In-vivo Efficacy Comparison Between Para-aortic and Intra-aortic Balloon Pump

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Abstract

This work aims to compare the counter-pulsion efficacy of a 40-ml stroke volume conduit-mediated para-aortic blood pump (PABP) to a 40-ml intra-aortic balloon pump (IABP) in an acute porcine model. Both pumps were placed in the descending thoracic aorta and driven by the same Datapulse 96 console. Hemodynamic measurements show that PABP unloads more effectively the end-diastolic aortic pressure (EDAP) (EDAP reduction: 28.7mmHg PABP vs. 15.17mmHg IABP). Moreover, PABP support also leads to better endocardial viability ratio (EVR) improvement (78.0% PABP vs. 21.9% IABP), indicating a better ability in relaxing the myocardium and restoring the degraded oxygen supply/demand ratio. Wave intensity analysis was used to evaluate the energy carried by propagating wavelets to the upstream aortic root and the downstream systemic circulation, respectively. It was found that PABP may generate stronger waves in both propagation directions, implying a better perfusion penetration ability of the assisted circulation to the microcirculation level. Stroke work derived from the pressure-volume loops shows that PABP can unload the ventricle more effectively. The augmentations of diastolic pressure and coronary blood flow both excel in the PABP group also. Both devices provide no significant cardiac output (CO) enhancement, as was observed previously in counter-pulsion devices. It is concluded that conduit-mediated PABP can provide superior counter-pulsion effectiveness than does IABP.

In-vivo Experiment Evaluation

- Experimental animal: 5m/o, 60kg wt TRl Black No.1 Pig
- Hemodynamic monitor: EKG, arterial pressure, CVP, PAP, LVP, CCO and SvO2
- Flow rate recording (Transonic System, Inc.): ascending Ao, PA, LAD coronary artery, descending Ao (proximal and distal to conduit)

Pressure-Volume Loops

Wave-Intensity Analysis

Wave Intensity = dldPdU (W/m²)

Counter-pulsion Index Comparison