Left Ventricle Unloading during High-risk Percutaneous Coronary Intervention with Pulsatile Left Ventricular Mechanical Support

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PULSE *trial*

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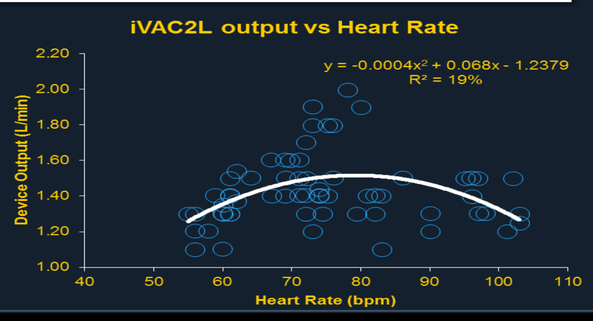
Purpose

Mechanical Circulatory Support (MCS) may complement high-risk Percutaneous Coronary Interventions (PCI) by unloading the Left Ventricle (LV) and improving myocardial perfusion. The iVAC2L® (PulseCath BV, Amsterdam, the Netherlands) is a 17F bi-directional catheter with an inlet tip, an integrated two-way valve and a connector to a membrane pump. It provides pulsatile support up to 2L/min, depending on heart rate and loading conditions.

The iVAC2L pVAD

- Bi-directional flow
- Totally percutaneous
- LV-to-aorta support
- 21mL added to innate SV
- Counterpulsation
- Driven by an IABP console



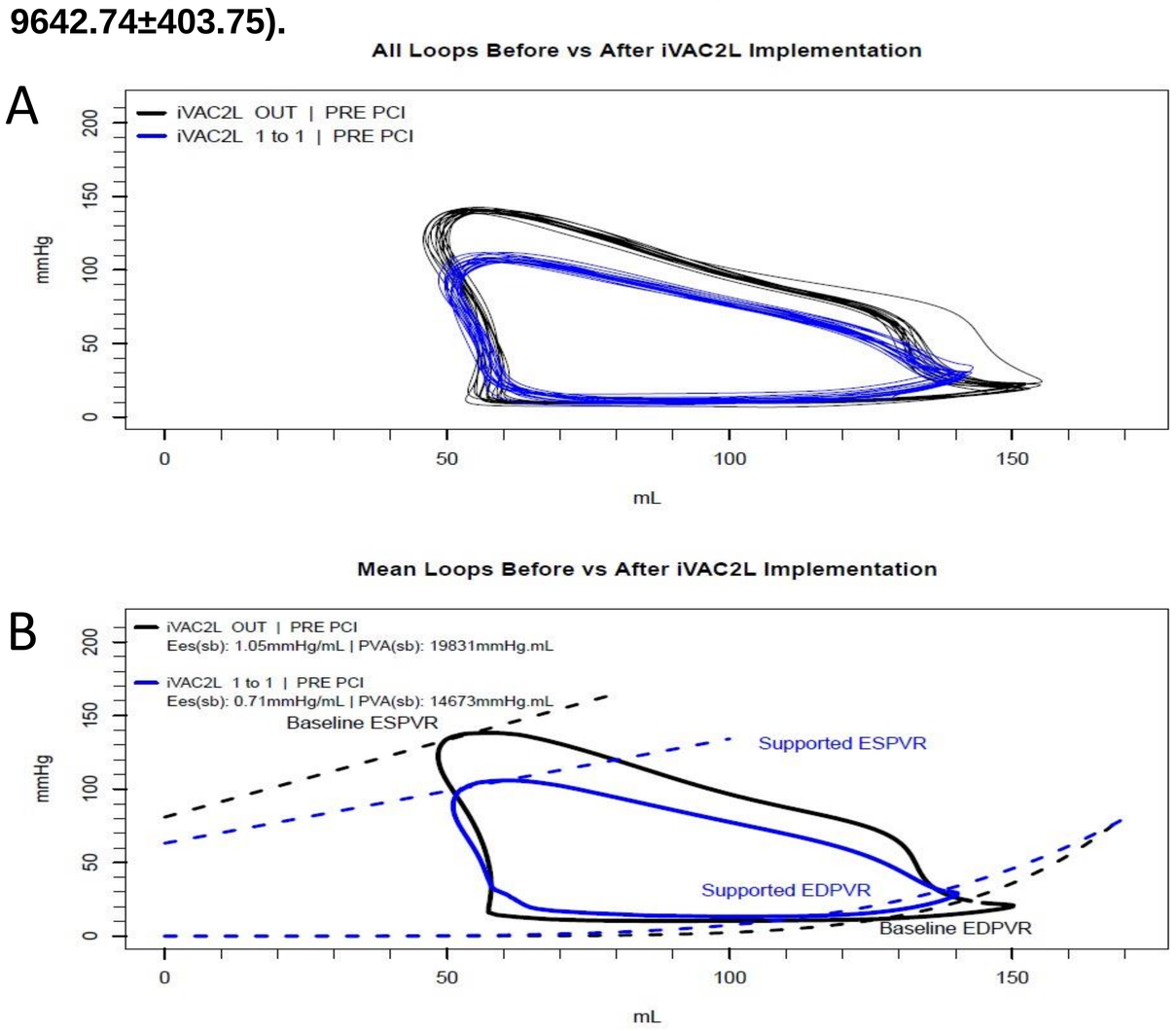
Den Uil CA, EuroIntervention 2017;12:1689-1696

Methods

An 89 years old patient with heart failure, previous stroke, hypertension, dyslipidaemia, atrial fibrillation and chronic kidney disease, presented with acute coronary syndrome and congestive heart failure. The echocardiogram showed poor LV function and moderate degenerative valve disease. The coronary angiography revealed a subtotal thrombotic lesion of the mid-RCA, diffuse disease at the RDP and PL branches, a significant distal lesion of the LM, and significant lesions of the LAD and RCX. The patient was considered inoperable based on advanced age and frailty. STS risk was estimated in 69%. The culprit lesion in the RCA was treated ad hoc, and in a staged procedure, the left coronary system was treated under MCS. PV loops before and after activating iVAC2L were recorded using a 7F conductance catheter and dedicated software (ConductNT, CDLeycom®, Hengelo, The Netherlands).

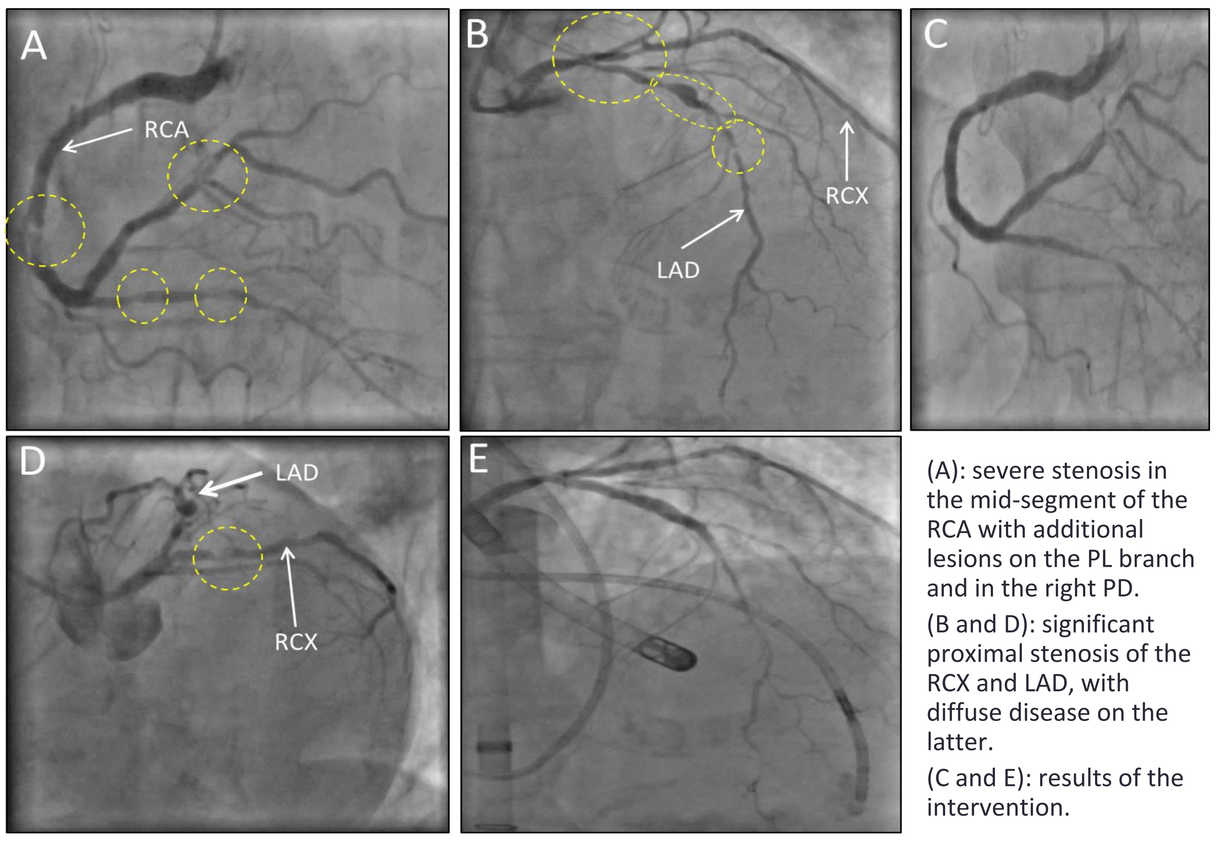
Results

MCS reduced the slope of the End-systolic Pressure-volume Relationship, or ESPVR (Ees: 1.86±0.18 vs 1.21±0.07), systolic dyssynchrony (3.92±1.49 vs 0.79±0.87), afterload (Ea: 1.60±0.06 vs 1.37±0.04) and the Pressure-Volume Area (PVA: 12443.30±536.20 vs 9642.74±403.75).



(A): In black, baseline pre-implantational PV loop set with iVAC2L out. In blue, post-activation PV loop set, with iVAC2L synchronically supporting the LV at 1:1 support ratio. All loops were obtained before the PCI ("PRE PCI"). **(B)**: Tracings composed by the mean of pressure-volume points obtained from multiple loops, and matched by time in the cardiac cycle. The tracings demonstrate iVAC2L out (black) and iVAC2L on at 1:1 ratio (blue). A complementary analysis of the averaged tracings was performed, also indicating reductions in the slope of the ESPVR and in the estimated PVA.

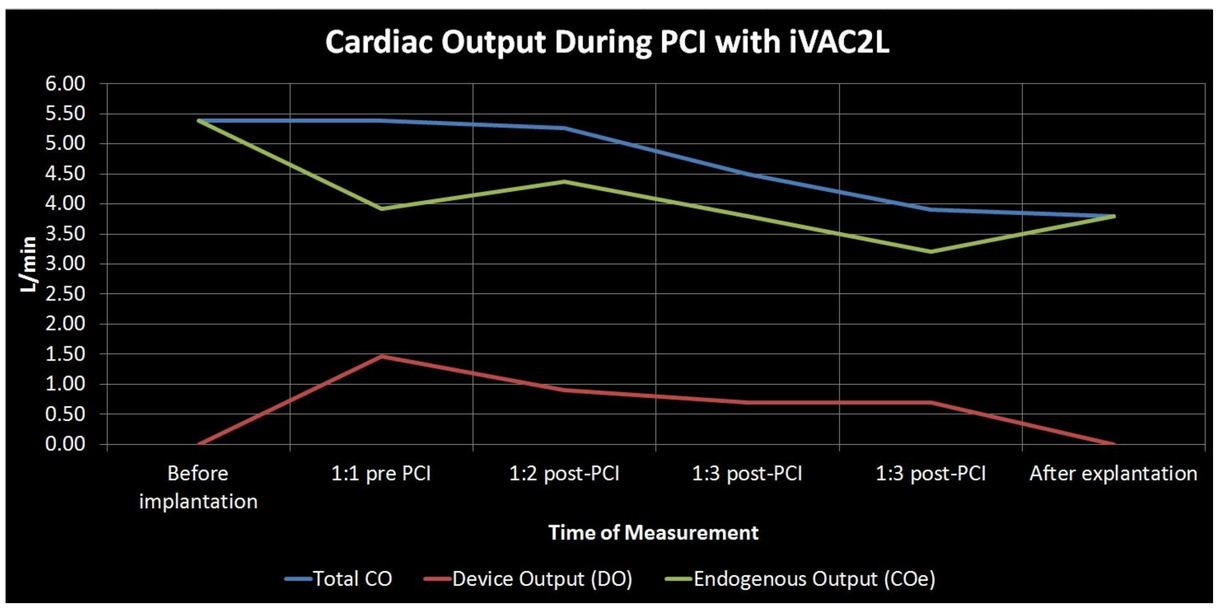
Results



(A): severe stenosis in the mid-segment of the RCA with additional lesions on the PL branch and in the right PD.

(B and D): significant proximal stenosis of the RCX and LAD, with diffuse disease on the latter.

(C and E): results of the intervention.



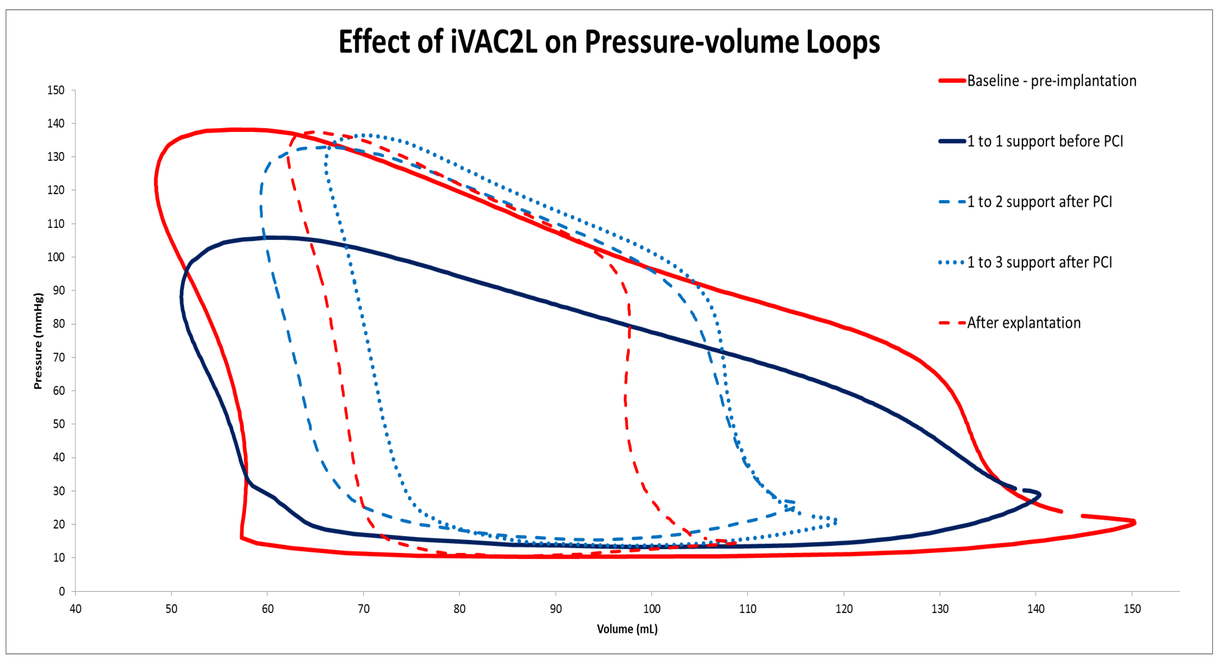


Table 1. quantitative analysis of beat-to-beat haemodynamics before PCI.

	LVAD out	LVAD on
HR	70.38±0.302	74.46±0.74
EDP	22.71±1.34	30.36±2.67
EDV	132.61±3.55	126.81±1.44
ESP	133.13±2.00	101.53±2.30
ESV	49.33±1.45	52.53±1.46
$+dP/dt_{max}$	738.34±8.87	451.39±15.67
$E_{es(SB)}$	1.86±0.18	1.21±0.07
$V_{0(SB)}$	-22.64±4.30	-31.56±5.61
E_a	1.60±0.06	1.37±0.04
E_a/E_{es} ratio	0.87±0.06	1.13±0.08
PVA	12443.30±536.20	9642.74±403.75
WS_{es}	134.61±2.02	102.73±2.31
WS_{ed}	23.39±1.38	31.23±2.75
V_{30}	142.76±4.75	123.01±3.90
Tau	42.10±2.10	42.70±2.9
$-dP/dt_{max}$	-940.91±7.63	-700.80±22.02
Dys. (systolic)	3.92±1.49	0.79±0.87
Dys (diastolic)	25.97±4.10	34.02±2.61

Conclusion

Our case illustrates pressure and volume unloading, with simultaneous reduction of mechanical dyssynchrony, myocardial oxygen consumption and afterload. Consistency of these findings will be further assessed in the upcoming PULSE trial (Clinicaltrials.gov NCT03200990).