LV Unloading using an Impella CP Reduces Wall Stress and Improves Coronary Flow and Perfusion in Infarcted Myocardium

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Background
LV unloading may improve coronary perfusion by increasing cardiac output and reducing LV wall stress. Whether sustained LV unloading improves myocardial perfusion in a post-MI setting remains uncertain.

Hypothesis
Unloading a post-MI LV with an Impella CP increases coronary flow and myocardial perfusion by reducing LV wall stress and increasing cardiac output.

Methods
To mimic patients who need LV support, large anterior transmural MI was induced by occluding the proximal LAD for 90 minutes in Yorkshire pigs (n=5, 40-50 Kg) followed by a thrombus injection through the balloon lumen to induce total occlusion of the LAD. Two weeks after the MI, animals underwent LV unloading with an Impella CP for 120 minutes. Epicardial coronary flow was assessed by coronary flow wire before, 5 minutes and 120 minutes after LV unloading. Myocardial perfusion was assessed using fluorescent microspheres before and 120 minutes after LV unloading.

Model
Proximal left anterior descending artery was percutaneously occluded for 90 min followed by thrombus injection through the balloon lumen.

Protocol
Two weeks post-MI

LV unloading using Impella CP reduces LV wall stress
Two hours after Impella support (P8), both end-diastolic pressure (EDP) and end-diastolic volume (EDV) decreased in all pigs, resulting in significant reduction of end-diastolic wall stress.

Impaired cardiac function 2 weeks after MI induction

Increased coronary flow assessed by flowire
Coronary flow was measured using flowire before Impella, 5 min. & 2 hrs after Impella initiation.

Increased myocardial perfusion in the infarct & its relation to end-diastolic wall stress

Summary
- Impella support increased coronary flow in both infarcted and non-infarcted artery.
- Myocardial perfusion was improved in only the infarcted area.
- There was a linear relationship between myocardial perfusion in the infarct and the end-diastolic wall stress.

Conclusion
Sustained LV unloading using an Impella CP increases coronary flow and perfusion of the infarcted myocardium for at least 2 hours.