

LV Unloading using Impella Reduces LA Pressure and Volume Overload in Chronic Mitral Regurgitation

Shin Watanabe, MD, Kenneth Fish, PhD, Lauren Leonardson, LVT, Roger J. Hajjar, MD, Kiyotake Ishikawa, MD, Icahn School of Medicine at Mount Sinai

BACKGROUND

Mitral regurgitation is a common presentation in patients with decompensated chronic heart failure. Whether an LV-to-aorta pLVAD is effective in relieving LA overload in this setting remains unclear.

HYPOTHESIS

LV unloading using an Impella CP reduces LA pressure and volume by actively pumping the blood towards forward direction.

METHODS

Chronic heart failure with mitral regurgitation was induced in Yorkshire pigs (n=3, 20 Kg) by percutaneously severing chordae tendinae of the mitral apparatus with a biopsy catheter. Three months later (body weight 43.5 ± 5.0 Kg), the animals underwent LV unloading with an Impella CP with a maximal flow support (p8). Hemodynamics before and during the LV unloading were assessed by Swan-Ganz catheter and pressure volume loop catheter (Millar catheter) in both LA and LV. Additionally, LA volumes were assessed by 3-dimensional echocardiography before and during the Impella support.

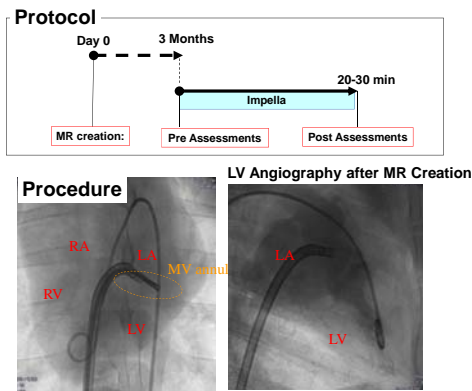
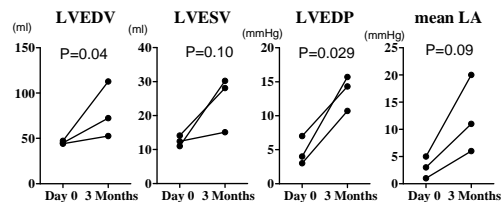


Figure 1. 3 months after MR creation



RESULTS

At 3 months, animals presented with moderate mitral regurgitation (regurgitant fraction $38 \pm 10\%$) with dilated LV (LV end-diastolic volume: 45.5 ± 1.7 mL to 89.7 ± 18.0 , $P=0.04$, LV end-systolic volume: 12.5 ± 1.6 mL to 31.2 ± 10.9 , $P=0.10$, Day0 to 3 month, respectively). LV unloading resulted in a significant reduction of LV end-diastolic pressure (13.6 ± 2.6 to 4.0 ± 4.0 mmHg, $P=0.029$). Although the visual assessment of MR degree by color-Doppler echocardiography did not change by LV unloading, mean LA pressure decreased significantly (12.3 ± 7.1 to 9.3 ± 6.1 mmHg, $P=0.035$). LA v-wave, which is accentuated in the mitral regurgitation due to the regurgitant flow, also reduced significantly, indicating a reduction of quantitative MR (17.3 ± 11.2 to 12.3 ± 9.5 mmHg, $P=0.038$). Furthermore, maximum LA volume assessed by three-dimensional echocardiography was significantly decreased (46.6 ± 13.4 to 29.7 ± 15.9 ml, $P=0.043$).

Figure 2. LVEDP significantly decreased by pLVAD

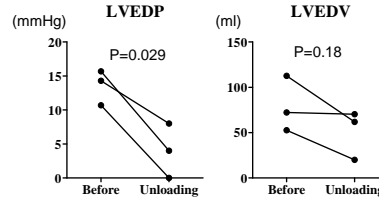


Figure 3. Mean LA pressure (mean LA) and v-wave LA pressure (v LA) significantly decreased by LV unloading

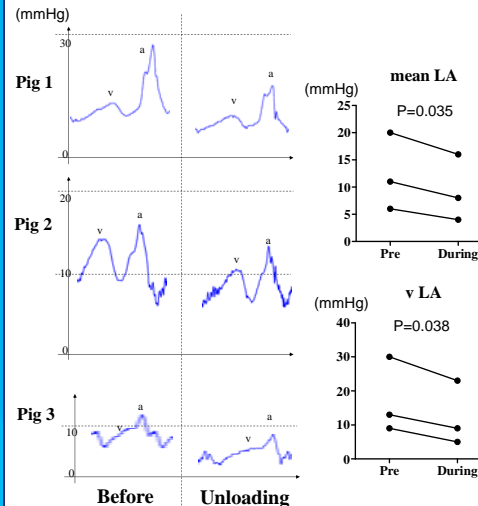


Figure 4. Representative MR image by color-Doppler echocardiography : Visual MR degree did not change significantly.

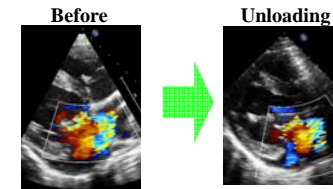
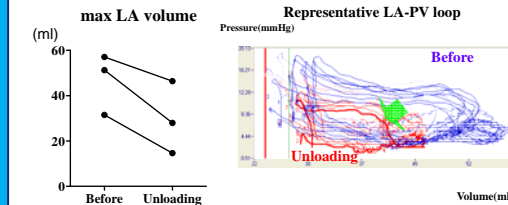


Figure 5. Maximal LA volume significantly decreased by LV unloading



CONCLUSIONS

LV-to-aorta pLVAD unloads not only LV, but also LA in a non-ischemic chronic heart failure model of MR. Although qualitative (visual) MR was not altered by LV unloading, LA pressure was significantly lowered suggesting the importance of quantitative measurements in MR. Reduced LV diastolic pressure likely facilitates trans-mitral flow and reduces LA pressure. Reduction in LV volume may decrease regurgitant flow by reducing mitral annulus area. Further experiments are required to determine if MR amount is indeed reduced by LV unloading.

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