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Integrating Cardiac CT and Nuclear Imaging: Protocols for SPECT-CT

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Appropriate diagnosis and therapy of coronary artery disease (CAD) frequently require information about both the morphological and functional status of the coronary artery tree. Thus, combined imaging consisting of invasive coronary angiography (ICA) plus myocardial perfusion imaging (MPI) is practiced in clinical routine diagnostic of patients with stable angina since many years and can therefore be accepted as the reference standard in the diagnosis of hemodynamically relevant coronary artery stenoses.

Both morphological and functional information are mandatory for the decision of performing an interventional therapy or initiating/maintaining medical treatment in numerous symptomatic patients. The hemodynamically relevance of coronary artery lesions is a major condition to decide whether an interventional therapy should be performed or not.

A non-invasive concept providing both information could provide accurate allocation of perfusion defects to their determining coronary lesion and specific morphological and functional classification of patients with coronary artery disease.

In symptomatic patients, a normal stress MPI confers a very low short-term risk for cardiac death and/or acute myocardial infarction. However, a normal MPI does not exclude the presence of underlying coronary atherosclerosis, which may be extensive although not yet flow-limiting. This was particularly true in patients who were at intermediate or high risk by Framingham criteria. In this regard, CT will unmask a sizeable subgroup of patients with coronary atherosclerosis who should receive more intensive anti-atherosclerotic intervention than would have been indicated by MPI results alone. Knowledge regarding the presence and extent of subclinical coronary atherosclerosis in patients who do not have ischemia by MPI can be of importance in patient management.

Additionally, the combination of SPECT and CT Angiography might play a potentially important role in the noninvasive diagnosis of CAD and introduce an objective decision-making tool for assessing the need for interventions in each occluded vessel.

Particular in terms of planning interventional therapy but also for clinical assessment and effective treatment of CAD the integration of sequential, near-simultaneous anatomic and physiologic information from CT and MPI might be of value. The combined SPECT/CT device provides noninvasive CT-based evaluation of coronary anatomy in the same setting with the MPI evaluation of its hemodynamic significance and might therefore offer higher clinical efficacy than the current clinical diagnostic methods. Although this can be achieved by mental integration of the information from ICA and MPI, standard myocardial distribution territories correspond in only 50%–60% with the real anatomic coronary tree.

Consequently, in addition to being intuitively convincing, 3D SPECT/CT fusion images in CAD provides added diagnostic information on the functional relevance of coronary artery lesions.

Additionally, in the clinical setting of patient screening, CT calcium scoring is mainly used for asymptomatic patients who are at least at intermediate risk for coronary atherosclerosis. Current guidelines recommend that asymptomatic patients with a CACS of <100 not undergo MPI, since this group has a low likelihood of significant CAD, a very low incidence of stress-induced ischemia (<2%) and an exceedingly low cardiac event rate. Notable exceptions may include asymptomatic high risk patients like diabetics. Conversely, patients with a CACS of ≥ 400 should routinely undergo MPI – this group has a high likelihood of having an ischemic perfusion defect irrespective of symptom status, and particularly where diabetes mellitus is present.