

Left Ventricular Unloading with Pulsatile Mechanical Circulatory Support in Ischemic Cardiomyopathy

B. Bastos M.¹, JJ. Schreuder¹, J. Daemen¹, CA. Den Uil^{1,2}, NM. Van Mieghem¹

(1) Erasmus University Medical Center, Interventional Cardiology, Rotterdam, Netherlands (2) Erasmus University Medical Center, Department of Intensive Care Medicine, Rotterdam, Netherlands

Case Summary: Changing dynamics of the Left Ventricle in a patient with ischemic cardiomyopathy and complex coronary disease undergoing mechanically assisted high-risk Percutaneous Coronary Intervention (PCI) using PulseCath iVAC2L.

History: An 81-year-old male patient with a history of COPD, hypertension, myocardial infarction and CABG in 1986, was admitted with NSTEMI.

Tests: There was significant left main stem (LM) disease extending into the left anterior descending artery (LAD) and occluded grafts. The echocardiogram showed mild to moderate left ventricular dysfunction, no valvulopathies, and 41% ejection fraction. There was heart team consensus for mechanical circulatory support assisted high-risk PCI based on the absence of a suitable landing zone for the left internal mammary artery graft.



Figure 1: (Left) Angiographic projection showing diffusely diseased LM, LAD, LCX and 1st Diagonal. There is severe stenosis in the Left Main (LM) and Left Anterior Descending (LAD). (Right) Final result showing patent vessels.

Procedure: A PulseCath iVAC2L (PulseCath B.V., Amsterdam, The Netherlands) was inserted. Stents were deployed from the LM to the distal LAD and in the bifurcation with the Diagonal branch. Real-time pressure-volume (PV) loops were recorded with a conductance catheter and dedicated software (INCA, CDLeycom, Hengelo, The Netherlands) throughout the PCI. The flow was 1.42L/min at 1:1 assist ratio and 0.81L/min during 1:3 assist ratio. With 1:3 support unassisted beats vs. assisted beats had lower end-systolic volume (ESV: 87.71±1.70 vs 90.77±1.88mL), wall stress (WSes: 113.26±3.72 vs 123.13±2.52mmHg), and effective arterial elastance (Ea: 1.24±0.05 vs 1.41±0.05mmHg/mL). Stroke work (SW: 8913.00±310.33 vs 8263.31±270.14mmHg.mL) and stroke volume (SV: 91.11±1.83 vs 87.04±2.49mL) were higher, but end-diastolic volume (EDV: 189.80±2.42 vs 189.31±2.07mL) and compliance (V30: 209.86±10.13 vs 215.07±15.11mL) were constant. In assisted beats systolic blood pressure decreased (SBP: 123.38±3.14 vs 131.18±2.37mmHg) and work efficiency ratio increased (SW/PVA: 0.63±0.03 vs 0.58±0.02) but mean arterial pressure (MAP: 77.17±2.14 vs 77.14±2.45, contractility (End-systolic elastance, Ees: 1.10±0.08 vs 1.4±0.07mmHg/mL) and the pressure-volume area (PVA: 14130.40±895.94 vs 14204.99±520.45mmHg.mL) were unchanged.

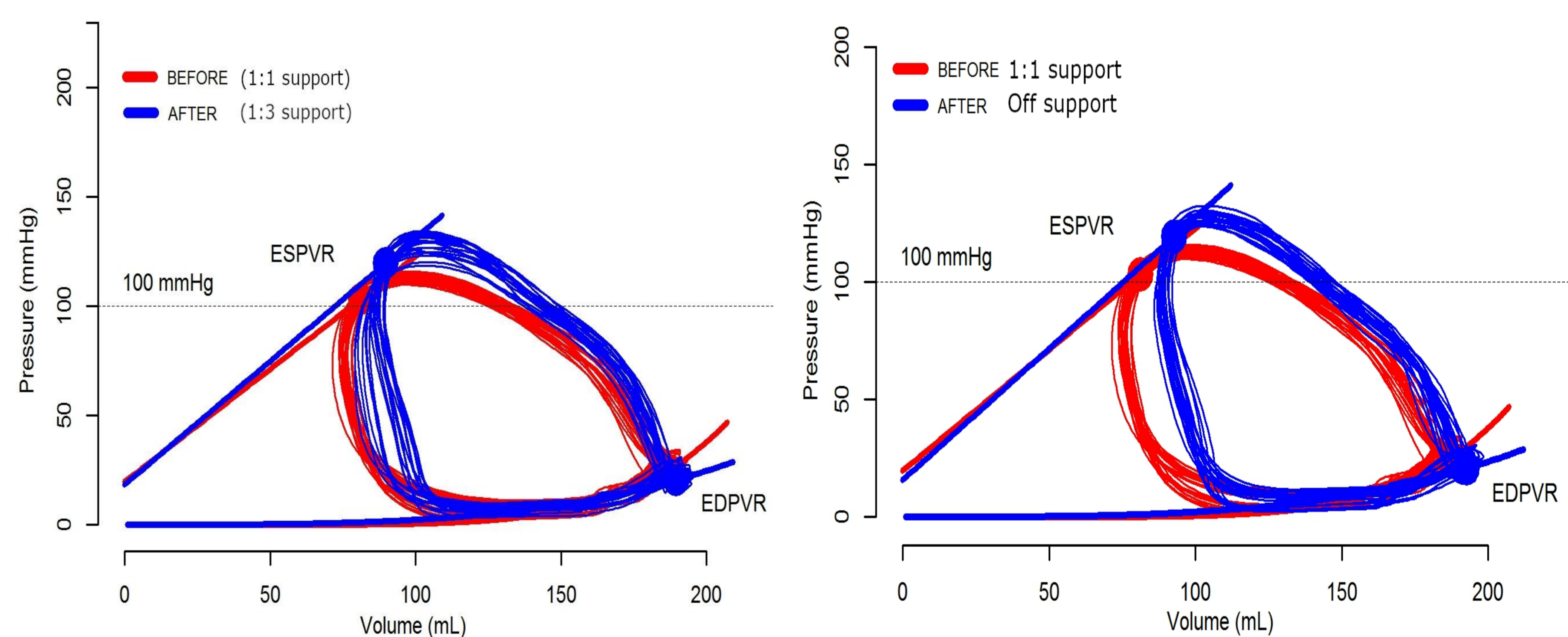


Figure 3: Pressure volume analysis post PCI. (left) Pressure-volume loops during 1:1 support (red) compared to 1:3 support moments later (blue). 1:1 support results in left shifting of the loop and indicates LV unloading. (Right) The effect is magnified when 1:1 support is compared to no support. Note the stable ESPVR and EDPVR, indicating that the observed changes are exclusively due to LV unloading.

Alternating Morphologies during 1:3 Support

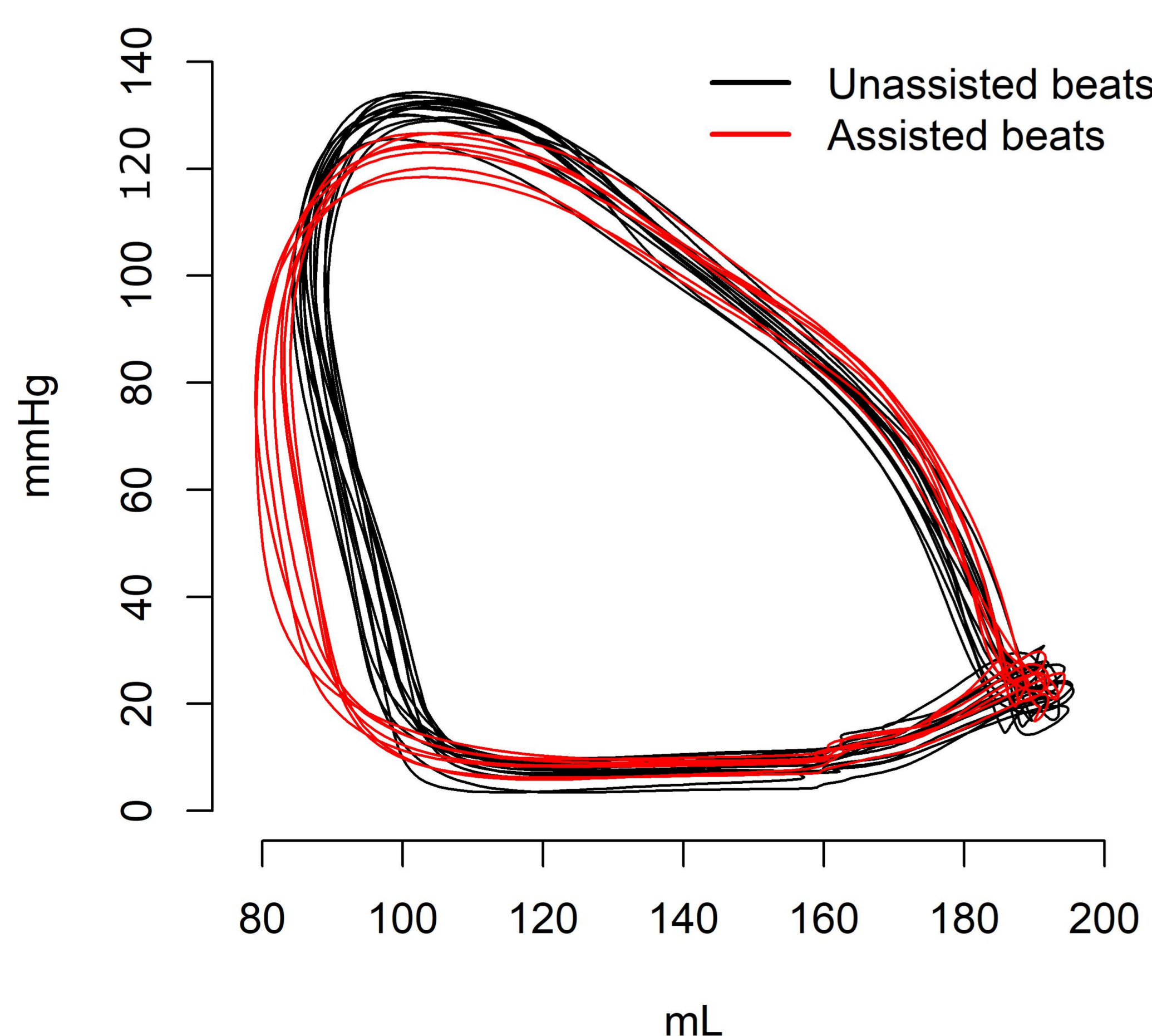


Figure 2: Beat-to-beat analysis of pressure-volume loops obtained during 1:3 support. For every three consecutive beats, iVAC2L removes blood from the LV in the first beat and remains inactive in the following two. Assisted loops (red) show a reduction in ESP and ESV that results from the aspiration of LV blood during systole. In diastole, iVAC2L ejects blood in the aorta and the LV fills back to levels that are similar to non-assisted beats.

Conclusion: iVAC2L unloads the LV. Assisted beats immediately optimize myocardial work efficiency. These findings will be verified in the ongoing PULSE trial (Clinicaltrials.gov NCT03200990).

Disclosure: B. Bastos M. works for PulseCath B.V. and is Affiliated Researcher at the Erasmus MC. JJ. Schreuder works for CD Leycom and is Affiliated Researcher at the Erasmus MC. NM. Van Mieghem is Clinical Advisor for PulseCath B.V. The other authors have nothing to disclose