Cardiovascular Magnetic Resonance in Ischemic Heart Disease

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ABSTRACT

Ischemic heart disease is one of the leading causes of death and disability, limiting individual’s quality of life. Cardiac magnetic resonance is radiation-free tool to image IHD patients and can depict inducible ischemia, extent and distribution of scar burden, associated complications like mitral regurgitation, thrombus, aneurysm formation, myocardial rupture, and any other incidental pathology. With increasing availability of the CMR there is an ever increasing need to interpret these images by non-imaging clinicians in order to manage patients more effectively. In this article, image interpretation for detection of ischemia, infarct and thrombus are discussed in simple easy to understand manner leaving behind intricate technical details which are of less important to the referring physicians.

Keywords: Ischemic heart disease, Ischemic cardiopathy, Cardiac Magnetic Resonance (CMR) Imaging, Interpretation of images.

I. IMAGING SEQUENCES

Imaging in ischemic heart disease is carried out with adenosine infusion [1] under electrocardiography triggered technique and takes about 45-60 minutes. Routine sequences carried out include Localisers, Half-Fourier Acquisition Single-shot Turbo spin Echo (HASTE), Steady State Free Precision cine imaging, FLASH based perfusion imaging, phase contrast velocity mapping, T1 mapping pre- and post-contrast and Phase Sensitive Inversion Recovery (PSIR)/Magnitude early gadolinium enhanced and late gadolinium enhanced (LGE) imaging. Navigated 3D coronary angiogram is used in the evaluation of coronary arteries especially their origin and course [2]. Aberrant coronary arteries with malignant course can potentially be one of the non-atheromatous causes of chest pain.

II. IMAGING FINDINGS

Localisers and HASTE images are normally evaluated for incidental extra cardiac findings including aortic, arch, and pulmonary vasculature, lung, mediastinal and upper abdominal mass lesions (Fig. 1).

SSF PR cine images are used to assess chamber sizes, myocardial thinning, ventricular ejection fraction, regional wall motion abnormalities and presence of thrombus or aneurysm formation. Furthermore, in acute cases, valve lesions especially mitral valve regurgitation and infarct associated VSD can easily be detected.

Native T1 and T2 values and ECV are used to characterize myocardial oedema and presence of scar. T1 values are increased in acute infarct and oedema and reduced in scar [3].

FLASH based perfusion imaging shows coronary artery territorial perfusion defects (Fig. 2) while patient’s heart is under pharmacologic stress particularly adenosine infusion at 140 to 210 microgram/kg/minute [4]. Some centres use dobutamine stress to assess contractile reserve. Early gadolinium enhanced images show intra-cavity thrombus as low signal mass (Fig. 3), especially in the LV apex with adjacent infarcted non-contractile or aneurysmal myocardium.

Late gadolinium enhanced images are very characteristic in IHD depicting subendocardial to transmural hyperenhancement in the area supplied by the culprit vessels depending upon increasing grade of myocardial injury. Infarct zone may show intra-myocardial thrombus or microvascular obstruction (Fig. 4).

Less than 50% hyperenhancement predicts residual viability in the affected territory [5]. Non-territorial
subendocardial LGE can be seen in amyloidosis and Loffler’s disease. Other differentials are myopericarditis with epicardial or mid wall type of LGE and non-ischemic cardiomyopathy with mid wall or patchy LGE (Fig. 5).

Fig. 3. Large clot in left ventricle apex (yellow arrow) and dangling clot in right ventricle (green arrow).

Fig. 4. Right coronary artery infarct (purple arrow) with microvascular obstruction (deep blue arrow).

III. CONCLUSION

CMR is increasingly available modality of choice in the imaging of IHD patients due to its non-invasive radiation free nature with superior soft tissue contrast. Image interpretation is highly specialized field which needs to be opened up not only to the cardiology and radiology registrars but also to non-imaging cardiologists and other physicians for better patient management and improvement in their quality of life in acute settings.

REFERENCES


Dr Sohail Iqbal, cardiac imaging doctor in North WestHeart Center, Wythenshawe Hospital, Manchester (University NHS) Foundation Trust, Manchester, UK had almost 5 years’ experience CMR reporting. Previously, he has served as a Specialist Radiologist in Ministry of Health Saudi Arabia for 5 years and worked in various NHS organizations as a Speciality Doctor in UK. He is keen researcher and has many cardiac and radiology publications.