Response to Letter Regarding Article, “Monitoring of Monocyte Recruitment in Reperfused Myocardial Infarction With Intramyocardial Hemorrhage and Microvascular Obstruction By Combined Fluorine 19 and Proton Cardiac Magnetic Resonance Imaging”

We thank Jansen and van Royen for their interest in our publication. They questioned whether the widely used contrast-enhanced MRI method indeed detects microvascular obstruction (MVO), because the incidence of MRI-defined intramyocardial hemorrhage (IMH) without MVO (isolated IMH) in our rat model was higher than those reported in large animals and patients.

Described for the first time by Kloner et al. in 1974, MVO is the underlying cause of the no-reflow phenomenon in reperfused myocardial infarction (MI). It is attributable to (1) regional swelling, intraluminal protrusions, and the cytoplasm blebs of endothelium; (2) activation of blood leucocytes adhesion and subsequent plugging of erythrocytes, platelets, and neutrophils; and (3) capillary compression by surrounding edematous tissue in experimental MI. In the 1990s, the hypoenhancement of MI area on contrast-enhanced MRI was carefully examined and established for detecting MVO noninvasively. In cardiac MRI, both terms MVO and no-reflow are used to describe the MI region with obstruction of microvasculature. MVO is also found highly associated with IMH.

In our article, the higher incidence of MRI-defined isolated IMH in comparison with that in large animals and patients, has been discussed in detail. In brief, it would be attributable to the dynamic features and severity of the MVO, especially given the small extent of MVOs in rats, and the extravasation of gadolinium contrast agent. In addition, conventional T2-weighted imaging is believed to be less sensitive than T2*-weighted imaging in detecting IMH. It could underestimate both the incidence and area of IMH owing to the confounding T2 effects of edema and hemorrhage after MI.

Jansen and van Royen claimed that the hypoenhancement but not the hypoenhancement of MI tissue indicates true MVO on contrast-enhanced MRI. They defined that MVO regions must contain intraluminal microthrombi within intact vessels positively stained by anti-CD31 immunohistochemistry in pathohistology (7 days after MI). Apparently, this definition excludes MVO regions that are attributable to other causes (eg, lumen blockage by edematous endothelium or mechanical compression by surrounding swelling tissue absent of microthrombi). In addition, the intact vasculature is not necessarily a characteristic of subacute MI tissue of MVO. Within an MVO area, the nonviable microvasculature and cardiomyocytes become a confluent necrosis and ultimately lose their physiological morphology. Therefore, it is not surprising that intact vasculature was rarely found in the hypoenhanced MI region. Furthermore, it is questionable whether their method using anti-CD31 immunohistochemistry is able to specifically detect necrotic endothelium and delineate the morphology of necrotic microvasculature. Likely, the positive CD31-stained microvessel wall within the hypoenhancement rim is viable endothelium, which seems contradictory to the primary characteristic of microvasculature within MVO area (nonviable endothelium).

In our opinion, the great disparity in the contrast-enhanced MRI pattern of MVO between Jansen and van Royen’s claim and those in the classical literature originates from the substantially different pathohistological definition of MVO by Jansen and van Royen.

Disclosures
None.

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