

The relationships between non-invasive myocardial work indices, myocardial blood flow and viability determined by PET

H. Ballo¹, W. Nammas¹, C. Paunonen¹, J. Teuho², R. Siekkinen², A. Roivainen², J. Knuuti², A. Saraste¹

¹Turku University Hospital, Heart Centre, Turku, Finland

²Turku PET Centre, Turku, Finland

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Backgrounds: Myocardial work (MW) indices are new echocardiography parameters of left ventricular (LV) performance that consider afterload and global longitudinal strain analysis. However, the relationships between MW indices, myocardial perfusion and viability remain unclear after acute myocardial infarction (AMI).

Aims: To evaluate relationships between echocardiographic MW indices, myocardial blood flow and viability based on positron emission tomography (PET) in patients with AMI.

Methods: Thirty prospectively recruited patients (64±9 years, 90% males) underwent PET scans 7.7±3.8 days after primary percutaneous coronary intervention (PCI) for ST-elevation AMI. Global and segmental absolute myocardial blood flow (MBF) and perfusable tissue fraction (PTF) at rest were assessed using 15O-water PET. Myocardial segments were graded as viable or non-viable using the previously defined PTF cut-off value of 0.69 per segment (reference). LV function was evaluated by transthoracic echocardiography on the day of the PET scan (baseline) and at 6 months follow-up. MW index (MWI), constructive MW (CMW), MW efficiency (MWE), and myocardial wasted work (MWW) were measured. The myocardial area at risk (AAR) is based on the culprit coronary arterial segment, determined from the invasive coronary angiography. Two segments remote from the AAR were considered as the remote area.

Results: At baseline, resting global MBF was 0.84±0.19 ml/g/min, global MWI 1327±334.9 mm Hg %, global MWE 87% [IQR 83-92], global CMW 1649.8±415.9 mm Hg %, and global MWW 210.9±133.7 mm Hg %. There was a positive correlation between global MBF and CMW ($r=0.42$, $p=0.02$), whereas MWI, MWE, and MWW were not correlated with MBF. However, none of the MW indices correlated with MBF corrected for rate pressure product.

In the AAR, MWI and MWE correlated with regional MBF ($r=0.53$, $p=0.003$, and $r=0.59$, $p<0.001$) and PTF ($r=0.41$, $p=0.03$, and $r=0.65$, $p<0.001$, Figure 1).

The average ejection fraction was similar at baseline and after 6 months (55.8±66.9 vs. 57.5±67.3 %, $p=0.2$). Of the 156 segments in the AAR, 114 were viable and 42 were non-viable based on based on PTF. There was no difference in MW indices between viable and non-viable segments in the AAR at baseline. However, viable segments in the AAR showed improved MWI, MWE, CMW, and MWW at 6 months compared to baseline ($P<0.001$, $P=0.02$, $P<0.001$, and $P<0.001$, respectively), whereas there was no change in non-viable segments (Table 1). Moreover, MWI in the remote area increased at 6-month follow-up ($p<0.001$).

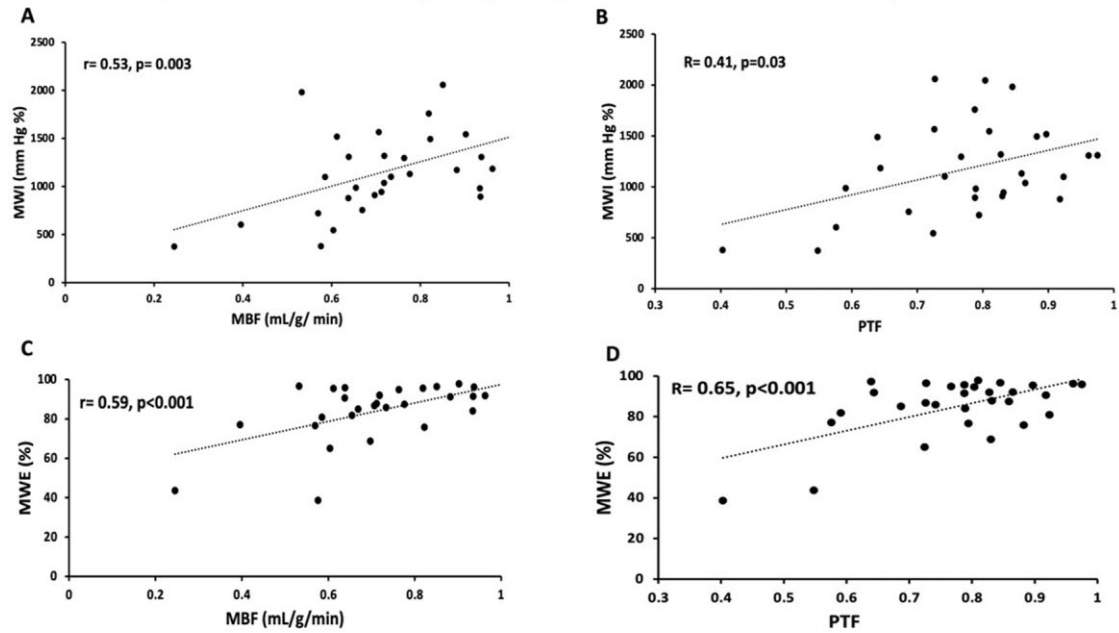
Conclusions: Although echocardiographic MWE was not associated with global MBF, it correlated with residual myocardial blood flow and PTF in the AAR after reperfused AMI. Furthermore, echocardiographic MW indices improved in viable segments of the AAR at the 6-month follow-up. Our results provide evidence that myocardial viability is an important determinant of MWE measured by echocardiography.

Table 1: Changes in myocardial work indices between baseline and 6-month follow-up

Variables	Remote (60 segments)			viable (PTF ≥ 0.69) (114 segments)			Non-viable (PTF < 0.69) (42 segments)		
	Baseline	6-month follow-up	P value	Baseline	6-month follow-up	P value	Baseline	6-month follow-up	P value
Regional MWI (mm Hg %)	1477.5±548.8	1800.2±546.4	<0.001	1175.7±494.1*	1667.9±630.6 [§]	<0.001	1128.2±825.7*	1236.6±746.5*	0.3
Regional MWE (%)	95 (86 - 98)	95 (91-99)	0.4	93 (81-97)	95(89-98)	0.02	88 (83-96) *	91 (77-98) *	0.1
Regional CMW (mm Hg %)	2011±637.7	2207.0±539.1	0.07	1306.5±523.5*	1830.4±684.5* [§]	<0.001	1433.7±870.5*	1491.6±798.9*	0.8
Regional MWW (mm Hg %)	192.1±219.8	170.7±267.6	0.6	249.5±328	143±158.9	<0.001	223.3±294.6	214.7±210.6	0.6

MWI, myocardial work index; MWE, myocardial work efficiency; CMW, constructive myocardial work; MWW, myocardial waste work. * $P<0.05$ versus remote, and [§] $P<0.05$ versus non-viable

Figure 1: Correlations between myocardial work index (MWI), myocardial work efficiency (MWE), myocardial blood flow (MBF) and perfusable tissue fraction (PTF) in the area at risk.



MWI, myocardial work index; MWE, myocardial work efficiency; MBF, myocardial blood flow; PTF, Perfusable tissue fraction