CPB Induced Acute Kidney Injury (AKI), Can Pulsatile Flow Mitigate the Risk?

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Introduction

The VENTRIFLO™ True Pulse Pump (VF-TPP - Design Mentor, Inc., Pelham, NH) is the first blood pump designed to mimic human arterial waveforms. The VF-TPP is intended to be a drop-in replacement for existing blood pumps within current CPB circuits and clinician use would be comparable to existing pumps. The pump offers the user the ability to control pump stroke and beat rate. The VF-TPP is preload and afterload-sensitive and delivers biomimetic stroke volumes, flows and pressure waveforms with full diastole.

Objective

Our aim was twofold: to demonstrate the feasibility and safety of this pump in preparation for future studies to determine possible clinical advantages and to measure the impact of physiologic pulsatile flow on microcirculation as a marker of adequate perfusion to all organs during prolonged CPB.

Methods

An initial animal study looking at microvascular tissue circulation of the groin with computer-assisted video microscopy (CAVM) during a 6-hour CPB procedure in a ~42 kg healthy pig model. One procedure was conducted with VF-TPP and a second with the commercially available ROTOFLOW blood pump.

Results

Results indicated improved capillary perfusion with the VF-TPP vs. ROTAFLOW after 6 hours on CPB. Specifically, capillary flow with the VF-TPP was considered to be equivalent to baseline and consistent with normal flow, yet flow was considered to be diminished in the ROTAFLOW piglet.

Conclusion

One of the oldest debates in cardiac surgery has been whether pulsatile flow has any clinical benefit over non-pulsatile flow. The development of improved pulsatile pumps that have the ability to generate physiologic pulsatility may improve multi-organ perfusion and decrease morbidity such as Acute Kidney Injury (AKI). Further research is needed to establish the benefits of physiologic pulsatile flow.

References


Pump Flow and Arterial Pressure Comparison Porcine Cardiopulmonary Bypass Model