Prognostic value of first pass perfusion transit time beyond the pulmonary circulation

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Background: Pulmonary transit time (PTT), defined as the time required for a bolus of contrast agent to pass from the right cavities to the left cavities, is an emerging parameter reflective of cardiopulmonary hemodynamics that can be measured in first-pass perfusion cardiovascular magnetic resonance (CMR). Transit times along the left heart (LHTT) and perfusion times of peripheral organs have not been explored so far.

Purpose: To assess the prognostic value of LHTT and peripheral organs perfusion time in a cohort of patients with left ventricular (LV) dysfunction.

Methods: 50 consecutive patients with LV dysfunction (ejection fraction ≤45%) and 56 normal controls who underwent a CMR at our institution were selected. Transit time was calculated as the peak-to-peak time interval between two different areas of the cardiovascular system. PTT was assessed between right ventricle (RV) and left ventricle. LHTT was assessed between left atrium and ascending aorta. Myocardial perfusion time (MyoPT) was measured between left ventricle and the peak of myocardial perfusion. Peripheral organ perfusion (kidney, KPT; spleen, SPT and liver, LPT) between abdominal aorta and the peak organ perfusion. The primary end point was a composite of cardiovascular death, hospitalization, ventricular arrhythmias and the need of any cardiac invasive intervention within the first year.

Results: Compared with controls, LV dysfunction patients presented higher PTT (7.4 [5.9-8.4] vs 11.9 [9.5-13.9] s, p < 0.001), LHTT (1.9 [1.05-2.3] vs 3.3 [1.9-4.8] s, p < 0.01), MyoPT (9.9 [7.8-11.5] vs 13.1 [9.7-16.6] s, p < 0.01), KPT (9.4 [7.8-11.2] vs 11.5 [8.3-15.5] s, p = 0.012). SPT showed a non-significant trend (9.4 [8.1-11.9] vs 11.5 [7.9-13.4] s, p = 0.058). There were no differences in LPT (28.9 [24.4-35] vs 33.3 [23.3-41.1] s, p = 0.267). Among the patients with LV dysfunction, 16 subjects reached the composite end-point; compared to those who did not, these patients had significant higher values of PTT (10.1 [8.7-13.7] vs 13.4 [10-15.7] s, p = 0.04), LHTT (2.3 [1.8-4] vs 4.3 [3.3-5.8] s, p = 0.008) and MyoPT (10.5 [8.8-17.5] vs 13.3 [11.9-20.5] s, p = 0.049). SPT showed a non-significant trend (10.3 [6.9-12.6] vs 12.6 [10.9-17.1] s, p = 0.078), KPT and LPT showed no significant differences. Patients with worse prognosis also presented lower LV ejection fraction (LV: 34.7 ± 9.5 vs 25.5 ± 9 %, p < 0.001) but no significant differences in RV ejection fraction: 52.9 ± 14 vs 49.3 ± 13.8 %, p = 0.473). Due to the small number of events we did not performed a multivariate analysis. KPT showed a weak but significant positive correlation with the creatinine measured at the time of the CMR study (r = 0.262, p = 0.024) and also at follow-up (r = 0.247, p = 0.042).

Conclusions: Transient time is a surrogate marker of the hemodynamic status that can be assessed beyond the pulmonary circulation. LHTT and organ perfusion times are markedly altered in patients with LV dysfunction and are associated with poor prognosis.