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What imaging techniques should be used in primary versus secondary prevention for further risk stratification?

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Abstract

Background and aims: An accurate assessment of the cardiovascular (CV) risk of an individual is key for guiding the appropriate treatment strategy for cardiovascular disease (CVD). Although conventional risk factors for CVD are well established, there can be substantial variation in the extent of atherosclerosis between patients. The use of a variety of imaging modalities can be beneficial in the primary prevention stage and in the classification of an individual's CV risk. Therefore, appropriate implementation of these imaging techniques for risk assessment purposes, in line with clinical guidelines, can influence the outcomes of CVD prevention.
Methods: The expert working group collaborated to review current invasive and non-invasive imaging techniques available to healthcare practitioners and how they can be used in the measurement of preclinical vascular damage and CV risk assessment.
Results: After evaluation of the current guideline recommendations and clinical data available, the expert working group collaborated to produce recommendations regarding the use of imaging in the risk stratification in primary prevention, CV risk in peri-acute coronary syndrome and CV risk assessment in secondary prevention.
Conclusions: Overall, a variety of both invasive and non-invasive imaging modalities were highlighted by the expert working group as having the potential to assist in the risk assessments of patients at risk of CVD. These imaging techniques can be utilised in both primary and secondary prevention strategies and have the potential to be important risk modifiers, improving the outcome of CV risk assessment.

Keywords: Invasive imaging; Non-invasive imaging; Cardiovascular disease; Risk assessment; Coronary artery calcium; Ankle–brachial index; Carotid artery ultrasound; Invasive coronary angiography

Introduction

An accurate risk assessment of a patient plays a pivotal role in the effective prevention of cardiovascular disease (CVD). Some of the newer aspects of risk determination, which are included in the 2016 European Society of Cardiology (ESC) guidelines for CVD prevention in clinical practice, include recommendations for the use of a wide variety of imaging modalities in patients at risk of CVD [1]. The implementation of such imaging techniques can be very useful in primary prevention and can be important tools for potentially reclassifying the cardiovascular (CV) risk of an individual. Such techniques may be particularly advantageous for those individuals deemed to be at intermediate risk of CVD according to their European Society of Cardiology Systematic Coronary Risk Evaluation (ESC SCORE) [1, 2].

In order to gain further insight into the use of imaging techniques in clinical practice, an international team of experts collaborated in order to offer their opinions for the working practice of imaging and its role in assessing and

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categorising associated risk, both in primary and secondary prevention scenarios, for patients with atherosclerosis, peri-acute coronary syndrome (ACS) and other CVDs. The purpose of this article is to summarise these expert opinions, along with the recommendations from published guidelines and background information on specific imaging techniques, in order to provide a guide for clinical professionals and other healthcare practitioners on when to use imaging techniques for further risk stratification.

What imaging techniques should be used to further stratify cardiovascular risk in primary prevention?

Several non-invasive imaging modalities are available for the measurement of preclinical vascular damage for primary prevention measures. Certain non-invasive imaging techniques can be considered to be risk modifiers and can be helpful for the assessment of the overall risk prediction of an individual; in turn, this can be useful for reclassification purposes if an individual's risk lies close to a decisional threshold.

Imaging techniques useful for refining the risk stratification

Expert working group opinion on which imaging techniques are useful for refining risk

- In primary prevention of CVD, for individuals deemed to be at intermediate risk as determined by their ESC SCORE the following non-invasive imaging techniques can be used to reclassify individuals into higher or lower risk categories:
  - Computed tomography coronary artery calcium (CT CAC; a CAC score of ≥300 Agatston units or ≥75th percentile for age, sex and ethnicity is indicative of an individual with an increased CV risk)
  - Carotid artery scanning (focal wall thickening that is ≥50% greater than the surrounding vessel wall or as a focal region with an intima–media thickness [IMT] measurement ≥1.5mm that protrudes into the lumen can be considered as an indicator of increased CV risk)
  - Ankle–brachial index (ABI; an ABI value of <0.9 is indicative of increased CV risk)
  - Carotid ultrasound IMT is not recommended for CV risk assessment

All of the imaging techniques suggested by the expert working group are described in the ESC guidelines for the CVD prevention in clinical practice [1] and may be considered as risk modifiers in CV risk assessment.

Multislice CT CAC is a sensitive technique that can detect coronary calcium plaques, which can then be quantified using the Agatston score (see Figure 1) [1, 3, 4]. A CAC score of ≥300 Agatston units or ≥75th percentile for age, sex and ethnicity can be indicative of an increase in CV risk. CAC

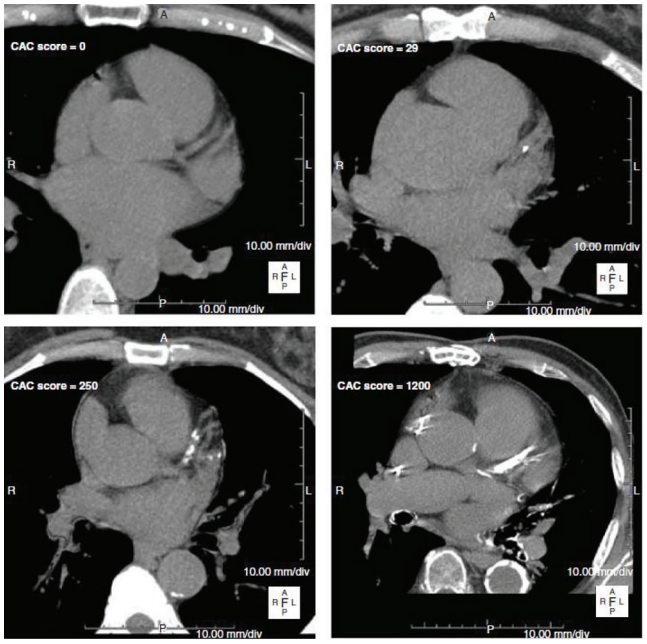

Fig. 1. Non-contrast CT scans of the heart demonstrating calcified coronary plaque of increasing severity, as quantified by calcium scoring according to the Agatston calcium scoring system.
CAC, coronary artery calcium; CT, computed tomography.
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scoring may be considered as an additional tool to increase CV risk prediction accuracy in individuals with calculated SCORE risks around the 5% or 10% thresholds. However, for CAC scoring, concerns have been raised regarding cost and radiation exposure. The advised radiation exposure for CT CAC scoring is currently ±1mSv [1].

The assessment of the severity of carotid artery plaque using ultrasonography can also be considered as a risk modifier in CV risk prediction, in certain cases [1, 5]. This technique allows the characterisation of plaques according to their abundance, size, irregularity and echodensity (echolucent versus calcified). Plaque can be defined as 'the presence of a focal wall thickening that is at least 50% greater than the surrounding vessel wall or as a focal region with an IMT measurement ≥1.5mm that protrudes into the lumen' [1].

The ABI test can also be useful for indicating those individuals who have increased CV risk and asymptomatic atherosclerotic disease. It is easy to perform and reproducible, making it applicable in a wide variety of cases. An ABI <0.9 indicates ≥50% stenosis between the aorta and the distal leg arteries, and is considered to be a reliable marker of peripheral artery disease (PAD) because of its acceptable sensitivity (79%) and specificity (90%) [1].

The systematic use of carotid ultrasound IMT measurement is not recommended in clinical practice for risk assessment. This is due to the lack of standardisation regarding the definition and measurement of IMT, its high variability and low intra-individual reproducibility [1, 2].