Flexible multilayered pump for use as a ventricular assist device

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Technology description

At a Glance:
This invention is essentially a ventricular assist device, made up of a flexible polymer involving prosthetic heart valves, hydraulic chambers and an artificial muscle, which will be used to help drive blood flow and are also used during heart failure.
This invention is believed to result in fewer adverse outcomes for patients, such a bleeding or thrombosis. It will require less power to operate, which will allow it to be battery operated with a simple control system. It is also inexpensive to create and is highly customizable.
The Ventricular Assist Device market
Background:
Cardiovascular disease has remained the leading cause of death for over a century in the United States. One result has been an increasing number of ventricular assist devices (VADs) being utilized to treat patients with various forms of heart failure, affecting 23 million people worldwide. Continuous-flow VADs are the most commonly used and consist of a driveline connected through the skin of a patient to control a mechanical impeller rotating inside a housing unit to pump blood. Despite substantial improvements in VADs, a larger application of the technology has been limited due to clinically significant adverse event including bleeding and thrombosis.
Technology Overview:
The developed invention is a flexible VAD that mimics the dynamics of the embryonic heart to create a novel electrohydraulic driven Pulsatile Undulating Multilayered Pump (PUMP). This consists of a gelatin layer sandwiched between a flexible inner lumen and an outer flexible muscle. The artificial muscle will consist of a flexible inextensible shell made from a commercially available polymer. Two polymer layers will be thermally welded with specific designs to create pouches along the length and width. Separately, for the inner lumen, a strip of the polymer will be welded onto another polymer sheet, with the shape of three heart valve leaflets. This will be repeated for the other side of the polymer sheet. The sheet will be used as the inner lumen of the pump, while the leaflet-shaped geometry will serve as a heart valve in the final configuration. This sheet will be shaped into a cylinder, while the shorter outer artificial muscle will be wrapped around the inner lumen, leaving the valve outside of the artificial muscle area. Separate ionic polymer-metal composites (IPMCs) will be affixed over the pouches on the polymer sleeve. The electrodes of the IPMCs will be connected to a power supply.

Advantages

Fewer adverse outcomes for patients, such as bleeding or thrombosis
Requires less power to operate
Inexpensive to create and highly customizable

Institution

Colorado State University

Inventors

David Bark
Assistant Professor
Mechanical Engineering