

Vortex Generators for Prosthetic Heart Valves

An array of vortex generators that gain passive flow control that minimizes the shear stresses experienced by blood elements flowing across bileaflet mechanical heart valves.

Inventors at Georgia Tech have designed an array of vortex generators to gain passive flow control that minimizes the shear stresses experienced by blood elements flowing across bileaflet mechanical heart valves (BMHV). The array of vortex generators are placed on the leaflets to counteract the formation of strong vortices leading the transitory leakage jet, thus reducing the overall platelet activation for the valve and blood damage. The vortex generators induce the formation of secondary counter-rotating stream wise vortex pairs which interact with the shear layer, resulting in a reduction of cross stream mixing. This cross stream mixing leads to broadening of the jet stream, and to the dissipation of small-scale motions.

There are two types of vortex generator arrays: (1) rectangular fins and (2) hemispherical fins. The arrays are fabricated using molding bio-compatible polymeric materials, such as PDMS. The elasticity and other mechanical properties of the fin's molding material minimizes the fin's cross stream protrusion when the flow over the leaflets reverses its direction. Additionally, the angle of attack, height, depth, and spacing of the vortex generators are great enough to retard boundary layer formation, thereby reducing the sheer stress. The vortex generators have been mounted on a 25mm BMHV and showed a reduction of thrombin anti thrombin (TAT) by greater than 42% during testing.

Summary Bullets

- **Unique-** biocompatible and customizable vortex generators
- **Lower-cost-** technology of quick molding fabrication
- **Reduced TAT-** vortex generators implanted in BMHVs have shown to reduce TAT by greater than 42%

Solution Advantages

- **Unique-** biocompatible and customizable vortex generators
- **Lower-cost-** technology of quick molding fabrication
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Potential Commercial Applications

Medical interventions used to treat impairments by cardiovascular disease

- Heart valves

- Stents
- Bypass pumps
- Flow-assist devices
- Conduits for transporting fluids

Background and More Information

Invasive and non-invasive medical devices used to transport biological fluids are associated with a significant risk for long term complications attributable to the nature of the blood element flow. Such devices include heart valves, stents, bypass pumps, flow-assist devices, and conduits for transporting such fluids. With these devices, blood elements are subject to highly strong non-physiological hemodynamic shear stresses, which result in cell damage, thrombus formation, and platelet activation. As a result, there is a current need for flow control devices that can minimize the magnitude of shear stresses experienced by the blood elements flowing through such medical devices.

Inventors

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Publications

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Images

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