

# Combined FDG-PET/MR in the Diagnostic Work-up of Myocardial Disease

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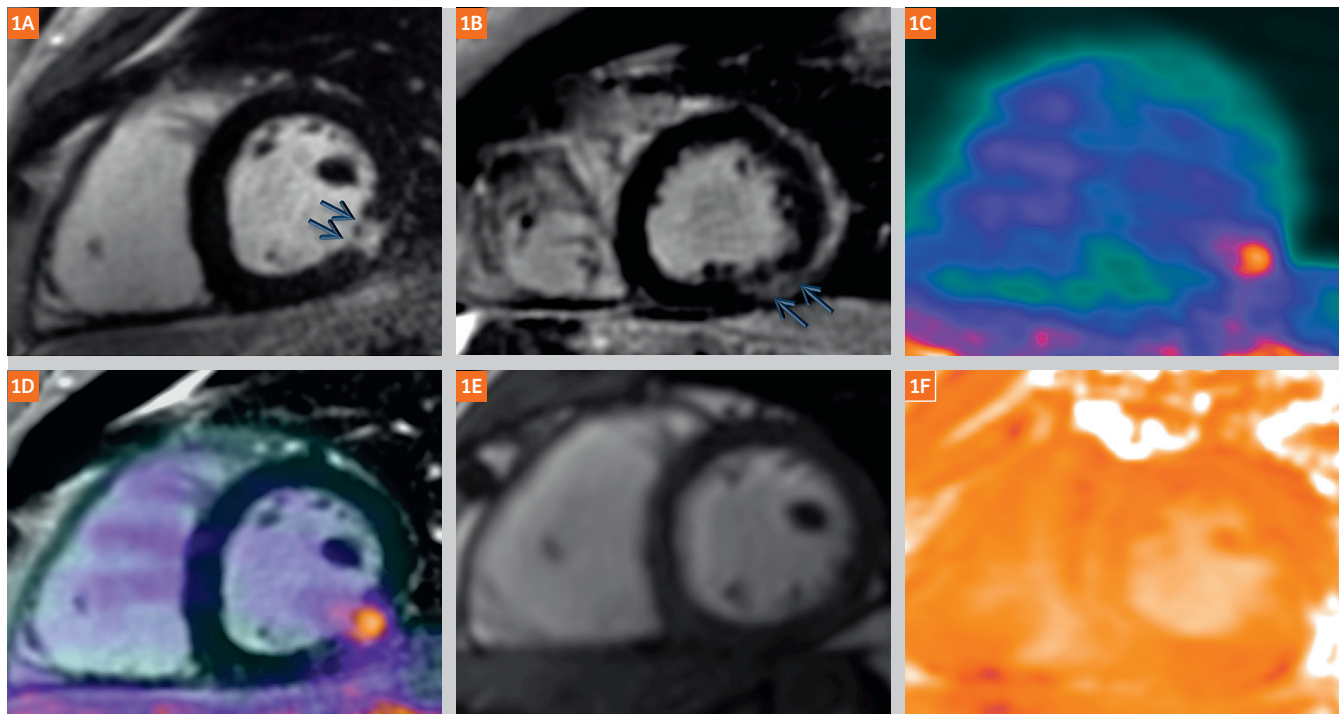
## Introduction

Cardiovascular magnetic resonance (CMR) is an established modality frequently used to diagnose a variety of cardiomyopathic processes. It relies on the characteristic appearances of the myocardium on late gadolinium enhancement (LGE) images coupled with detailed morpho-functional assessment [1, 2]. Positron Emission Tomography (PET) on the other hand, offers information on disease activity and as such is complementary to CMR. In the

cardiovascular field, <sup>18</sup>F-Fludeoxyglucose (FDG)<sup>1</sup> has been employed to study inflammation in the myocardium [3-5]. PET is usually coupled with computed tomography (CT) to provide anatomical and attenuation information. Consequently, assessment of data from CMR and PET, often collected on different days, must be done by image registration and is often challenging.

With the advent of hybrid PET/MR systems, we have now the unprecedented opportunity to combine the versatility of CMR with functional molecular imaging [6]. The simultaneous acquisition of PET and CMR data enables accurate co-registration of complementary data within the

<sup>1</sup> The full prescribing information for the Fludeoxyglucose F<sup>18</sup> injection can be found at page XX.



**Figure 1:** Two-chamber short-axis view of the right and left ventricles showing a discrete area of LGE in the infero-lateral wall (blue arrows) (**1A-B**). Focal increase in FDG nearing the inferior wall of the myocardium and adjacent to the liver as seen in the PET alone (**1C**). Fused FDG-PET/MR images showing increased FDG signal perfectly localized to area of LGE (**1D**). Two-chamber short-axis cine CMR showing mild hypokinesis of the infero-lateral wall (**1E**). Native CMR T2 mapping (**1F**).

myocardium or area of LGE and allows differentiation of the signal in these areas from activity in the blood pool or surrounding tissues. Moreover, compared to PET/CT, PET/MR has the advantage of reducing the radiation exposure.

In this report, we present one clinical case where the addition of PET/MR resolved the initial uncertainty about both the etiology of the clinical presentation and the activity of the underlying disease process.

### Clinical presentation

A 50-year-old man without prior medical history was hospitalized for recent onset of chest pain and shortness of breath. On arrival to the Emergency Department, he was found to have elevated cardiac biomarkers (CK and Troponin) and 1-2 mm inferior ST elevation on the ECG. Coronary angiogram was normal. Contrast CT of the chest showed no evidence of pulmonary embolism, pulmonary pathology or lymphadenopathy. A combined PET/MR study was requested to assess for wall motion abnormalities, myocardial damage and inflammation.

### PET/MR imaging

Simultaneous PET and MR imaging of the heart was performed on the Biograph mMR hybrid PET/MR system (Siemens Healthcare, Erlangen, Germany) using a flexible 6-channel body arrayed-receiver coil and a 6-channel spine arrayed-receiver coil mounted in the scanner table. Dynamic PET data was acquired in list-mode using a 90 min bedtime, starting 10 min following administration of 5 MBq/kg of <sup>18</sup>F-FDG. The last 30 min were binned to produce a static image for evaluation. The MR protocol included long and short-axis cine imaging, late gadolinium enhancement (10 min following administration 0.02 mmol/kg Multihance (Bracco Diagnostics, Milan, Italy)) and native T2 mapping. Image analysis was performed on fused, co-registered static PET and CMR LGE images. In preparation for the scan, patients were asked to follow a carbohydrate-free and high-fat diet for 24 hours, and fast for at least 6 hours prior to the study, to suppress the high physiological uptake of <sup>18</sup>F-FDG naturally present in the myocardium.

### Findings

CMR revealed normal biventricular size. Mild hypokinesis was observed in the mid infero-lateral wall but overall systolic function was preserved (EF 60%). On LGE imaging, there was a very discrete area of subepicardial/transmural myocardial scar in the mid infero-lateral wall (Figure 1 panel A, B and E); this pattern was felt to be consistent with a diagnosis of myocarditis rather than myocardial infarction. When the PET data was viewed in isolation, a focal area of increased <sup>18</sup>F-FDG uptake was observed near the inferior wall of the myocardium, although it was adjacent to the liver and not clear that it was originating from the myocardium (Figure 1 panel C). After image fusion with CMR, the increased PET activity perfectly co-localized with the region of injury on LGE (Figure 1 panel D) allowing us to report active myocardial inflammation in that area

with confidence. By contrast no clear increase in signal was observed on the T2 mapping images in this region (Figure 1 panel F).

### Impression

In the absence of coronary artery disease and prior medical history, our PET/MR findings were felt to be consistent with a diagnosis of active myocarditis.

### Conclusion

Simultaneous acquisition of PET and MR data offers valuable and complementary clinical information. On the same scan, the pattern of injury can be carefully co-localised to disease activity providing a unique method for combining anatomical and dynamic functional imaging. With the rapid development of novel PET radiotracers and CMR techniques for imaging the function and structure of the heart, hybrid PET/MR systems have the potential to further improve diagnostic accuracy and provide insight into the variety of molecular pathways and mechanisms underlying myocardial disease in our patients.

### References

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