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# The role of imaging in coronary artery disease – What do the ESC guidelines say

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SOUHRN

Klíčová role zobrazovacích metod v moderní kardiologii je nesporná. Naším cílem je shrnout indikace pro užití různých zobrazovacích metod u pacientů, jimž byla stanovena diagnóza ischemická choroba srdeční nebo u nichž existuje podezření, že touto chorobou trpí, podle současných doporučených postupů Evropské kardiologické společnosti (ESC).



ABSTRACT

The pivotal role of imaging in contemporary cardiology is unquestionable. Our aim is to summarize indications for the use of different imaging techniques in patients with diagnosed or suspected coronary artery disease according to the current ESC practice guidelines.

## Introduction

Contemporary patient management in cardiology stands on two pillars: imaging and interventions. The current issue of *Cor et Vasa* addresses the use of different imaging techniques in patients with diagnosed or suspected coronary artery disease. Our aim is to present a "horizontal" view of the topic in different clinical settings, rather than viewing it by the imaging modalities. The European Society of Cardiology (ESC) delivers practice guidelines endorsed by many member National Societies. This paper will be based on recommendations from the four ESC official documents, related to stable coronary artery disease (CAD) [1], acute coronary syndromes [2,3], and myocardial revascularization [4].

## Stable coronary artery disease [1]

In patients with stable CAD, cardiac imaging is pivotal at several management stages, including establishment of the diagnosis, identification of associated conditions, risk stratification, facilitation of the choice of treatment, and evaluation of treatment effect.

Diagnosis of stable CAD is based on the Bayesian approach. As the initial step, the pre-test probability of the disease is estimated, derived from patient's age, sex, and chest pain characteristics. Further testing strategy, including different kinds of imaging, depends on the pre-test probability of CAD. In general, in patients categorized as having low (<15%) likelihood of ischemia, no additional non-invasive testing is advocated. It has to be kept in mind, however, that in this group there is a small proportion of subjects who actually do have ischemia. Some patients, especially those with a positive family history of premature CAD, concomitant diabetes or renal dysfunction, may benefit from further testing.

Patients with high pre-test likelihood of ischemia (>85%) may be diagnosed as having CAD and offered medical treatment. Patients with stable symptoms and an intermediate (15–85%) probability of significant disease are clearly candidates for non-invasive testing.

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After the diagnosis of CAD has been made, and optimal medical therapy instituted, as the third step of the diagnostic algorithm, based on the results on non-invasive testing and symptoms, patients who could potentially benefit from revascularization should be selected for the invasive testing.

At the initial presentation, all patients should have a resting transthoracic echocardiography (TTE) performed (class I, level of evidence B). It enables exclusion of other causes of chest pain, identification of wall motion abnormalities suggestive of CAD, and evaluation of left ventricular (LV) function which bears prognostic information. Cardiac magnetic resonance (CMR) may be used as an alternative imaging method to detect structural changes and assess LV function in patients with inconclusive TTE results and no contraindications to CMR.

The guidelines also state that carotid ultrasound should be considered at this stage (class IIa, level of evidence C) to detect increased intima-media thickness or plaque.

Further non-invasive testing depends on the likelihood of the disease, test availability, and center experience. Patient's ability to perform the test should always be taken into consideration. As mentioned, in patients with the intermediate likelihood of CAD (15–85%), non-invasive testing to confirm or rule-out CAD is of special importance. In this entire group, stress imaging is preferred to the ECG exercise testing, but the imaging methods are especially valuable in subjects in the high-intermediate range (66-85% likelihood of CAD or LV EF<50% without typical angina; class I, level of evidence B), and in those in whom resting ECG abnormalities do not allow to reliably interpret the exercise-induced changes (class I, level of evidence B). Stress echocardiography, CMR, and radionuclide methods (mostly single-photon emission computed tomography [SPECT], but also positron emission tomography [PET]), are potentially useful to prove or disprove the presence of ischemia. If the first imaging test (or the ECG stress test) is not diagnostic, then another imaging test should be performed. Exercise stress is deemed superior to pharmacologic testing when possible (class I, level of evidence C).

CT angiography, which has a very high negative predictive value, is most useful to rule-out rather than to confirm the diagnosis of CAD.

Hybrid techniques, combining SPECT/CT, PET/CT and PET/CMR are now available at a few specialized centers. These techniques combine the anatomical with functional coronary assessment or provide more objective pathophysiological data. Their role is likely to increase in the future.

It is important to note that imaging also plays an important part in patients with the established stable CAD diagnosis. An imaging stress test should be considered in symptomatic patients with prior revascularization, and in those with intermediate lesions on coronary arteriography (both class IIa, level of evidence B).

## Acute coronary syndromes

### *Patients presenting with ST-segment elevation (STEMI) [2]*

Two different time points must be taken into consideration in this clinical setting: at hospital presentation and after the acute phase – preferably before discharge.

At presentation, patients with STEMI should be directed to the invasive coronary angiography and subsequent primary PCI with no delay (class I, level of evidence A). Echocardiography may assist in making the diagnosis in uncertain cases, but should not delay transfer for angiography (class IIB, level of evidence C).

After the acute phase, all patients should have a transthoracic echocardiogram performed to assess the infarct size and resting left ventricular function (class I, level of evidence B). If echocardiography is not feasible, CMR may be used as an alternative (class IIB, level of evidence C).

In patients with multivessel CAD in whom revascularization of other vessels is considered, stress testing or imaging, e.g. using stress perfusion scintigraphy, stress echocardiography, PET or CMR, are indicated for evaluation of residual ischemia and myocardial viability (class I, level of evidence A).

According to the guidelines, CT angiography has no role in the routine management of STEMI patients (class III, level of evidence C).

### *Patients presenting without persistent ST-segment elevation (NST-ACS) [3]*

In the "rule-in" and "rule-out" algorithm for the NST-ACS, the guidelines rely on the biochemical markers only. It needs to be emphasized however that coronary artery calcium (CAC) evaluation by CT, especially in patients older than 45 years, can be useful in this setting to rule-out the ACS. In these circumstances there is no need for quantification, and therefore, the test can be performed even in patients with arrhythmia, without the ECG gating. If no calcium is present, the diagnosis of an ACS is unlikely, and another etiology for the symptoms needs to be searched for.

If there is a high suspicion of NSTE-ACS, coronary angiography should be performed, while in those with low to intermediate CAD likelihood, CT angiography should be considered.

During hospitalization for NSTE-ACS, echocardiography should be performed in all patients. It is useful to identify abnormalities suggestive of myocardial ischemia or necrosis (segmental hypo- or akinesia). Contrast echocardiography and/or strain/strain rate imaging might improve the diagnostic and prognostic value of the conventional echo assessment. Echocardiography may be also useful in identification of the alternative diagnoses, and in diagnosing the patients with hemodynamic instability of suspected cardiac origin.

At the time of hospital discharge, echocardiography, as well as other imaging techniques, can provide important prognostic information.

As pertains to the official ESC recommendations:

1. In patients with no recurrence of chest pain, normal ECG and normal cardiac troponin levels, but suspected ACS, a non-invasive stress test (preferably with imaging) for inducible ischemia is recommended before deciding on an invasive strategy (class I, level of evidence A).
2. Echocardiography is recommended to evaluate regional and global LV function and to rule out differential diagnoses (class I, level of evidence C).

3. CT coronary angiography should be considered as an alternative to invasive angiography to exclude ACS if there is a low or intermediate likelihood of CAD, and when cardiac troponin values and/or ECG findings are not conclusive (class IIa, level of evidence A).

## Myocardial revascularization [4]

In the candidates for myocardial revascularization, non-invasive imaging is used to confirm the presence of ischemia, assess the area of ischemia, and detect myocardial viability,

The use of non-invasive test depends on clinical presentation of CAD. This has been more specifically addressed in previous paragraphs of this paper. Notably, confirmation of the presence of ischemia is required in patients with suspected or known CAD in the non-acute setting. In patients with the intermediate (15–85%) pretest probability of CAD, imaging tests, such as stress echo, nuclear imaging, stress CMR or PET perfusion (all class I, level of evidence A), should be done, and are preferred over the ECG stress testing. In those with a high (>85%) probability of significant CAD, a straight advancement to the invasive coronary angiography is advocated (class I, level of evidence A).

As the presence of a large area of ischemia, exceeding 10% of the left ventricular mass, is associated with prognostic improvement with revascularization (class I, level of evidence B), it should be assessed in patients, in whom revascularization for symptomatic improvement alone is questionable. Radionuclide methods, especially SPECT, as well as CMR, are best suitable here, but stress echo is also acceptable.

With the exception of patients with STEMI in whom the echocardiographic examination might delay PCI, all revascularization candidates should have the LV function assessed by echocardiography. In those with poor LV function, myocardial viability should be assessed using stress echo, radionuclide imaging and/or CMR in order to establish the optimal treatment strategy.

Obviously, invasive coronary angiography has to be performed in all patients in whom the need for myocardial revascularization is considered. Again, the clinical setting is important here. Patients with ACS generally require an acute intervention (most commonly PCI). Also in stable symptomatic patients with high (>85%) probability of significant CAD, an invasive angiography with no previous noninvasive testing is advocated, if revascularization is considered. Otherwise, noninvasive functional tests are indicated as described above.

The results of invasive angiography enable calculation of the SYNTAX score [5], which should be used to choose the optimal revascularization strategy (PCI vs CABG) in patients with the left main and three-vessel disease.

Further tests, such as IVUS, optical coherent tomography (OCT) and FFR, performed at the time of invasive coronary angiography, are clinically useful in establishing lesion severity and its functional significance, providing better guidance on the need for and strategy of the revascularization procedure. IVUS and OCT also play a role in the assessment of the immediate PCI result.

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