initial filter for coronary angiography. Absence of coronary calcium on EBCT has a negative predictive value of >95% for the presence of obstructive CAD and the occurrence of future coronary events. Although measurement of coronary calcium by EBCT has its limitations, the absence of coronary calcium, together with other risk factors, will certainly be more cost-effective.

We suggest to use a two-staged diagnostic approach for risk stratification prior to coronary angiography, with EBCT as first step and selective use of non-invasive stress tests (MPS, cardiac stress magnetic resonance imaging, or stress echocardiography) in patients with intermediate calcium scores as second step. Patients with low calcium scores do not need coronary angiography, and patients with high calcium scores should undergo coronary angiography without non-invasive stress testing. This approach will result in a low rate of coronary angiographies in patients without obstructive CAD, in combination with a more optimal identification of patients requiring revascularization therapy. Given the costs of EBCT and MPS, a two-staged approach will certainly be more cost-effective.

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Gatekeeper for coronary angiography: reply

We thank Geluk and Zijlstra for their kind words as well as their considerations and proposals. The latter hits right into the heart of the issue: should one stick to the 'anatomic' paradigm urging us to detect and treat coronary stenoses and calcifications rather than follow the 'physiological' approach to examine for and potentially treat the hyperfusion, often but not always, caused by stenoses?

Following the first paradigm, a sensitivity of 81% for obstructive coronary artery disease (CAD) and may be even one of 95% for three-vessel disease should be considered suboptimal in what Geluk and Zijlstra term a not-low-risk population. In their opinion, this speaks of using a costly technique such as electron beam computed tomography as a filter detecting coronary calcifications, i.e., a late manifestation of CAD, because the absence of calcifications implies a high negative predictive value with regard to CAD.

However, from a physiological point of view, the reasoning by Geluk and Zijlstra is somewhat upside down. If accepting that angina pectoris is caused by myocardial hyperfusion or ischaemia, one should primarily prevent, detect, and treat this condition rather than stenoses per se which do, far from always, cause reduced perfusion. Secondly, one should examine whether or not regional myocardial ischaemia is reversible, as revascularization is ineffective in patients with irreversible or fixed perfusion defects. Consequently, it is only when reversible ischaemia has been documented that invasive treatment and preceding catheterization is justified, especially if one considers the cost and risk associated with these procedures. Therefore, MPS is preferable as gatekeeper rather than angiography or EBCT because none of these methods provides information on ischaemia or hyperfusion. The often used argument that MPS may overlook three-vessel or left main disease is hardly relevant because in our intermediate risk population (in which MPS is generally considered most useful), we 'overlooked' severe coronary disease in only 1%. In addition, it has been shown years ago, before the advent of modern medical treatment, that it is only a minority of patients with three-vessel or left main disease who will live longer with coronary revascularization than without, namely patients with depressed left ventricular function. All our patients with normal perfusion and 'overlooked' severe CAD had a normal ejection fraction.

Absence of coronary calcium on EBCT may have a high negative predictive value for the presence of obstructive CAD but not for the atherosclerotic process, which is rational to detect and treat if reversible ischaemia is present. In fact, with the advent of non-invasive angiography with 64-vessel CT, we fear that the search for coronary calcifications will spread and intensify like a steppe fire and lead to even more catheterizations and revascularizations unless MPS (and the presence of reversibility and not coronary calcium) is used as filter early in the work-up process.

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