

## Tissue characterization in Takotsubo cardiomyopathy; a valuable approach?

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Over the past years considerable progress has been made in the field of CMR, which provides accurate evaluation of left ventricular function particularly in patients with ischemic heart disease and various manifestations of cardiomyopathy [1–11]. Stress first-pass contrast-enhanced myocardial perfusion CMR can be used to detect subendocardial ischemia and recent studies have demonstrated the high diagnostic accuracy of stress myocardial perfusion CMR for detecting significant coronary artery disease [12–17]. Magnetic resonance angiography (MRA) has been introduced as a method that can provide visualization of all three major coronary arteries, coronary anomalies, coronary bypasses and the aorta within a single three-dimensional acquisition [18–21]. CMR has become the first choice imaging modality in complex congenital heart disease [22–26] and imaging great vessels [27–30].

Contrast-enhanced CMR has been used to visualize the transmural extent of myocardial infarction with high spatial resolution [31–35]. Infarcted myocardium appears hyperenhanced compared with

normal myocardium when imaged by late enhancement CMR. The transmural extent of delayed gadolinium enhancement predicts functional outcome after interventional procedures performed in patients with acute myocardial infarction and chronic ischemic heart disease [36–42]. In this way, tissue characterization of the myocardium has become a major asset of CMR, providing unique information of the structure of the myocardium both in normal and abnormal conditions. In particular, late gadolinium enhancement techniques make use of T1-weighted images for tissue characterization and these techniques are used regularly both in experimental research and clinical cardiology.

For over 25 years it is known that in the acutely infarcted heart the signal intensity in T2-weighted images correlates well with myocardial edema [43–49]. This “edema imaging” on T2-weighted images has been shown to be dependent of infarct age: edema-associated hyper-intense zones in T2-weighted images resolve over time and the area of T2 abnormality delineates the area at risk rather than the infarcted area. An advantage of the clinical use of T2-weighted images is the fact that T2-weighted imaging detects acutely infarcted myocardium better than chronic infarction, the latter being assessed best with late gadolinium enhancement imaging.

In the current issue of the International Journal of Cardiovascular Imaging, Joshi et al. [50] studied 8 patients, all female, with typical chest pain and elevated troponin levels. At coronary angiography all

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Editorial Comment on the article of Joshi et al.  
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patients showed normal coronary arteries but clear signs of left ventricular ballooning consistent with the syndrome of Takotsubo cardiomyopathy. Four patients had apical ballooning and 4 patients had midwall- or basal ballooning. CMR was performed at hospital admission and the images were analyzed with commercially available software (QMASS MR Version 6.2.1, Medis, Leiden, the Netherlands). The authors used a T2-weighted imaging technique and the T2 signal was assessed both in normal and dysfunctional myocardial regions. Interestingly, it was found that T2-signal intensity was highest in the dysfunctional segments, potentially indicating the presence of myocardial edema in the affected areas of patients with Takotsubo cardiomyopathy. Interestingly, in the 5 patients who had a 2–3 week follow-up CMR scan, there was normalization of the wall motion abnormalities associated with a significant reduction in T2 signal intensity.

Takotsubo cardiomyopathy has recently been recognized in patients with typical signs of acute myocardial infarction mostly due to emotional stress. In these patients the coronary arteries appear normal but they show reversible wall motion abnormalities [51–54]. As a result, it might be of great interest to know the pathophysiological condition of the affected myocardial tissue in the acute phase. Therefore, several indications exist to use CMR-employed T2-weighted images in the setting of the acute myocardial infarction in these patients [55–57]. Whereas decreased T2-weighted contrast ratios significantly correlate with the extent of persistent microvascular obstruction and intra-myocardial hemorrhage, this way of tissue characterization may contribute to early detection of myocardial injury due to myocardial infarction. In addition, CMR derived parameters may be of great significance in the follow-up of these patients as they may show spontaneous recovery of the cardiac abnormalities. As a result, the article by Yoshi et al. [50] clearly shows that the T2-weighted imaging technique may be a valuable approach in patients who are suspected for Takotsubo cardiomyopathy, both in the acute and subacute phase.

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