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REVIEW

Patterns of myocardial late enhancement: Typical and atypical features

Rehaussement tardif en IRM cardiaque : aspects typiques et atypiques

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Summary Myocardial late enhancement, an imaging technique acquired after gadolinium administration, has become an integral part of cardiovascular magnetic resonance imaging over the past decade. Initially principally utilized for imaging myocardial infarction, more recently it has also become an invaluable tool for identifying myocardial scarring in other cardiomyopathic processes. Our experience using this technique has led us to identify several manifestations of late gadolinium enhancement imaging that can confound interpretation of pathology and potentially lead to misinterpretation and subsequently misdiagnosis for the patient. The purpose of this article is to review and illustrate typical and atypical myocardial late enhancement in the most common myocardial diseases seen in routine clinical practice.

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MOTS CLÉS

Imagerie cardiaque
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Rehaussement tardif

Résumé Les séquences de rehaussement tardifs, acquis après injection de produit de contraste sont devenues une part clé de l'IRM cardiaque. Initialement utilisée dans l'imagerie de l'infarctus du myocarde, ces séquences sont devenues un outil indispensable d'identification de cicatrice myocardique dans un grand nombre de cardiomyopathies. Notre expérience dans ce domaine nous a conduit à identifier des rehaussements tardifs typiques mais également

Abbreviations: CMR, cardiovascular magnetic resonance; DCM, dilated cardiomyopathy; HCM, hypertrophic cardiomyopathy; LGE, late gadolinium enhancement; MI, myocardial infarction; MVO, microvascular obstruction.

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atypiques pouvant potentiellement conduire à des diagnostics erronés. Le but de cette revue est d'identifier et d'illustrer des rehaussements tardifs typique et atypiques dans quatre principales cardiopathies (infarctus aigu du myocarde, myocardite, cardiopathie dilatée et cardiopathie hypertrophique).

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Technical aspects of late gadolinium enhancement

A myocardial LGE study is performed 10 to 20 minutes after injection of an extracellular contrast agent that distributes in extracellular water but cannot cross the intact myocyte cell membrane. LGE imaging utilizes inversion-recovery gradient echo sequences with the inversion time set to null viable myocardium.

The technique for LGE imaging has been shown to be effective in identifying the presence and extent of myocardial scarring. Compared with normal myocardium, the wash out of gadolinium in a myocardial scar is delayed. In the acute stage (i.e. necrosis), leaky cell membranes allow gadolinium to enter the cells, thereby increasing the volume of distribution of gadolinium, resulting in a bright signal intensity of suitable inversion-recovery ('LGE') images [1]. In the chronic setting, fibrous tissue replaces necrotic tissue and is associated with a significant expansion of the interstitial space and a subsequent increase in the volume of distribution of gadolinium [1]. The enhancement is not disease specific and can be caused by ischaemic necrosis, inflammatory or infectious pathology, ischaemic and non-ischaemic scars and tumorous lesions.

Different patterns of LGE have been described, primarily segmented into ischaemic and non-ischaemic patterns. Ischaemic necrosis expands from the subendocardium to the epicardium with increasing coronary occlusion time [2]. Infarct-related areas of bright signal in LGE images are typically subendocardial with an increasing degree of transmural

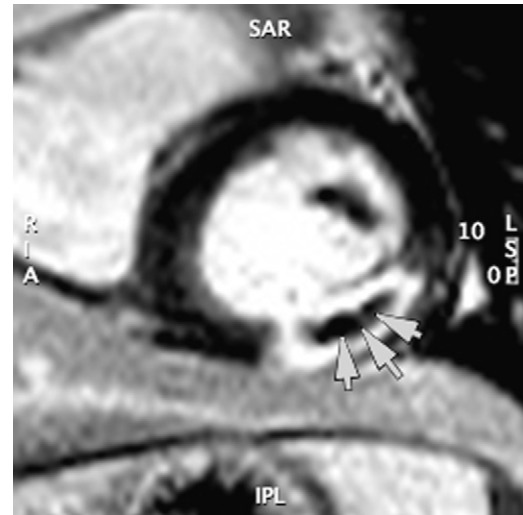


Figure 1. Typical transmural infarct with microvascular obstruction: a 37-year-old male with an acute reperfused inferolateral myocardial infarction. Mid short-axis image shows a dark zone embedded within a transmural region of late enhancement presenting microvascular obstruction in an infarct (arrows).

extension, depending on the extent of the infarct. The circumferential extent is related to the size of the perfusion bed and the location of the coronary artery occlusion. Conversely, in the non-ischaemic pattern, the subendocardium typically is spared, with the high-signal areas localized in the midwall and subepicardium, appearing patchy or more diffuse.

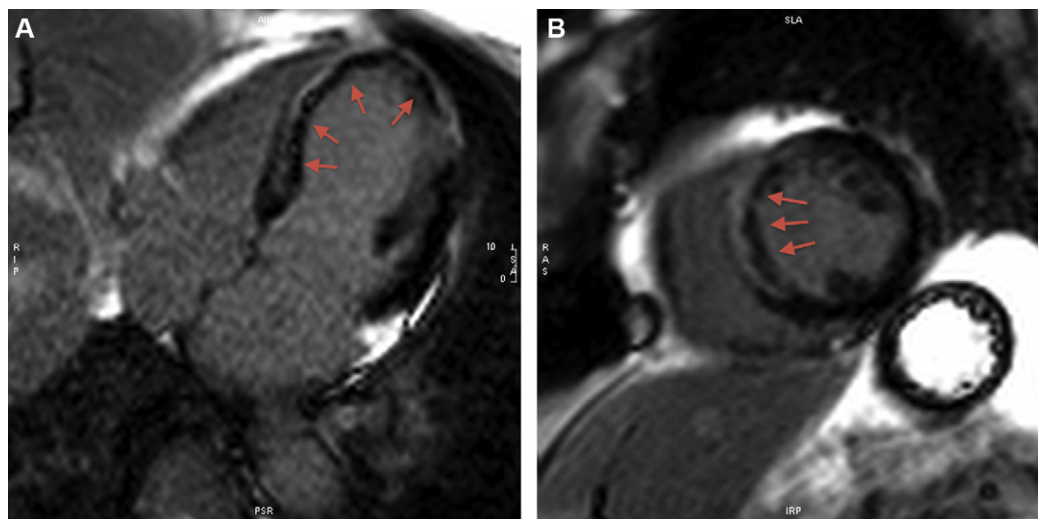


Figure 2. Atypical microvascular obstruction: an 83-year-old female with an acute anterior myocardial infarction with mid left anterior descending artery occlusion. Four-chamber long-axis (A) and mid short-axis (B) images show a laminated subendocardial dark area of microvascular obstruction overlying a near transmural anterior myocardial infarction (arrows).

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