

Original article

Assessment of coronary bypass graft patency by first-line multi-detector computed tomography

Évaluation de la perméabilité des pontages coronaires par scanner multi-détecteur en première ligne

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Abstract

The purpose of the study was to assess whether a strategy based on a MDCT performed routinely before CA can reduce the radiation dose during the CA, without increased global exposure in patients who need imaging of CABG. A total of 147 consecutive patients were included. The radiation dose during CA (KAP 12.1 vs 22.0 Gy/cm², $P < .01$) and the volume of iodinated contrast (155 vs 200 mL, $P < .02$) were reduced when preceded by a MDCT. Patients' cumulative exposures were not different in the 2 strategies (5.0 vs 5.1 mSv, $P = .76$). MDCT performed in first line is a valuable strategy for the assessment of CABG.

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Keywords: Multi-detector computed tomography; Coronary artery disease; Coronary artery bypass grafts; Coronary angiography; Percutaneous coronary intervention

Résumé

Le but de cette étude était d'évaluer si une stratégie basée sur un scanner multi-détecteur réalisé systématiquement avant une coronarographie peut réduire la dose de rayonnement au cours de la coronarographie, sans augmentation de l'exposition globale chez les patients qui ont besoin d'une imagerie de leurs pontages coronaires. Cent quarante-sept patients consécutifs ont été inclus. La dose de rayonnement lors de la coronarographie (KAP 12,1 vs 22,0 Gy/cm², $p < 0,01$) et le volume de produit de contraste iodé (155 vs 200 mL, $p < 0,02$) ont été réduits quand elle est précédée par un scanner multi-détecteur. Les doses cumulées des patients n'étaient pas différentes dans les deux stratégies (5,0 vs 5,1 mSv, $p = 0,76$). Le scanner multi-détecteur réalisé en première ligne est une stratégie valable pour l'évaluation des pontages coronaires.

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Mots clés : Scanner multi-détecteur ; Coronarographie ; Pontages coronaires

1. Introduction

The natural history of coronary artery bypass grafts (CABG) involves a high risk of occlusion. A total of 25% of grafts are found to be occluded within 5 years after surgery [1], and patency rates at 10 years average 60% for venous grafts and 90% for

arterial grafts [2]. Conventional coronary angiography (CA) is the gold standard for imaging of CABG, but it is time-consuming, exposes the patient and the operator to higher doses of radiation [3], and may lead to an incomplete assessment of the CABG.

The cardiac multi-detector computed tomography (MDCT) is an effective and accurate tool for the detection or exclusion of coronary artery disease (CAD) [4–6]. MDCT has been proposed as a non-invasive technique for the evaluation of CABG lesions [2,6,7]. MDCT can demonstrate the patency of graft with

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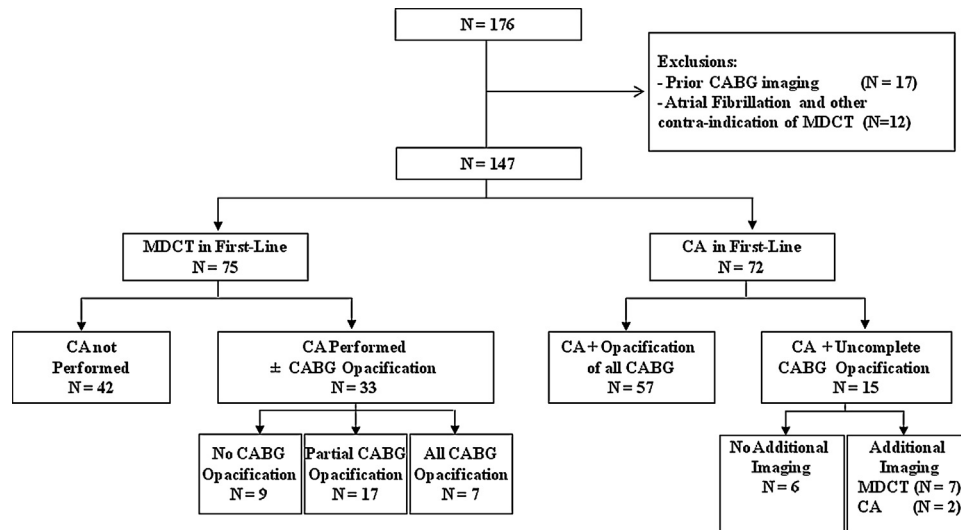


Fig. 1. Patient flow diagram for selection of patients referred to coronary artery bypass graft imaging. MDCT: multi-detector computed tomodensitometry; CA: coronary angiography; CABG: coronary artery bypass graft.

a diagnostic accuracy up to 100% for the detection or exclusion of significant stenosis in arterial and venous grafts [7]. MDCT has initially suffered from high doses of radiation, up to 29 milliSievert (mSv) [8,9], and can now be achieved with low doses less than 5 mSv [10,11].

Although MDCT is very effective in the assessment of CABG, the usefulness of MDCT performed systematically before, or instead of CA has not been evaluated in current practice, to our knowledge. The aim of the study was to assess the usefulness and hazards of a strategy based on a low-dose MDCT performed systematically before CA in ischemic patients awaiting CABG imaging, compared to a classical strategy of first-line CA. The first step was to analyse the additional clinical value of first-line MDCT for assessment of CABGs and native coronary arteries. The second step was to test the hypothesis that the radiation dose to the patient during angiographic assessment of CABG and/or native coronary arteries is significantly decreased when a MDCT has been performed in first-line. The third step was to compare the cumulative effective dose to patient related to either MDCT or CA, or both, between the two diagnostic strategies.

2. Methods

2.1. Patients

We conducted this prospective non-randomized study in 176 consecutive coronary patients with history of CABG who were referred to our institution between June, 2010 and June, 2012 for assessment of CABG. Indications for CABG imaging were suspected stable angina pectoris or silent ischemia with documentation of significant ischemia during stress ECG, scintigraphy or echocardiography, and non-ST elevation acute coronary syndromes at low or intermediate risk. Patients with ST elevation myocardial infarction and high risk non-ST elevation ACS were excluded. Other exclusion criteria were persistent or permanent atrial fibrillation, allergy to iodine-containing

contrast media, renal insufficiency, and unstable hemodynamic condition ($n = 12$), and knowledge of CABG status on prior imaging ($n = 17$). A total of 147 patients were included into the study (Fig. 1). Procedures were in accordance with institutional guidelines. The institutional review committee approved the protocol study and all included patients gave their written informed consent.

2.2. Diagnostic strategies

Patients were split into 2 groups, according to the diagnostic strategy. In the first one (group 1), MDCT was performed in first-line in all patients. CA was not systematically performed, and was indicated only when:

- first-line MDCT was unable to analyze all the CABG;
- first-line MDCT showed one or more CABG injuries;
- MDCT suggested at least one lesion on native coronary artery, suitable for a percutaneous coronary intervention (PCI).

In the control group (group 2), CA was performed in first-line without prior MDCT. Patients of this group in whom CA failed to visualize one or more grafts might undergo a second-line MDCT or a new CA. A minimum of 48 hours was required between MDCT and CA for patients undergoing successive procedures. During the study period, cardiologists who referred to patients and cardiologists of the institution were informed of the possibility of performing first-line MDCT. In the absence of randomization, the choice of the strategy was at the physician discretion, and mainly took into account the clinical presentation of the patient and the availability of the MDCT.

2.3. Computed tomography angiography analysis

All patients were scanned with a 64-detector CT with prospective acquisition and iterative reconstruction (Discovery 750 HD or VCT Lightspeed 64; GE Healthcare, Milwaukee,

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