Available online at www.sciencedirect.com

ScienceDirect

journal homepage: http://www.elsevier.com/locate/crvasa

Review article – *Special issue: Imaging in Coronary Artery Disease*

Imaging in coronary artery disease. Cardiac magnetic resonance

Mateusz Śpiewak *

Magnetic Resonance Unit, Department of Radiology, Institute of Cardiology, ul. Alpejska 42, 04-628 Warsaw, Poland

ARTICLE INFO

Article history:
Received 11 August 2015
Received in revised form
28 September 2015
Accepted 29 September 2015
Available online 28 October 2015

Keywords:
Imaging
Cardiac magnetic resonance
Coronary artery disease
Acute coronary syndromes

ABSTRACT

Imaging in coronary artery disease should be regarded as a tool supporting patients' management. Imaging helps physicians to diagnose patients more precisely and to treat them more effectively. There is a constant need to improve the decision-making process in patients with coronary artery disease. The growing number of cardiac magnetic resonance (CMR) centres, patients undergoing CMR studies and the plethora of evidence for the use of CMR both in patients with stable coronary artery disease, as well as acute coronary syndromes, justify reviewing its capabilities. Although research applications and technical developments are of particular value for progress being made in the field of imaging, clinical applications are the most crucial for patients and treating physicians, thus they will be discussed.

Contents

* Tel.: +48 22 3434657; fax: +48 22 3434552.
E-mail address: mspiewak@ikard.pl

http://dx.doi.org/10.1016/j.crvasa.2015.09.009

Introduction

Imaging in coronary artery disease (CAD) should be regarded as a tool supporting patients' management. Imaging helps physicians to diagnose patients more precisely and to treat them more effectively. Although in many cases the diagnosis or the exclusion of stable CAD can be made on the basis of clinical evaluation including patients' age, sex and chest pain characteristics, in numerous patients the tool verifying the baseline clinical judgement is needed. Moreover, a physician needs information additional to clinical evaluation to make a decision about management strategy (conservative vs invasive treatment, percutaneous vs surgical treatment, etc.) [1,2].

In the case of acute coronary syndromes (ACS), in the vast majority of cases, there is no need (and no sense) to perform imaging test additional to clinical evaluation and ECG to confirm that the patient really has ACS [3,4]. Particularly, in patients with ST-segment elevation myocardial infarction (STEMI) coronary angiography should be performed without any delay [4]. Invasive imaging (coronary angiography) is crucial for patients' treatment, and non-invasive imaging is indispensable for determining complications, further treatment needs and options as well as patients' prognosis.

There is a constant need to improve the decision-making process in these situations. Among other imaging modalities, cardiac magnetic resonance (CMR) is being more and more commonly used not only in research projects, but also in normal clinical scenarios. The growing number of CMR centres, patients undergoing CMR studies and the plethora of evidence for the use of CMR both in patients with stable CAD, as well as ACS justify reviewing its capabilities [5]. Although research applications and technical developments are of particular value for progress being made in the field of imaging, clinical applications are the most crucial for patients and treating physicians, thus they will be discussed.

Stable coronary artery disease

The main questions that a physician treating a patient with suspected CAD needs to answer include the following [1,2]:

- Does a patient have CAD?
- Should a patient undergo revascularisation?
- Should a patient undergo percutaneous (percutaneous coronary intervention – PCI) or surgical treatment (coronary artery bypass grafting – CABG)?
- Is there any additional disease that should be treated simultaneously (valvular disease, dilated aorta)?
- If not CAD, what could be the cause of chest pain?

When we review diagnostic capabilities of each imaging modality, one should think whether it could answer these questions. Does CMR answer these questions? It does! (. . . well almost).

Does the patient have CAD?

CMR has emerged as a valuable tool in the assessment of patients with suspected CAD. The growing evidence supporting the use of CMR to diagnose the presence of CAD has led to the recognition of stress CMR as a method equal to well established methods of functional testing in the case of suspected CAD, namely stress echocardiography, nuclear imaging (single photon emission computed tomography – SPECT), and positron emission tomography (PET) perfusion [1,2]. But the very first imaging modality in patients with suspected CAD should be transthoracic echocardiography and determining left ventricular ejection fraction (LVEF) [1]. This guides further management:

(A) Patients with typical angina and impaired LVEF (<50%) should undergo invasive coronary angiography without delay related to additional test. Except for patients with poor acoustic window, in whom echocardiography is not able to provide reliable data on LVEF, there is no room for CMR at this initial diagnostic step in these patients. However, CMR (or other stress imaging test) may be needed after coronary angiography to assess the extent of ischaemia and/or myocardial viability.
(B) In patients with LVEF <50% without typical angina, imaging stress test should be the initial test for diagnosing CAD.
(C) In the remaining patients (i.e. those with LVEF ≥50%), a physician should determine pre-test probability of CAD. Stress testing for ischaemia is needed in patients with intermediate pre-test probability of the disease. Alternatively, anatomical detection of CAD with the use of computed tomography (CT) angiography may be applied in selected patients.

Stress CMR offers several stress agents and protocols that are similar to those used in nuclear imaging (vasodilators: adenosine, dipyridamole or regadenoson) or stress echocardiography (dobutamine-atropine protocol) [6–8]. Details in protocols as well as pharmacological agents used in stress CMR may vary between CMR centres.

Should the patient undergo revascularisation?

Perfusion defects or new wall motion abnormalities during stress testing confirm the diagnosis of stable CAD. This is, however, not enough to make a decision regarding revascularisation. Current guidelines for revascularisation require evidence that the extent of ischaemia is significant, since only in this group of patients revascularisation improves prognosis in terms of CAD and all-cause mortality [1,2]. The huge