Coronary Artery Bypass Using only Computed Tomography as Pre-Operative Angiogram

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Coronary artery bypass graft (CABG) is a well established procedure with current precise indications. The advent and spread of this technique was possible after the introduction of the coronary angiogram. Although many evaluation methods have been developed in the past years, to date, none have been able to replace the invasive coronary angiogram as a pre-operative exam. Computed tomography angiography (CTA) has emerged as an alternative to invasive coronary angiogram. In this report we describe two CABG cases that were performed using only this technique as a pre-operative anatomic coronary arteries evaluation.

Background

Coronary artery bypass graft (CABG) is a well-established procedure with current precise indications. The advent and spread of this technique was possible after the introduction of the coronary angiogram by Sones[1]. The technique allowed precise identification of coronary stenosis and thus correct graft placement.

Although many evaluation methods have been developed in the past years, many of them non-invasive, to date, none have been able to replace the invasive coronary angiogram as a pre-operative exam, providing accurate coronary vessel topography, in order to perform the CABG.

Recently, the computed tomography angiography (CTA), especially the 64-slice CT, has emerged as an alternative to invasive coronary angiogram, with high sensitivity, specificity and predictive values, when compared to the gold standard method[2]. The main focus of the method, regarding cardiac surgery, is the evaluation of bypass patency.

To date, there have been no reports of CABG performed using the CT as the only pre-operative form of coronary angiogram. In this report we describe two CABG cases performed using only this technique as a pre-operative anatomic coronary artery evaluation.

Key Words

Coronary Angiography; Myocardial Revascularization; Tomography, Emission-Computed.

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Case Reports

Case 1

A 68 year-old male patient, with stable angina pectoris and numerous risk factors (tobacco, hypertension, high serum cholesterol and sedentary lifestyle) was admitted to our facility for a routine evaluation. The non-invasive stress test (echocardiogram) showed an ischemic area in the anterior left ventricle wall, in addition to normal ejection faction (60%) and ventricular diameters. Sinus rhythm was present.

A 64-slice CTA (Sensation Cardiac) was performed, indicating a single severe obstruction in the proximal left anterior descending (LAD) artery. No artifact images were present at the examination, and good visualization of the vessel was achieved (Figure 1).

Superimposing of images of the ischemic areas of the two non-invasive studies allowed a safe assessment of the coronary anatomy and stenosis.

The patient's free and informed consent was obtained. The patient underwent an off-pump CABG and a left internal

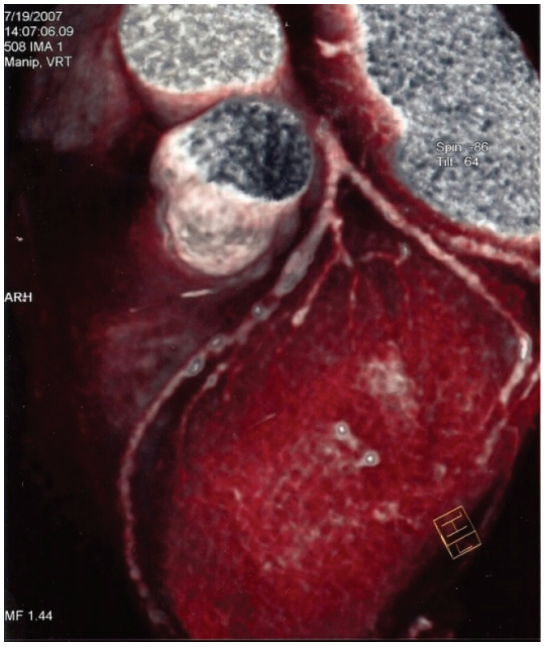

Figure 1 – Coronary angiotomography disclosing a proximal lesion in the anterior descending artery (ADA).

mammary artery (LIMA) to LAD graft was performed. Intra-operative and post-operative periods were uneventful. The control non-invasive ischemic test demonstrated relief of ischemia and the patient became asymptomatic.

Case 2

A 62-year-old male patient, with previous myocardial infarction and multiple risk factors (tobacco use, hypertension and diabetes) was admitted to our unit with stable angina and a positive, non-invasive, ischemic test for evaluation.

A 64-slice CTA (Sensation Cardiac) was performed, indicating a single severe obstruction in the proximal LAD. No artifact images were present at the examination, and good visualization of the vessel was achieved.

Superimposing of images of the ischemic areas of the two non-invasive studies allowed a safe assessment of the coronary anatomy and stenosis.

The patient's free and informed consent was obtained. The patient underwent an off-pump CABG and a LIMA-LAD graft was performed. Intra-operative and post-operative periods were uneventful. The control non-invasive ischemic test could demonstrate relief of ischemia and the patient became asymptomatic.

Comments

The first reports of the use of CTA for the evaluation of CABG are from the 80´s[3]. Unfortunately, for many years the technique remained underused, mainly due to inadequate resolution, capture speed and ECG gating. In the last years, interesting news has been reported about the method. New 64-slice CTA equipment is now able to provide improved images with a resolution and capability similar to conventional invasive coronary angiogram with high sensitivity and specificity[2].

The majority of studies aim to assess the grafts, not the native coronary vessels. Because of that, there is still a lack of consistent information regarding the method's capacity to correctly define the native coronary bed. A recent report demonstrated a diagnostic accuracy of 97% in detecting lesions in patients with suspected coronary artery disease[4].

In spite of these good results, some technical issues remain unsolved. Breath holding, presence of metal clips (re-operative patients) and intense calcium artifacts reduce image quality and the method's cpacity to provide precise and perfect images. The evaluation of the retrograde flow is another question; the evaluation of the distal anastomotic site is still challenging[5].

The role and effectiveness of CTA is controversial and lack a strong evidence base to allow a widespread use and avoidance of invasive study. A recent meta-analysis demonstrated that CTA is comparable to invasive angiogram in evaluating grafts, but could not demonstrate the same regarding native coronary vessels and suggested new randomized clinical trials in order to achieve sufficiently powerful evidence to clarify this issue[6].

On the other hand, the demand for a precise, rapid and non-invasive method for assessing the coronary tree is mandatory. The risk of invasive coronary angiography is low, but the complications are serious and many of them are life-threatening[7]. Furthermore, the use of radiation is increased in CTA, comparable to invasive angiogram.

In re-operative patients the use of CTA can provide useful information as graft position for a safer sternotomy, not only patency. In this scenario, the use of only CTA to perform CABG is limited to a small number of patients with well-defined lesions, no intense calcium presence and avoidance of artifacts. The absence of arrhythmias, such as atrial fibrillation, and a low cardiac frequency are mandatory.

The constant evolution of computed tomography images and software to reduce artifacts with improved acquisition speed will probably, in a near future, provide images comparable to the gold-standard invasive coronary angiogram. This evolution will represent a cornerstone in the coronary artery disease assessment and treatment, giving a better opportunity to the patient and his clinician, interventional cardiology and surgeon to choose the better approach to CAD in each specific situation, no longer under the pressure of an in-site catheter presence.

The advancement and improvement of the recent CTA will probably, in a near future, provide adequate native and coronary graft visualization and assessment, allowing this technique to be the only method needed in the pre-operative and post-operative periods.

The possible avoidance of invasive coronary angiogram will reduce patients' risks and will provide a valuable tool in the pre-operative selection of the best CAD treatment, including CABG.

Potential Conflict of Interest

No potential conflict of interest relevant to this article was reported.

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Study Association

This study is not associated with any post-graduation program.

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