

Potential role of coronary computed tomography angiogram in cardiac preoperative evaluation

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ABSTRACT

Preoperative assessment of the cardiac patients before noncardiac surgery is concern in the clinical practice of anesthesiologist, surgeon, and medical consultant. The preferred stress testing is exercise electrocardiogram (ECG) in patients who are able to exercise and have normal ECG; however, either stress myocardial perfusion scintigraphy (MPS) or stress echocardiography is necessary if further testing is appropriately indicated before surgery. Unfortunately, stress MPs or stress echocardiography is not widely available and has some limitations. Coronary computed tomography angiogram (CCTA) has demonstrated excellent diagnostic accuracy in detecting coronary artery disease and accurate left ventricle function measurement. CCTA seems to be feasible, reliable, and has strong potential of becoming sole screening test before surgery.

Key words: Cardiac preoperative evaluation, coronary computed tomography angiogram, stress echocardiography, stress myocardial perfusion scintigraphy

INTRODUCTION

We report a case of preoperative evaluation before major noncardiac surgery where preoperative cardiac testing is appropriately indicated in a 56-year-old male patient with very poor exercise capacity and less than 4 metabolic equivalents (METs). Stress myocardial perfusion scintigraphy (MPS) was not diagnostic due to bowel activity artifacts. Coronary computed tomography angiogram (CCTA) was diagnostic and revealed normal coronary artery anatomy and normal left ventricular (LV) function; the patient underwent the surgery without any perioperative cardiac complications.

CASE REPORT

A 56-year-old male patient with histologically proven colon cancer was referred to our institution for surgical resection. He had ongoing symptoms related to his malignancy, such

as alteration in bowel habit, weight loss, anemia, and poor functional capacity (e.g., he can walk indoor around his house but can not climb a flight of stairs or walk up a hill). He is known to have diabetes mellitus and hypertension; both are well controlled with medications. He had no history of coronary artery disease (CAD) such as angina pectoris, myocardial infarction (MI), or symptoms of heart failure. No previous cardiac work up has been preformed such as echocardiography, electrocardiogram (ECG), or exercise stress testing. At this admission, vital signs and physical examination were normal, except mild lower abdominal tenderness related to his primary colon cancer. ECG was normal. Apart from mild anemia, his comprehensive laboratory work up was normal. He was referred for stress MPS for cardiac risk stratification before elective surgery for colon resection. MPS was not diagnostic due to excessive bowel artifact that was located adjacent to the heart; both delayed and attenuation correction imaging was performed, but unfortunately, study still was not diagnostic [Figure 1]. Prone imaging which is commonly performed in such cases, to overcome attenuation artifact, could not be performed as patient developed sever abdominal pain. Subsequently, CCTA was performed and revealed normal coronary artery anatomy and normal LV function [Figure 2]. The patient underwent surgery without any perioperative complications, such as myocardial ischemia, MI, heart failure, or pulmonary edema.

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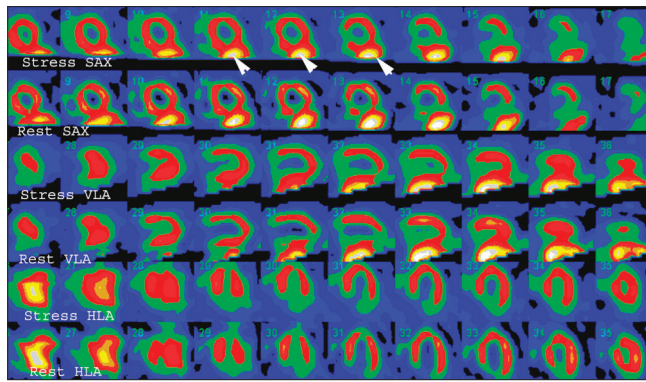


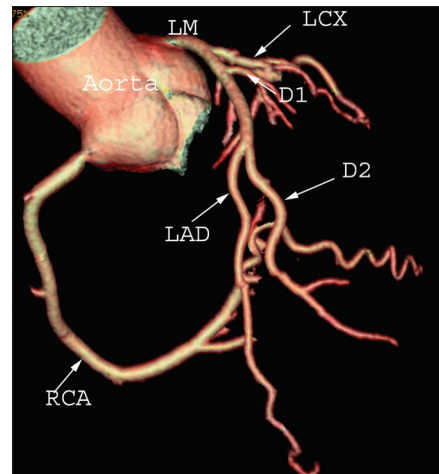
Figure 1: Nondiagnostic myocardial perfusion scintigraphy (MPS) due to excessive bowel activity adjacent to the inferior wall (arrow heads) in both stress and rest images renders it impossible to interpret the study

DISCUSSION

Cardiovascular complications are the major cause of perioperative mortality and morbidity. The majority of these complications occur during the first week after surgery. Important cause of perioperative cardiac event such as MI and death are myocardial ischemia, LV dysfunction, and aortic valve stenosis.^[1] CAD may be asymptomatic because of reduced exercise capacity caused by noncardiac disease such as stroke, arthritis, or claudication. To reduce perioperative morbidity and mortality, perioperative cardiac screening is of paramount importance in patients with risk factors or known CAD.^[2]

Noninvasive cardiac testing should not be regarded as a routine step in perioperative evaluation of even high-risk patients, unless test results have the potential to substantially affect patient's management, such results may prompt modification of pharmacological therapy, perioperative surveillance, and postoperative follow-up and management. However, exercise stress testing and noninvasive cardiac imaging should be considered in the assessment of perioperative risk in patients with multiple cardiac risk predictors undergoing high-risk surgery. In patients with normal ECG results who are able to exercise, the preferred test is exercise ECG testing, but in patients with abnormal resting ECG that preclude interpretation of exercise ECG test, stress cardiac imaging is indicated; in patients who are unable to perform adequate exercise, pharmacological stress imaging will be necessary.

Noninvasive imaging with MPS and stress echocardiography have been the most widely used test in perioperative evaluation, the choice of the test should be that in which center has the most experience and availability. MPS provides useful information about cardiac risk in patients requiring noncardiac surgery. MPS has been performed in this setting that showed the positive predictive value of



Figures 2: A Volume-rendered coronary computed tomography angiogram in the patient in figure one shows normal coronary artery. LM = Left main, LCX = Left circumflex artery, D1 = First diagonal artery, D2 = Second diagonal artery, and RCA = Right coronary artery

inducible ischemia for perioperative death or MI of 12.9%, compared with negative predictive value of 98.6%.^[3-5] Several studies of dobutamine stress echocardiography have also been performed showing comparable positive and negative value with MPS.^[6,7] The vulnerability of MPS to artifacts has been largely recognized as a major limitation of the technique, in addition, there are several limitations of MPS such as limited availability, ionizing radiation exposure, and expenses. The main disadvantages, if stress echocardiography includes relatively low sensitivity, particularly in single vessel disease, limited expertise, operator dependency, and poor acoustic window.

CCTA with multidetector computed tomography scanning has a recognized high negative predictive value and may provide a noninvasive alternative in this subset of patients. Results in the current literature show a high diagnostic accuracy in detecting significant coronary lesions and, particularly, an excellent capability of excluding them, due to high negative predictive value ranging from 96 to 99%.^[8,9] CCTA may be considered a complete screening test before noncoronary cardiac surgery (coronary artery anatomy, coronary artery stenosis, and ventricular function). Russo *et al.* showed that no cardiovascular perioperative complications such as myocardial ischemia, MI, or heart failure occurred in any patients with normal CCTA, and 30 of 36 patients with significant coronary artery stenosis (more than 50% luminal stenosis) by CCTA underwent bypass surgery or coronary angioplasty, but in 8 patients, CCTA overestimates the severity of coronary artery stenosis.^[10] Gillard *et al.* confirmed the high ability of CCTA to rule out significant coronary artery stenosis in patients with negative predictive value of 100%.^[11] Coronary angiography was performed in all patients as a gold standard reference. Although currently there are not enough data

available regarding the role of CCTA in the setting of the preoperative evaluation, it seems that CCTA is feasible and reliable in cardiac risk stratification and has the potential of becoming the sole test before high-risk surgery. Obviously, there are some limitation of CCTA, such as ionizing radiation exposure, need for iodine contrast, regular and slow heart rate, and most importantly patient cooperation.

In summary, coronary CTA offers comprehensive evaluation of coronary artery anatomy, severity of stenosis, and LV function. It is reasonable to consider CTA as an alternative test for stress MPS and stress echocardiography in the setting of preoperative evaluation.

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