

## A thoughtful use of CT angiography among patients with prior coronary artery bypass grafts: more lights than shadows?

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Coronary computed tomography (CCT) scans with 64 slices has already shown high sensitivity and specificity in the evaluation of coronary artery bypass grafts (CABG) (1). However, there is still debate in the literature regarding its effectiveness and reliability compared to invasive coronary angiography (CA) in the case of native vessels disease (2).

Once starting from these concepts, CCT could be kept in mind as a good alternative to CA for both patients complaining of chest pain with a clinical history of stable angina (SA) and the ones admitted for non-ST elevation acute coronary syndrome (NSTE-ACS) with low to intermediate risk (in which coronary evaluation can be safely delayed for about 48 hours). It is quite obvious as, in the case of STEMI or in high-risk NSTE-ACS, invasive CA is instead mandatory.

In patients with SA, symptoms may be related to a diseased graft or to a progression in the native vessels (ungrafted vessel, or grafted vessels downstream of the graft anastomosis). CCT can be here successfully used as first line assessment in order to rule out graft failure with a high degree of accuracy (1).

Reports in the literature show that the rate of LIMA and vein occlusion at 1 year after CABG is respectively 8% and 20% (3) and up to 25% of grafts are found to be occluded at 5 years after CABG surgery (4). Obviously, whereas the CCT properly diagnoses the graft failure as the cause of the chest pain the invasive approach is mandatory unless revascularization would be excluded due to the location or

extent of the disease. Moreover, CCT might address the proper radial or femoral approach according to the site of the graft occluded; it may also save procedural time, X-ray and contrast medium. In the last analysis, it might be used to avoid the albeit minimal risks associated with cannulation of clean and guiltless grafts (5). Then, CCT can provide additional information such as the minimal lumen diameter (MLD), the minimal lumen area (MLA) and the plaque burden (6).

Instead, if grafts patency has been shown at the CCT analysis, native vessels diseases have to be taken into consideration. It is well known in the literature, that the worsening of native bypassed stenosis (until occlusion) on grafted vessels after CABG is a common occurrence. Mainly, it seems to be related to blood flow alterations and shear stress carried out by the grafts themselves, along with cardiovascular risk factors (7,8).

Previous studies with 64 slice CCT have demonstrated high sensitivity, specificity and accuracy values (respectively 95.4%, 97.3% and 97%) in the assessment of native vessel distal to the surgical anastomosis, allowing for a reliable evaluation of the grafted but also of the native circulation in CABG patient (9,10). In such study, the prevalence of poor quality coronary segments because of extensive calcification is less than 9% (10) permitting the abovementioned high values of global sensitivity and specificity. Demonstration of grafts patency without critical disease in grafted or ungrafted native coronaries at the CCT analysis, means

that there are not unprotected field of myocardium. This issue, despite probably being overestimated by the study design bias, was found in no less than 56% of patients who were assessed with CCT for thoracic pain in the paper by Pesenti-Rossi *et al.* (5).

Despite the progression of the native vessels disease is associated with major adverse cardiac events (MACE) rates at follow-up (9), the first approach in this situation is usually the optimization of medical therapy due to the high technical difficulty in performing percutaneous coronary intervention of the native artery via graft.

An interesting approach that belongs to the same time evaluation of vessel and myocardium of CCT is that if critical stenosis is highlighted, either on the graft or on the native vessel, then could be useful to think as abovementioned in terms of unprotected coronary territory (UCT) that means (I) myocardial areas vascularized from not bypassed vessel with critical coronary stenosis; (II) myocardial areas vascularized by a graft with a critical stenosis; and (III) myocardial areas for which both native coronary and its graft present critical stenosis.

Different groups clarified how the simultaneous evaluation of the native coronary bed and of the CABG allows to get to a risk assessment of subsequent coronary events (11-14). The presence of UCT determines a progressive and incremental risk of MACE that should be an indication to proceed with invasive CA, whereas the absence of UCT is a fairly certain sign not to proceed further with invasive tests. The wise use of this data in selected patients (sinus rhythm, good BMI, atypical angina pain and young grafts) could therefore translate CCT benefits into everyday practice, greatly reducing the need for invasive CA and related hospitalization and cost in a substantial proportion of patients.

Looking at the future, more powerful scans with higher spatial resolution, and the implementation of software to derive functional information (i.e., perfusion study and Fractional Flow Reserve Computed Tomography), will further increase the ability to exclude the probability of significant disease (15,16). Furthermore, the increasing acquisition speed in newer CCT scan with even more than 64 slices will offer the advantage of increasing contrast resolution in relation to adjacent structure; this would be an unquestionable advantage in the evaluation of smaller vessels like those distal to CABG anastomosis.

In conclusion, CCT should not be viewed as an alternative to invasive CA in patients who have undergone CABG surgery, but rather as a helpful adjunct that allows

the safe ruling out, in a good percentage of patients, of the presence or progression of coronary artery disease on the bypass or into the native coronary arteries, improving management and patient outcomes. Given the economic costs and the greater risk compared with not invasive procedures, it would appear attractive to reserve CA only for patients with an elevated risk of disease in the grafts or native vessels distal to the surgical anastomoses.

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## Footnote

*Conflicts of Interest:* The authors have no conflicts of interest to declare.

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