Cardiovascular magnetic resonance derived pressure volume loop variables in patients with ST-elevation myocardial infarction provide physiological information beyond ejection fraction

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Background

A novel non-invasive method for generation of pressure volume loops (PV-loops) using brachial blood pressure and cardiovascular magnetic resonance (CMR) imaging has recently been presented and validated (1). The aim of the present study was to investigate if PV-loop variables such as stroke work, contractility and ventriculoarterial coupling could provide incremental diagnostic information beyond conventional measurements such as cardiac dimensions and ejection fraction in patients with acute myocardial infarction (MI).

Method

100 patients with ST-elevation MI and 75 healthy volunteers were included in the study and underwent a CMR examination. All patients were examined 2-6 days after MI. Non-invasive PV-loops were generated by combining volumetric CMR data and brachial sphygmomanometric pressure measurements by using a recently validated method (1). Maximal elastance (E_{max}, translated to contractility), stroke work and ventriculoarterial coupling (E_a/E_{max}) were measured from the PV-loops. Examples of the delineations and PV-loops are shown in Figure 1. Infarct size and myocardium at risk were assessed using late gadolinium enhancement and contrast-enhanced steady state free precession images, respectively.

Results

All PV-loop variables differed significantly in patients with acute myocardial infarction compared to healthy volunteers (Table 1). Furthermore, contractility, stroke work and ventriculoarterial coupling correlated to infarct size (E_{max}: r^2=0.29, E_a/E_{max}: r^2=0.41, stroke work: r^2=0.25) and myocardium at risk (E_{max}: r^2=0.25, E_a/E_{max}: r^2=0.36, stroke work: r^2=0.21) as shown in Figure 2.

Conclusion

Non-invasive cardiovascular magnetic resonance derived PV-loop variables such as contractility, stroke work and ventriculoarterial coupling provide incremental diagnostic information beyond cardiac dimensions and ejection fraction early after acute myocardial infarction.

References

(1) Seemann F., Arvidsson P., Nordlund D., et al. Noninvasive Quantification of Pressure-Volume Loops From Brachial Pressure and Cardiovascular Magnetic Resonance. Circ Cardiovasc Imaging 2019;12(1). Doi: 10.1161/CIRCIMAGING.118.008493.

Figure 1. Example of PV-loops in patients with myocardial infarction.

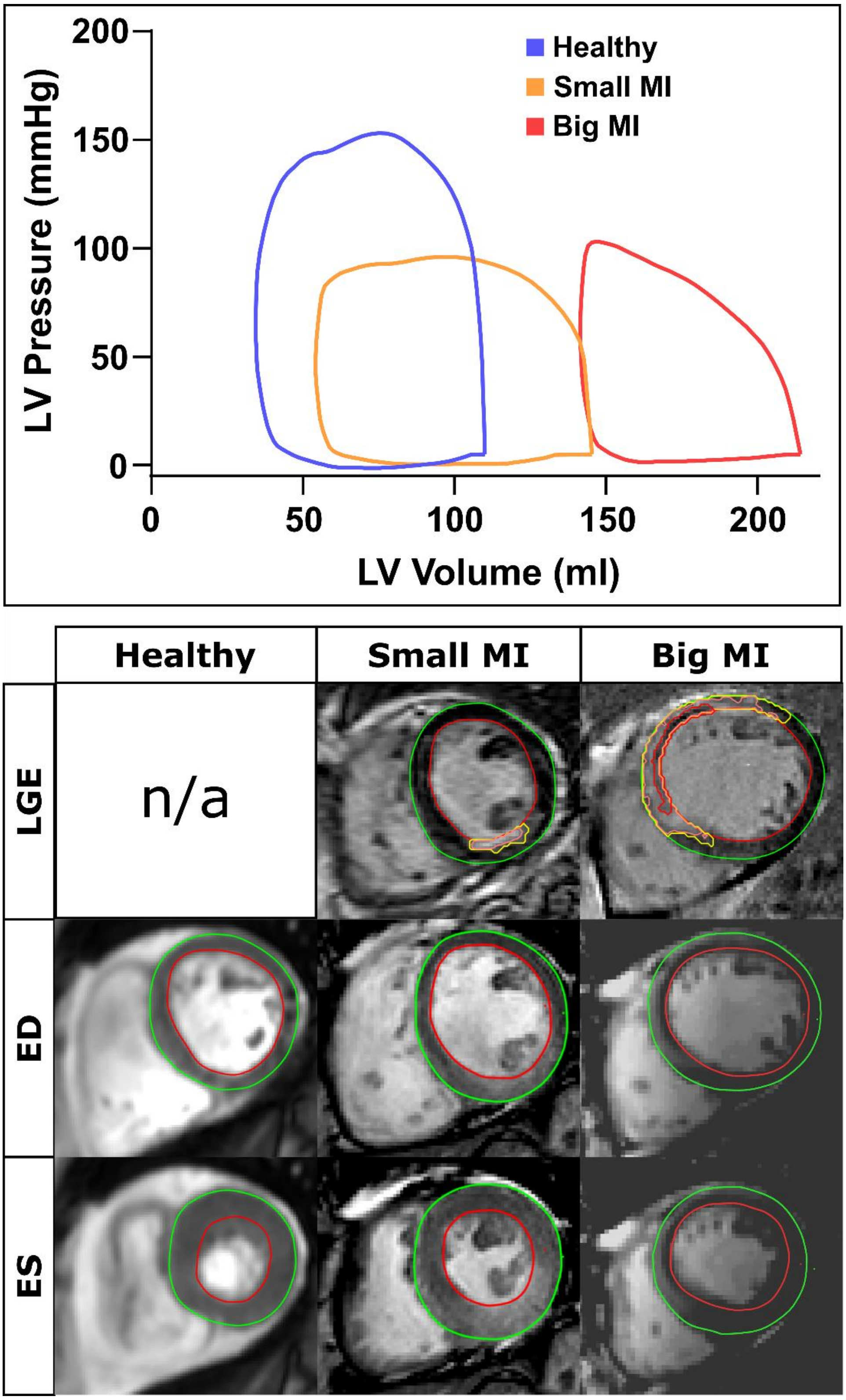

Table 1. PV-loop variables in patients with myocardial infarction and healthy volunteers.

Variables	**Myocardial infarction**	**Healthy volunteers**	**p-value**
Contractility, mmHg/ml	1.34±0.48	1.50±0.41	0.024
Ventricular arterial coupling	1.27±0.61	0.73±0.17	<0.001
Stroke work, J	0.96±0.32	1.38±0.32	<0.001
EDV, ml	166.5±34.0	174.3±32.9	0.131
EF, %	48.6±10.0	61.0±5.9	<0.001

Figure 2. Stroke work, contractility and ventriculoarterial coupling versus myocardium at risk (left column) and infarct size (right column).