explicitly recite the features. Also, the features described can be combined in a variety of ways. Various features and steps as described elsewhere in this disclosure may be included in the examples summarized here.

[0010] One way to apply circular or cylindrical transcatheter valve technology (e.g., as may be used with aortic valve replacement) to non-circular valve replacement (e.g., mitral valve replacement, tricuspid valve replacement, etc.) would be to use an anchor (e.g., a coiled anchor, helical anchor, mitral anchor, etc.) or docking device/docking station that forms or otherwise provides a more circular or cylindrical docking site at the native valve position (e.g., mitral valve position) to hold such prosthetic valves.

[0011] The anchoring or docking devices themselves can be designed for delivery via a transcatheter approach. One such anchoring or docking device is a coil or anchor that includes a helically shaped region that has a plurality of turns defining a circular or cylindrical inner space for docking the prosthesis or bioprosthesis, e.g., THV. In this manner, existing expandable transcatheter valves developed for the aortic position, or similar valves that have been slightly modified to more effectively replicate native valve function (e.g., native mitral valve function), could be more securely implanted in such a docking device/station positioned at the native valve annulus (e.g., native mitral annulus).

[0012] The docking device/station can first be positioned at the native valve annulus, and thereafter, the prosthesis (e.g., valve implant or transcatheter heart valve) can be

WHAT IS CLAIMED IS:

1. A delivery device for delivering a docking device to a native valve annulus of a patient's heart, the delivery device comprising:

a delivery catheter having a first lumen; and

a pusher tool comprising:

a pusher slideably received within the first lumen, the pusher having a distal portion, and proximal portion, and a second lumen extending from the proximal portion to the distal portion;

a locking mechanism fixedly attached to the proximal portion of the pusher; and

a retrieval line extending through the second lumen from the locking mechanism to the docking device to connect the docking device to the pusher tool;

wherein the locking mechanism includes a rotatable member connected to the retrieval line, the rotatable member having a first position that locks the amount of retrieval line that extends from the locking mechanism and a second position that allows the amount of retrieval line that extends from the locking mechanism to be increased or decreased.

2. The delivery device of claim 1 wherein the pusher comprises a helically wound wire.

3. The delivery device of claim 1 wherein the pusher comprises a patterned cut tube.

4. The delivery device of any of claims 1-3 wherein the locking mechanism comprises a line access window for accessing a single end of the retrieval line.

5. The delivery device of claim 4 further comprising a divider in the window, wherein a first end of the retrieval line is on a first side of the divider and a second end of the retrieval line is on a second side of the divider.

6. The delivery device of any of claims 1-5 wherein the rotatable member comprises a first passage extending along a rotational axis of the rotatable member and a second

passage that intersects the first passage, wherein the retrieval line extends through the first and second passages.

7. The delivery device of any of claims 1-6 wherein the locking mechanism comprises a detent that prevents the rotatable member from rotating when the rotatable member is in the first position.

8. The delivery device of any of claims 1-7 wherein the detent allows the rotatable member to rotate when the rotatable member is in the second position.

9. The delivery device of any of claims 1-8 wherein the rotatable member is biased to the first position.

10. A pusher configured to extend through a delivery catheter, the pusher comprising:
 an elongated tube having a distal end, a proximal end, and a lumen extending from the distal end to the proximal end
 a first section having a first stiffness;
 a second section having a second stiffness;
 a third section having a third stiffness;
 wherein the first section is closer to the proximal end than the third section;
 wherein the second section is between the first section and the third section;
 wherein the second section has a stiffness that is higher than a stiffness of the first section; and
 wherein the third section has a stiffness that is higher than the stiffness of the second section.

11. The pusher wire of claim 10, wherein the first, second, and third sections are adjacent to one another.

12. The pusher wire of any of claims 10-11, wherein the pusher wire comprises hypotube, polymer tube, coil pipe, coil spring, or flexible tube.

13. The pusher wire of any of claims 10-12, wherein the third section comprises an uncut hypotube.
14. The pusher wire of any of claims 10-13, wherein the second section of the plurality of sections comprises a hypotube having a plurality of interrupted cuts.
15. The pusher wire of claim 14, wherein an interval of the uninterrupted cut is constant.
16. The pusher wire of any of claims 10-15, wherein the pusher wire further comprises a polymer cover.
17. A locking mechanism for a line comprising:
 - a body having a first portion;
 - a second portion extending away from a central region of the first portion;
 - a rotatable member connected to and rotatable relative to the first portion of the body;
 - wherein the rotatable member has a first axial position that locks the rotatable member against rotation and a second axial position that allows rotation of the of the rotatable member;
 - a biasing member that biases the rotatable member to the first axial position.
18. The locking mechanism of claim 17, further comprising intersecting bores that connect the first portion of the body to the second portion of the body.
19. The locking mechanism of claim 18, further comprising a window in the second portion that one of the intersecting bores.
20. A delivery device for delivering an anchoring device to a native valve annulus of a patient's heart, where the anchoring device is usable to secure a prosthetic heart valve at the native valve annulus, the delivery device comprising:
 - a delivery catheter having a distal region configured such that it can transition from a first shape to a second shape different from the first shape, the second shape being curved; and

a pusher tool, the pusher tool comprising:

- a body rotationally fixable relative to the delivery catheter;
- a control connected to the body; and
- a pusher connected to the control;

wherein the pusher is configured to extend through the body to the delivery catheter, and to move translationally in the delivery catheter when the knob is actuated, to move the anchoring device within and/or out of the delivery catheter.

21. The delivery device of claim 20, wherein the pusher comprises a spring wire.
22. The delivery device of any one of claims 20 and 21, wherein the body defines a pathway for the pusher, and wherein the pathway is configured such that the pusher extends from the control into the pathway in a substantially straight orientation.
23. The delivery device of any one of claims 20-22, wherein the control is a knob rotatable relative to the body and the delivery device is configured such that rotation of the knob relative to the body causes the pusher to move translationally to move the anchoring device.
24. The delivery device of claim 23, wherein the knob includes a slot configured to hold the pusher that extends circumferentially around the knob in a spiraling manner.
25. The delivery device of claim 24, wherein a plurality of ribs extend into the slot for enhancing engagement between the knob and the pusher.
26. The delivery device of claim 24, wherein the body has a guiding key configured to extend into the slot to maintain axial alignment between the body and the knob.
27. The delivery device of any one of claims 20-26, further comprising a suture for connecting a distal end of the pusher to the anchoring device.
28. The delivery device of claim 27, wherein the pusher tool further comprises a locking feature for holding at least one end of the suture.

29. The delivery device of any one of claims 20-28, further comprising a controller for adjusting a curvature of the distal region of the delivery catheter.

30. The delivery device of claim 29, further comprising a catheter handle connected to the delivery catheter, wherein the controller is on the catheter handle, and wherein the catheter handle is configured to be rotationally fixed relative to the body of the pusher.