A major advance took place 10 years ago in the diagnosis of heart disease: multislice computed tomography (MSCT) using retrospective electrocardiogram (ECG) gating was able to image the coronary tree [1]. For the first time, cardiologists could use a non-invasive method to assess coronary stenosis and atheroma. The role of MSCT in routine clinical practice has now to be defined [2—4].

The diagnostic and predictive value of bicycle or treadmill ECG tests, stress imaging and invasive coronary angiography are documented by a large body of evidence, and their use in guiding patient management is well established and codified in clinical guidelines [5,6]. The use of computed tomography (CT) versus angiography has been widely evaluated, initially with small studies involving highly specialized teams, and more recently in a multicentre evaluation [7] and a meta-analysis [8]. At first, exploration using coronary CT appeared unsuitable for all cases. Regular and low sinus rhythm is necessary, patients must be able to tolerate a 5 to 10-second episode of apnoea and an experienced team is needed to perform the test.

Non-obstructive coronary atheroma can be responsible for the development of acute coronary syndromes. This condition is assessable with MSCT, unlike stress tests or, in certain cases, conventional coronary angiography [9]. The prognostic value — the major concern for patient care — of MSCT has also been evaluated successfully in small studies [10,11]. In contrast to stress tests that identify only two groups (subjects with or without obstructive atheroma), coronary MSCT further identifies a third group: subjects with non-obstructive atheroma. New challenges will emerge regarding medical treatment as this newly identified group has a poorer prognosis than patients without coronary atheroma [10]. Should we, for example, consider patients with non-obstructive atheroma for primary or secondary prevention?

Recent technical evolutions offer new perspectives: acquisition of the entire heart in one beat with approximately 1 mSv radiation exposure may extend the use of coronary CT...
and may broaden the field of indications. This very low dose, equivalent to the natural irradiation dose received during a 4-month stay in Brittany is no longer an issue, and has to be compared with the 10—15 mSv current exposure emitted for coronary CT.

The current status of cardiac CT means that it is unlikely to replace any of the cardiac exploration methods in use today. Diagnostic tests are valuable only if they lead to a treatment associated with better clinical outcomes; to date coronary CT has not been proven to have a direct effect on clinical outcomes.

The presence of calcification, a major component of atheroma, compromises stenosis assessment. In a recent multicentre study, 22% of the original cohort were excluded because they had an Aggoston calcium score greater than 600 [7]. Moreover, CT performance was logically compared with angiography alone, with a cut-off value of 50% stenosis. This measure, when considered alone, is of little value in the decision to perform revascularization, which has to be functionally driven. Documentation of ischaemia is still necessary before considering revascularization, and stress tests are warranted after the identification of greater than 50% stenosis. CT scanning will not replace conventional angiography, not only because the latter has a better spatial and temporal resolution, but also because most of the revascularization can be performed during the same diagnostic procedure.

The indications for CT angiography depend on the performance of the CT scan or on other explorations in the defined clinical condition (left bundle branch block [LBBB], inability to perform a stress test, inconclusive test) and the pretest probability of coronary disease. Most of the available accuracy data concerning the detection of coronary stenoses by CT angiography have been obtained in patients with suspected coronary artery disease and stable symptoms. The consistently high negative predictive value (NPV) in all of these studies suggests that CT angiography will be clinically useful to rule out coronary stenoses in this patient group. In patients with a very high pretest likelihood of disease, the use of CT angiography will most likely not result in a ‘negative’ scan that would help avoid invasive angiography. Therefore, the use of CT angiography should be restricted to patients with an intermediate pretest likelihood of coronary artery disease.

A recent meta-analysis [8] carried out to assess the performance of 16- versus 64-slice CT showed, respectively: 95% versus 97% sensitivity (P = 0.03); 69% versus 90% specificity (P < 0.001); 79% versus 93% positive predictive value (PPV) (P < 0.001); 92% versus 96% NPV (P < 0.001). Sixty-four-section spiral CT had a significantly higher specificity and PPV on a per-patient basis compared with 16-section CT for the detection of greater than 50% coronary artery stenosis. These promising results obtained from a meta-analysis of data from specialized, single-centre studies need to be considered in terms of the data from another recent multicentre study [7] showing a sensitivity of 85% (95% CI, 79—90), a specificity of 90% (95% CI, 83—94), a PPV of 91% (95% CI, 86—95), and a NPV of 83% (95% CI, 75—89). However, CT angiography was similar to conventional angiography in its ability to identify patients who subsequently underwent revascularization.

Several studies have evaluated the accuracy of CT angiography in specific clinical scenarios. The study by Boulmier et al. in patients with cardiomyopathy of unknown origin [12], published in this issue of Archives of Cardiovascular Diseases, shows interesting results: the sensitivity, specificity, PPV and NPV for detecting coronary artery disease were 87.5, 98.5, 67.7 and 99.6%, respectively, in the per-segment assessment, and 100, 91, 75 and 100% in the per-patient evaluation, in accordance with other studies [13]. In the same study, both the coronary venous system and left-ventricular ejection fraction (LVEF) were assessable. This ‘one-shot exploration’ can confirm LVEF dysfunction, classify whether or not the cardiomyopathy is ischaemic, and helps the intervention, should it be judged necessary, by considering either revascularization (in the case of diffused coronary disease or with characteristics of total chronic occlusions or calcifications) or resynchronization.

Imaging the coronary artery in patients with heart failure has several specific issues. Tachycardia is often present and the use of beta-blockers to lower the rhythm may be dangerous. Injecting a bolus of contrast medium may, by elevating LV diastolic pressure, lead to cardiac decompensation; thus the exploration has to be performed in specialized centres in stable patients. With reduced cardiac output, circulation time increases, and the delay between the injection of contrast medium and the scanning must be adjusted accordingly. Most scanners can make such adjustments automatically using a bolus tracking that triggers image acquisition. Some physiological aspects may improve the image quality: as cardiac output decreases image contrast increases because of reduced dilution of contrast medium by blood; left-ventricular dysfunction mechanically decreases coronary motion speed and amplitude, resulting in theoretically fewer motion artifacts. However, the image quality may not be as good as expected, probably because coronary perfusion can decrease as left-ventricular end-diastolic pressure increases.

LBBB was observed in 50% of the patients in the study reported by Boulmier et al. [12]. Many issues are apparent for functional non-invasive explorations in the case of LBBB. The diagnostic accuracy of stress myocardial perfusion imaging and stress echocardiography in patients with LBBB can be reduced because of heart-rate dependent reversible perfusion defects in the former and conduction-related abnormalities of septal motion or thickening in the latter. The treadmill test is also uninterpretable because of conduction abnormalities. In contrast, performance of the CT scan is not influenced by the presence of LBBB [14].

The pretest probability of coronary artery disease may impact on the diagnostic performance of the CT scan [4]. The specificity is lower in the high pretest probability group compared with the low pretest probability group, whereas sensitivity is lower in the per-segment analysis in the low pretest probability group. This observation can probably be explained by the higher calcium scores in the higher probability groups, which tend to overestimate the severity of stenosis. Because of the very high NPV, a negative CT scan in an intermediate estimated pretest probability reduces the estimated post-test probability almost to zero. Thus these patients would not need to have further downstream diagnostic tests. In their article, Boulmier et al. report a 41%
Positioning coronary multislice computed tomography as a pertinent tool for cardiac exploration

prevalence of coronary disease and criteria for ischaemic heart disease in 10% of patients. Thus coronary disease has been ruled out for more than 50% of the patients, positioning the CT scan as a pertinent tool in this indication.

Conflict of interest

None.

References


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