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

Echocardiography in coronary artery disease

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ABSTRACT

Coronary artery disease (CAD) is one of the major causes of morbidity and mortality. Imaging techniques represent the key method for disease extent and severity assessment and evaluation of hemodynamic complications. In skilled hands the method provides useful information for clinical management and prognosis assessment. Complex evaluation brings information about global and regional myocardial function, myocardial viability, ischemic mitral regurgitation, and about development of complications such as left ventricular thrombus formation, myocardial rupture and pericardial effusion. The main drawback of echocardiography is the limited echogenicity of many patients and its undeniable operator-dependence. However, the possibility of bringing the echocardiographic imaging to the bedside of our patients makes the method essential and its knowledge indispensable for all cardiologists.

Contents

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Introduction

Coronary artery disease (CAD) is one of the major causes of morbidity and mortality. Imaging techniques represent the key method for disease extent and severity assessment and evaluation of hemodynamic complications. Echocardiography is one of the most useful imaging methods due to its availability, ease of use, price, capacity to serve as bedside technique and repeatability. In this review we summarize fundamental principles of echocardiographic imaging recommended for the assessment of patients presenting with both acute and chronic manifestations of CAD.

Evaluation of the regional systolic function

Major consequences of ischemia include an impairment of regional systolic contractility. If severe ischemia persists myocardial necrosis develops followed by scarring which affects the regional function permanently. The regional myocardial function is usually assessed only visually by evaluating wall thickening and endocardial motion of myocardial segments. It is widely recognized that myocardial movements may be caused by adjacent segment tethering or overall LV displacement. It seems therefore preferable that regional deformation should be analyzed by using methods that are at least partially independent of tethering such as speckle tracking though keeping in mind that even the deformation may be passive [1].

The usual practice is a grading of regional myocardial function depending on the quality of contraction. The recommended scoring based on the current guidelines is as follows: (1) for normal or hyperkinetic, (2) for hypokinetic (reduced thickening), (3) akinetic (absent or negligible thickening), and (4) dyskinetic (systolic thinning or stretching or aneurysm). An aneurysm is characterized by a focal dilatation and thinning (remodeling) of the myocardial wall with either akinetic or dyskinetic systolic deformation (Fig. 1). In the past, a separate grade 5 was assigned to aneurysm [2]. This approach is still being kept by many echocardiographic laboratories. Based on the segmental motion evaluation a Wall motion score index (WMS) can be calculated as a sum of all scores divided by the number of visualized segments.

The segmentation of the left ventricular cavity may vary between imaging techniques and echocardiographic laboratories. A 16-segments model was proposed both for WMS calculations at basal conditions and for evaluation of stress echocardiography (Fig. 2). However, the recent guidelines suggested to use a 17-segments model where the 17th segment is represented by the ''apical cap''. Therefore the apical segment is now divided into five segments instead of four used in the past. This approach is recommended only for perfusion studies as it allows a better comparison with other imaging modalities as single photon emission tomography (SPECT), positron emission tomography (PET) or cardiac magnetic resonance (CMRI) [1]. However, this segmentation should not be used for regional motion assessment and deformation (strain) studies where the 16-segments model is still the method of choice due to the fact that endocardial excursion and thickening of the apical cap are imperceptible.

The use of deformation imaging, nowadays mostly using the strain and strain rate derived from speckle tracking, should allow less subjective evaluation of myocardial contraction as compared to simple visual assessment. The speckle tracking echocardiography replaced techniques based on tissue Doppler imaging (TDI) originally used for myocardial motion and

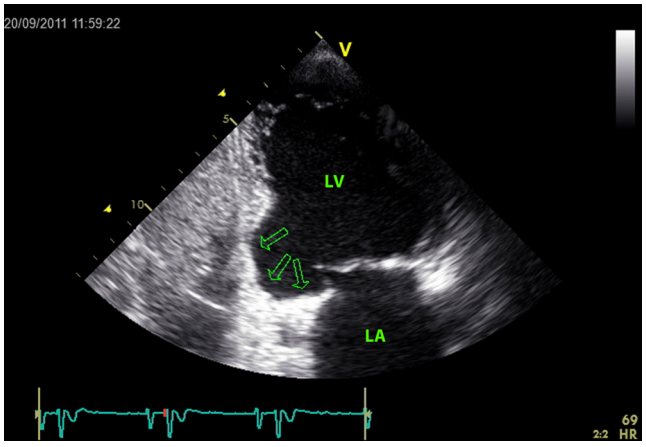

Fig. 1 – Aneurysm of the inferior wall (arrows) visualized by transthoracic echocardiography. LV = left ventricle, LA = left atrium.

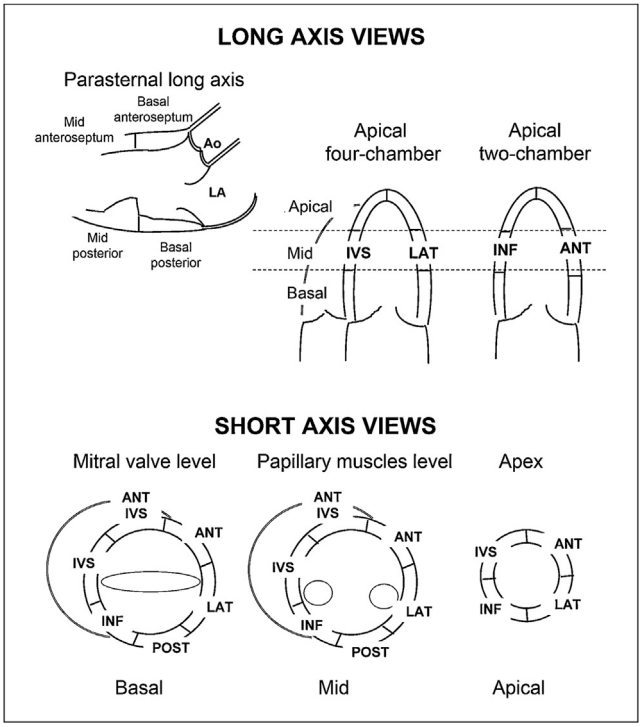

Fig. 2 – The classical segmentation of the left ventricular walls using 16-segments. Ao = aorta, LA = left atrium, IVS = interventricular septum (for mid and basal portion often labeled as inferoseptum), ANT = anterior wall, POST = posterior or inferolateral wall, INF = inferior wall, LAT = lateral or anterolateral wall.
Adapted from Ref. [2].