

Speckle Tracking Echocardiography Accurately Detects Acute Myocardial Infarction and Reperfusion

Noa Bachner-Hinenzon¹, Assaf Malka^{2,3,4}, David Meerkin⁵, Yaron Barac^{2,3,6}, Offir Ertracht⁷, Rona Shofti³, Marina Leitman^{8,9}, Zvi Vered^{8,9}, Dan Adam¹, Ofer Binah^{2,3,4}

¹*Faculty of Biomedical Engineering, Technion, Israel*

²*Department of Physiology, Technion, Israel*

³*Ruth and Bruce Rappaport Faculty of Medicine, Technion, Israel*

⁴*Rappaport Family Institute for Research in the Medical Sciences, Technion, Israel*

⁵*Structural and Congenital Heart Disease Unit, Department of Cardiology, Shaare Zedek, Israel*

⁶*Department of Cardiothoracic Surgery, Carmel Medical Center, Israel*

⁷*Eliachar Research Laboratory, Western Galilee Hospital, Israel*

⁸*Department of Cardiology, Assaf Harofeh Medical Center, Israel*

⁹*Sackler School of Medicine, Tel Aviv University, Israel*

Objective:

We aim to detect damage of left anterior descending artery (LAD) occlusion and reperfusion on myocardial strain by speckle tracking echocardiography in a pig model compared with histological analysis.

Method and Results:

Ten pigs underwent percutaneous LAD occlusion for 90 minutes followed by reperfusion up to 60 days. Echocardiography was performed at baseline, at 90 minutes of occlusion, and after 2 hours, 30 and 60 days of reperfusion. Short axis scans were post-processed by a speckle tracking echocardiography program to measure circumferential (SC) and radial (SR) strains. Additionally, segmental wall motion scoring was given. Subsequently, the pigs were sacrificed, and histological analysis for infarct transmural was performed. Transmural was scored as follows: 0=viable, 1=scar<25%, 2=75%>scar>25%, 3>75%.

The SC was reduced from $-19.2\pm 2.3\%$ at baseline to $-13.1\pm 4.5\%$ at 90 min of occlusion ($P<0.001$), and recovered after reperfusion at the posterior ($-15.8\pm 4.9\%$), inferior ($-20.5\pm 4.5\%$) and septal ($-19.9\pm 5.1\%$) walls ($P<0.05$). The anterior wall did not show full recovery after 60 days of reperfusion (60 days: $-10.6\pm 6.1\%$, baseline: $-19.8\pm 5.6\%$, $P<0.05$). The lateral and antero-septal walls recovered at the papillary muscles level (baseline: lateral: $-14.4\pm 2.0\%$, antero-septal: $-21.3\pm 1.9\%$, 60 days: lateral: $-9.2\pm 1.0\%$, antero-septal: $-20.2\pm 2.3\%$, $P<0.05$), but not at the apical level (baseline: lateral: $-19.0\pm 1.4\%$, antero-septal: $-21.8\pm 2.4\%$, 60 days: lateral: $-9.4\pm 1.8\%$, antero-septal: $-12.9\pm 1.5\%$, $P<0.05$). The SR was reduced only during 90 minutes of occlusion and 2 hours after reperfusion (baseline: $48.6\pm 12.0\%$, 90min: $23.0\pm 6.6\%$, 2hrs: $17.5\pm 8.2\%$, $P<0.05$).

Histological analysis showed that the main injury was at the anterior wall (scored 2 or 3), anterior septum and lateral wall (scored 1 or 2). The septum scored 0 or 1, and the posterior and inferior walls were normal. Wall motion scoring gained 97% specificity and 69% sensitivity.

Conclusion:

SC accurately detects ischemia and reperfusion, while SR can detect ischemia only at the acute stage of myocardial infarction.