








# Anatomical and functional coronary imaging to predict long-term outcome in patients with suspected coronary artery disease: the EVINCI-outcome study

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## Aims

To investigate the prognostic relevance of coronary anatomy, coronary function, and early revascularization in patients with stable coronary artery disease (CAD).

## Methods and results

From March 2009 to June 2012, 430 patients with suspected CAD (61 ± 9 years, 62% men) underwent coronary anatomical imaging by computed tomography coronary angiography (CTCA) and coronary functional imaging followed by invasive coronary angiography (ICA) if at least one non-invasive test was abnormal. Obstructive CAD was documented by ICA in 119 patients and 90 were revascularized within 90 days of enrolment. Core laboratory analysis showed that 134 patients had obstructive CAD by CTCA (>50% stenosis in major coronary vessels) and 79 significant ischaemia by functional imaging [>10% left ventricular (LV) myocardium]. Over mean follow-up of 4.4 years, major adverse events (AEs) (all-cause death, non-fatal myocardial infarction, or hospital admission for unstable angina or heart failure) or AEs plus late revascularization (LR) occurred in 40 (9.3%) and 58 (13.5%) patients, respectively. Obstructive CAD at CTCA was the only independent imaging predictor of AEs [hazard ratio (HR) 3.2, 95% confidence interval (CI) 1.10–9.30; *P* = 0.033] and AEs plus LR (HR 4.3, 95% CI 1.56–11.81; *P* = 0.005). Patients with CAD in whom early revascularization was performed in the presence of ischaemia and deferred in its absence had fewer AEs, similar to patients without CAD (HR 2.0, 95% CI 0.71–5.51; *P* = 0.195).

## Conclusion

Obstructive CAD imaged by CTCA is an independent predictor of clinical outcome. Early management of CAD targeted to the combined anatomical and functional disease phenotype improves clinical outcome.

## Keywords

stable coronary artery disease • computed tomography coronary angiography • coronary functional imaging • coronary anatomical imaging • coronary revascularization • prognosis • clinical outcome

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functional non-invasive imaging phenotype, it was associated with the worst prognosis. Thus the present results underline the need for an ischaemia-guided patient management.<sup>23</sup>

The EVINCI-outcome study shares the same limitations of the main EVINCI study,<sup>14</sup> particularly regarding the non-randomized design and the relatively small population. The latter was due to the complexity of the protocol, which required both CTCA and at least one functional test for each patient to be available and interpretable by core-labs, causing a relatively high number of drop-outs and protocol violations. Nevertheless, the same protocol allowed a well-characterized population of patients with stable chest pain and suspected CAD to undergo evaluation by both anatomical and functional coronary imaging, and this has provided unique insights into the relationship between imaging phenotype and clinical outcome.

The main EVINCI study was adequately powered on the basis of the primary diagnostic endpoint.<sup>14</sup> However, due to the relatively small population and low event rate at follow-up, the EVINCI outcome study was relatively underpowered in particular to assess the prognostic role of the modalities that were performed more rarely, such as PET and CMR. Thus, the results of different stress imaging modalities were merged. This, together with the low prevalence of significant inducible ischaemia, could have disadvantaged ischaemia testing as compared to coronary imaging, which was performed in every patient with CTCA.

Only core laboratories imaging results were considered in the main outcome analysis to ensure a more objective and unbiased evaluation of the prognostic role of imaging. This choice may have introduced some limitations but had also some advantages. The core laboratories did not have full clinical information available and hence had neither the benefit nor the possible bias, of integration with clinical features in evaluating imaging studies. This could explain the sub-optimal agreement of imaging interpretation between centres and core laboratories. Core laboratories reclassified to a lower category 43% of patients with CAD and significant ischaemia at centres while upgrading to significant ischaemia 8% of the remaining patients (Supplementary data online, Figure S1). Since patient management was at the discretion of the referring physician, it could have been more consistent with the local imaging findings than with core laboratories interpretation.

The specific reasons of management choices, as in most similar studies, were not available. It cannot be excluded, that comorbidities or high interventional risks might have discouraged early revascularization in some patient with significant ischaemia, conditioning *per se* a worse prognosis.

## Conclusion

In a population with low prevalence of significant CAD, the high negative predictive value of CTCA and the good prognosis of patients without anatomically significant CAD suggest that a strategy using CTCA as the first test is reasonable. Nevertheless, when anatomical disease is found by CTCA, coronary functional imaging should be encouraged before ICA since this allows patients with significant inducible ischaemia, who have most to gain by revascularization, to be identified.

Results from specific large randomized trials are expected to answer more directly the question of whether revascularization or medical treatment based on anatomical and functional imaging results are able to change outcome.<sup>24</sup>

## Supplementary data

Supplementary data are available at *European Heart Journal - Cardiovascular Imaging* online.

**Conflict of interest:** none declared.

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