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Review article

Imaging methods in cardiomyopathies

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ARTICLE INFO

Article history:
Received 27 April 2016
Received in revised form
5 September 2016
Accepted 7 September 2016
Available online xxx

Keywords:
Tissue doppler imaging methods
Echocardiography
Cardiomyopathy
Cardiovascular magnetic resonance
Arrhythmogenic right ventricular cardiomyopathy
Late gadolinium enhancement
Cardiac CT

ABSTRACT

The echocardiography, as a widely available and relatively inexpensive basic imaging method, fulfills an irreplaceable function of a screening method in cardiomyopathies. Among new imaging methods, three-dimensional (3D) echocardiography may prove useful, particularly in spongious and apical hypertrophic cardiomyopathies; speckletracking echocardiography in differentiation of athletic heart from hypertrophic cardiomyopathy, various types of restrictive cardiomyopathy (including the initial stages of cardiac amyloidosis) and distinguishing between stress and spongious cardiomyopathy. More detailed information may be provided by cardiac magnetic resonance imaging, especially in arrhythmogenic right ventricular cardiomyopathy and the prognostic assessment in all types of cardiomyopathies. A cardiac CT scan serves particularly for discrimination of ischemic heart disease and detection of various extracardiac structures. Nevertheless, an essential disadvantage of this method is the radiation exposure, preventing its use in long-term follow-up.

Contents

Introduction

The development of new imaging methods is thriving. If imaging methods were studied during the era when the legendary cardiology textbook was penned by professor Jonáš [1], the imaging methods would comprise cardiovascular radiology, such as orthodiagraphy, orthodiascopy, teleradiography, radiographic kymography and electrokymography,

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http://dx.doi.org/10.1016/j.crvasa.2016.09.002
0010-8650/

X-ray cinematography and skiascopy [1]. With the exception of skiascopy, none of the aforementioned methods is being used nowadays.

In this review, we discuss the non-invasive imaging methods, as defined by the European Association of Cardiovascular Imaging (EACVI), involving echocardiography, cardiac magnetic resonance, computer tomography and nuclear cardiac imaging.

Nuclear cardiac imaging uses intravenous radioactive tracers and includes multi-gated acquisition (MUGA) scans, stress testing with single-photon emission computed tomography (SPECT) and positron emission tomography (PET). Both MUGA and SPECT paging provide information on the right and left ventricular volume, ejection fraction and wall motion assessment. The methods of nuclear cardiology might be sometimes useful in detection of cardiac sarcoidosis or amyloidosis but – on the other hand – these methods do not belong to common imaging methods in cardiomyopathies.

Echocardiography is the most established imaging method (introduced by C.H. Herz and I. Edler in 1953), which may be used bedside, applied repeatedly and it is the cheapest of all previously named methods. However, we may ask the following question: is it advancing further or has it reached its zenith? Indeed, in the earliest and most traditional modes, primarily two-dimensional (2D) and Doppler echocardiography, no fundamental innovations have emerged and it is difficult to picture any. However, there have been many advances in 3D echocardiography and in some of the more recent modes, particularly in tissue Doppler and speckle-tracking imaging.

3D echocardiography has proven effective in diagnostics of non-compaction cardiomyopathy, which affects the left or/and right ventricle. It seems that its greatest asset lies in distinguishing isolated left ventricular or right ventricular (or both) forms, in confusing or non-characteristic images, preventing the proper reading [2–4], and as a result the patients are frequently misdiagnosed, i.e. with cardiac tumor. 3D echocardiography may lead to the refinement or correction of previous diagnosis [2]. According to some authors, it enables more accurate assessment of apical hypertrophic cardiomyopathy [5] – Fig. 1, obstruction (particularly mid-ventricular), and recognition of complications following cardiac surgery in hypertrophic cardiomyopathy, such as fistulae [6,7]. Furthermore, 3D left ventricular volumetry is more precise compared to 2D volumetric analysis [8,9].

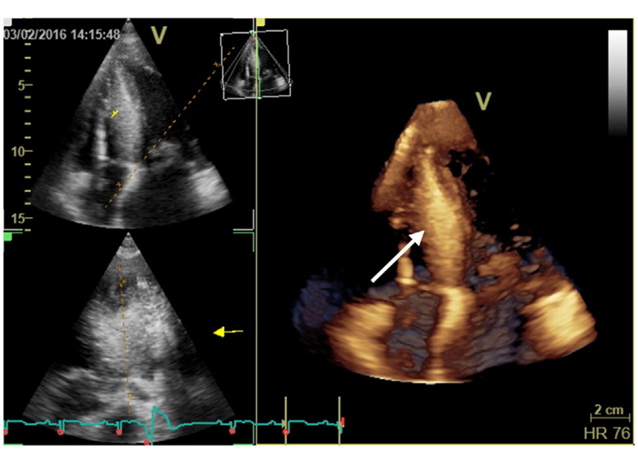

Fig. 1 – 3D echocardiography in hypertrophic cardiomyopathy, with significant interventricular septal hypertrophy (arrow). Apical four-chamber view.

Tissue Doppler imaging methods (TDI and TVI) – Fig. 2 – are based on suppression of the high-velocity signals from the blood flow and assessment of the lower-velocity signals of myocardial or vascular tissue motion (Tissue-Tracking Imaging – TTI and Tissue Synchronization Imaging – TSI). They allow the evaluation of the strain (deformation) and measurement of relevant parameters such as strain and strain rate – SR, as an instantaneous velocity difference between two points relative to their distance [s^{-1}]. There are several limitations to TDI, such as incidence angle dependence, which are a necessity of higher frame rate, as well as possibility of modification by extracardiac motions [9–11].

A unique imaging method, used in the past few years, is the *speckle-tracking echocardiography (STE)*, where the strain curve is created based on analysis of spatial dislocation of the myocardial tissue spots (speckles) – Fig. 3. It is a non-Doppler parametric imaging with the assessment of deformation in three dimensions. Given the non-Doppler character of this method, it is angle independent in contrast with TDI. Recently, the guidelines for standardization of this method in 2D mode

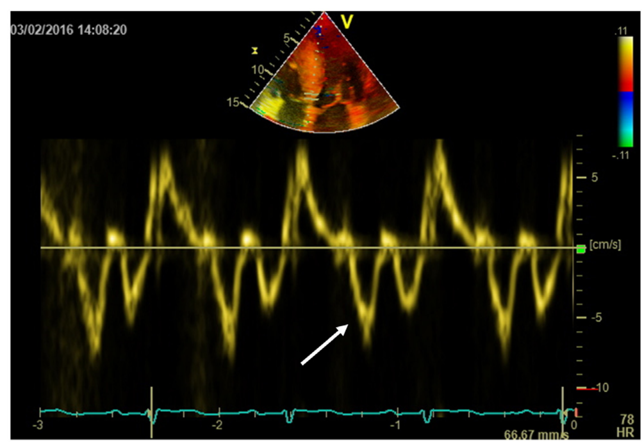

Fig. 2 – Tissue Doppler echocardiography in a patient with hypertrophic cardiomyopathy. TDI measured at septal mitral annulus, with low velocity of the E′ wave.

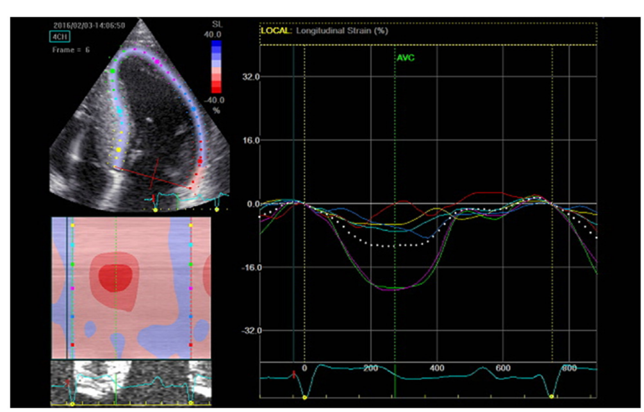

Fig. 3 – 2D speckle tracking shows a reduced longitudinal strain in a patient with hypertrophic cardiomyopathy.