An Extracorporeal Device to Reduce Afterload During VA-ECMO

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Overview

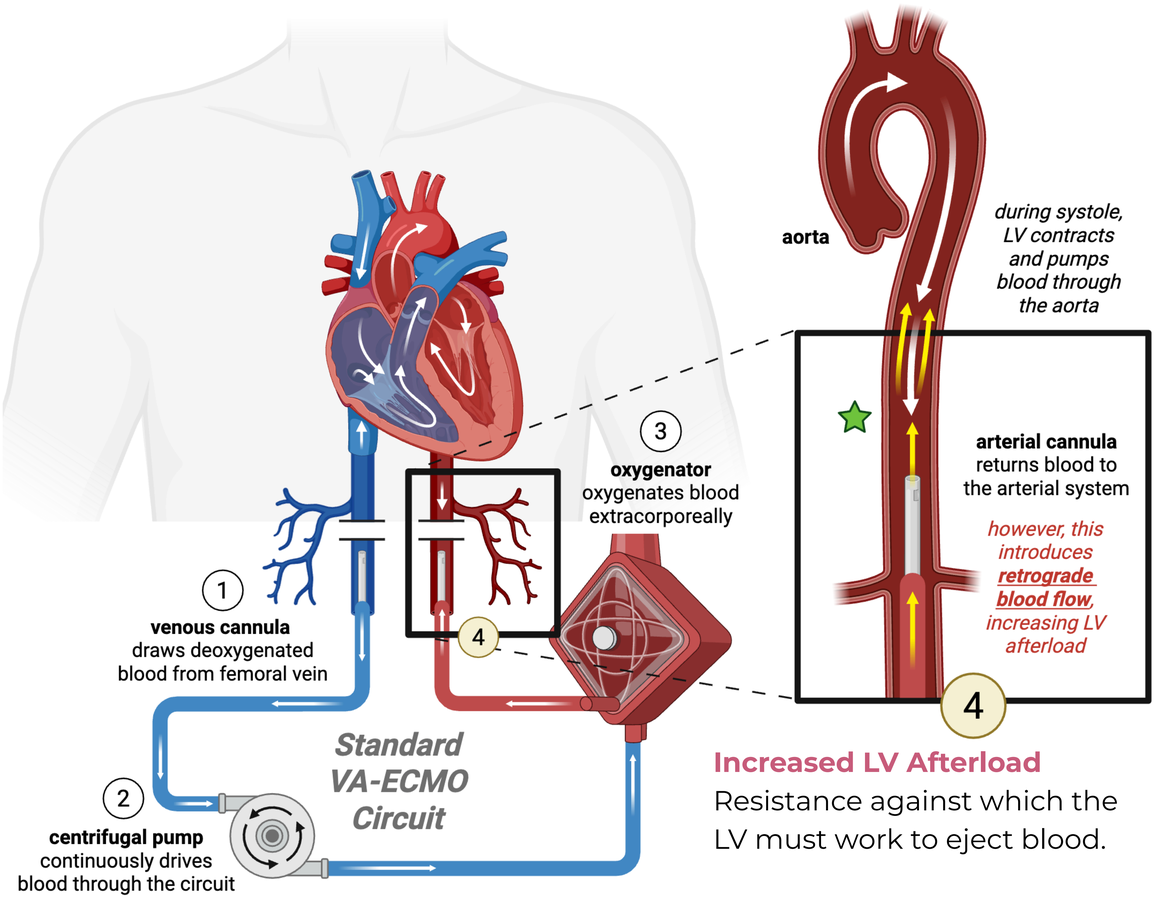
Cardiogenic shock (CS) is a life-threatening condition in which the left ventricle (LV) cannot pump blood effectively due to impaired contractility. Venoarterial Extracorporeal Membrane Oxygenation (VA-ECMO) is a life-support technology that removes blood from the venous system, oxygenates it outside the body, and returns it to the arterial system for organ perfusion. VA-ECMO is often the only option for critically ill CS patients who cannot tolerate invasive procedures. Despite its benefits, only 51% of patients survived to discharge, mainly due to increased afterload—the resistance the LV must overcome to eject blood. In patients on VA-ECMO, afterload increases due to continuous retrograde blood flow toward the aortic root. During systole, the compromised LV cannot expel residual blood against this higher pressure, causing blood stasis and LV distension. With a 23-fold increase in VA-ECMO usage since 2002, increased afterload is an imperative problem to solve. CircuFlow, a non-invasive device, reduces afterload during systole and alleviates LV burden, reducing downstream complications.

Problem Background

Cardiogenic Shock (CS)

- Affects **~ 50,000** people annually
- Often caused by heart attacks
- Characterized by **impaired LV contractility**

→ CS patients are placed on **VA-ECMO**



Increased LV Afterload

Resistance against which the LV must work to eject blood.

The Need

Cardiothoracic surgeons need a **minimally invasive** method to **reduce afterload** in CS patients on VA-ECMO to lower rates of left ventricular distension.

Design Goals

Non-Invasive & Extracorporeal
spliced into VA-ECMO circuit

Prevents Thrombus Formation
blood velocity does not fall below 0.1 m/s

Reduces Systolic Flow
from 5-7 L/min to 0.5-1 L/min

Minimizes Hemolysis
circuit pressure under 250 mmHg

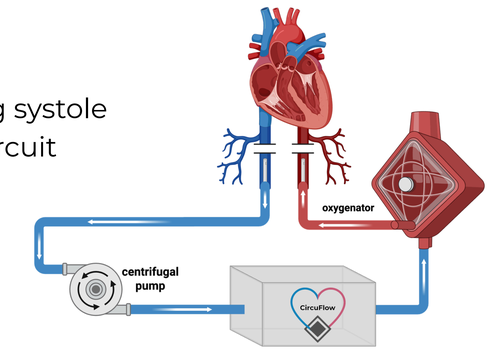
Our Solution

CircuFlow

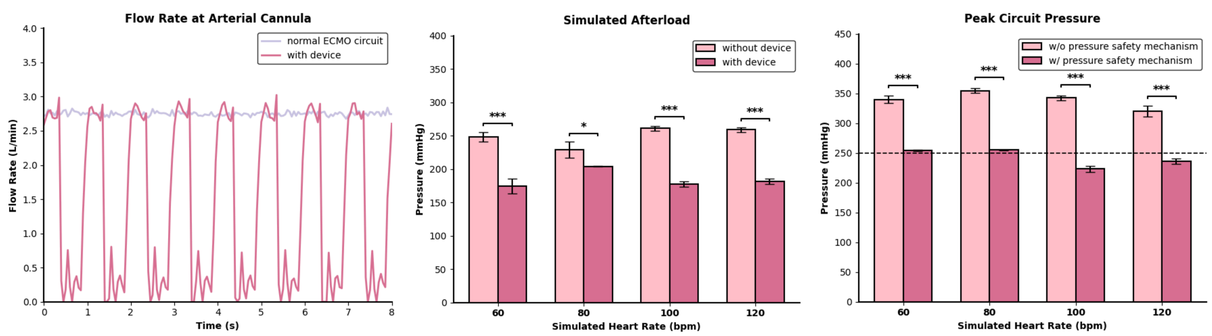
- Spliced into VA-ECMO circuit
- **Multi-component device** to reduce flow during systole
- **Retains safe levels of pressure** in the ECMO circuit

Current Progress

- Provisional patent filed Oct 2025
- Benchtop flow studies completed Dec 2025
- First *in vivo* porcine study completed Apr 2026



Preliminary results in benchtop flow studies demonstrate **(1) reduction of systolic flow rate while maintaining diastolic flow**, and **(2) reduction of pressure at the arterial cannula**, indicating afterload is likely reduced. Our novel safety mechanism also **(3) prevents pressure spikes** above the safety threshold of 250 mmHg during systole.



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