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Obesity and the Challenges of Noninvasive Imaging for the Detection of Coronary Artery Disease

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ABSTRACT

Obesity is a significant health problem that could potentially lead to increased cardiovascular risk. Noninvasive imaging plays an important role in the evaluation of cardiovascular symptoms and risk of these patients. Selection of the appropriate test in the diagnosis of obstructive coronary artery disease in this unique population is important. In this article, we focus on the strengths, limitations, and recommendations of the various noninvasive cardiac imaging modalities available in the detection of obstructive coronary artery disease. We have suggested an algorithm to help direct investigation. Ultimately, patient management should be individualized based on clinical judgement, test availability, and local expertise.

RÉSUMÉ

L'obésité est un important problème de santé qui pourrait entraîner l'augmentation du risque cardiovasculaire. L'imagerie non effractive joue un rôle important dans l'évaluation des symptômes et du risque cardiovasculaires de ces patients. La sélection de tests appropriés au diagnostic de la coronaropathie obstructive de cette population unique est importante. Dans le présent article, nous nous concentrons sur les forces, les limites et les recommandations des diverses modalités d'imagerie cardiaque non effractives disponibles pour la détection de la coronaropathie obstructive. Nous avons suggéré un algorithme pour faciliter l'examen direct. Finalement, la prise en charge des patients devrait être individualisée selon le jugement clinique, la disponibilité des tests et l'expertise locale.

Patients with obesity, defined as a body mass index (BMI) of $\geq$ 30 kg/m^2, are increasingly referred for investigation of coronary artery disease (CAD). There is scant literature defining optimum testing strategies and comparison to the gold standard of angiography or how well they predict event rates during long-term follow-up.

The debate over the initial use of invasive coronary angiography to image these patients is beyond the scope of this article, but some centres prefer this approach because radial access has significantly reduced the morbidity of this procedure in this group and the test is definitive.

In this article, we focus on the strengths, limitations, and recommendations of noninvasive cardiac imaging modalities available for the detection of CAD in the patient with obesity.

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See page 226 for disclosure information.

Why Is Obesity an Issue for Noninvasive Imaging Tests?

An increase in soft tissues might reduce image quality, which might ultimately affect test sensitivity and specificity (Figure 1). Table weight and bore size limits are also limitations for imaging patients with obesity, except with stress echocardiography.[1]

There are assumptions of an increase in the number of noninterpretable studies that might lead to misdiagnosis, and further downstream utilization of resources and increased costs, but as yet not well supported in the literature.

When Does One Consider Investigation?

The decision to investigate for obstructive CAD is currently similar to that in the general population, and is based on clinical symptoms and/or the presence of multiple risk factors.

Symptoms such as chest pain and dyspnea form the basis of most imaging referrals. Asymptomatic patients should be tested only if functional capacity is poor and/or with

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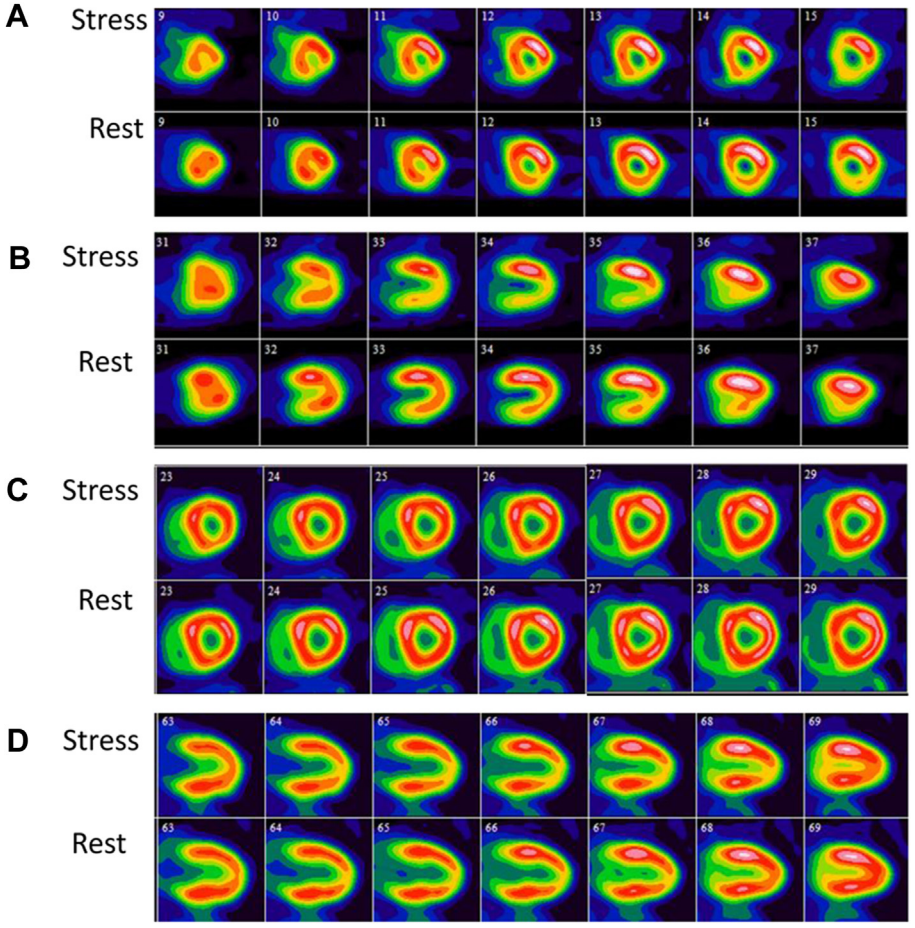

Figure 1. Stress thallium-201 single photon emission computed tomography (**A**, short axis, and **B**, vertical long axis images) in a 48-year-old woman who presented with atypical chest pain and a body mass index of 35. There is a mildly reversible perfusion defect in the inferior and inferolateral walls suggestive of mild ischemia in the right coronary artery territory. The patient was subsequently referred for rubidium-82 positron emission tomography (**C**, short axis, and **D**, vertical long axis images). Rest and stress perfusion images were normal and gated images showed normal wall motion. There was partial volume artifact at the apex of the left ventricle. She underwent coronary angiogram which showed mild coronary artery disease. Single photon emission computed tomography findings were believed to be artifact related to the patient's body habitus. She was given aspirin and rosuvastatin in addition to her antihypertensive medications. The patient started a graded exercise program and maintains an active lifestyle with good functional capacity.

multiple risk factors for CAD. Thus, patients with obesity are at risk of a lower threshold for investigation related to symptoms such as dyspnea, poor cardiovascular fitness, and musculoskeletal limitations.

Before investigation, the pretest likelihood of obstructive CAD should be determined and used as a guide for investigation, using the patient's clinical characteristics of chest pain features, age, and sex (Supplemental Fig. S1). This model does not include risk factors because they are believed to be dwarfed in prediction models when clinical features are used. This approach is used frequently in guidelines, including the recent update by the Canadian Cardiovascular Society.[2] Those with an intermediate pretest likelihood of obstructive CAD (10%-90%) are best served with noninvasive testing. Testing should be avoided in those with a low pretest likelihood of obstructive CAD (< 10%), unless there are associated significant risks factors (Supplemental Table S1).

Noninvasive Cardiac Imaging Tests

Single photon emission computed tomography

Single photon emission computed tomography (SPECT) can be used with exercise, vasodilator (eg, dipyridamole [persantine]), and dobutamine stress. Two-day protocols with larger tracer doses, which are weight based, are used in patients who are > 250-350 pounds. Improved cameras, software, computed tomography (CT)-based attenuation correction algorithms and prone imaging are newer techniques that enable a reduction of attenuation artifacts, in combination with gated imaging. Accuracy increases with SPECT, when using 99m-technetium-labelled radiotracers. A large literature identifies patients with high-risk severe coronary disease using SPECT.[1]

The use of SPECT imaging was reviewed in 433 patients with BMI $\geq$ 40 kg/m^2. Image quality was suboptimal in only 2% of patients, good in 61%, and adequate in 37%. Male sex