CORONARY CTA VERSUS CARDIAC CATHETERIZATION

Essay

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By

Hend Abd El-Moneim Abd El-Maksoud

M.B.B.Ch.

Supervised by

Prof. Dr. Samer Malak Botros

Assistant Professor of Radio-diagnosis

Faculty of Medicine- Ain Shams University

Dr. Hossam Moussa Sakr

Lecturer of Radio-diagnosis

Faculty of Medicine- Ain Shams University

Faculty of Medicine

Ain Shams University

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Aim of the Work

To determine the role of MSCT coronary angiography as a non invasive imaging technique versus invasive cardiac catheterization in evaluating coronary artery diseases

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List of Abbreviations

ACS = Acute coronary syndrome

ALCAPA= anomalous origin of the LCA from the pulmonary artery

AS= Agatston Score

AVN = Atrioventricular node

AVGA = Atrioventricular groove artery

BMI= Body mass index

CAD Coronary Artery Disease

CHD =coronary heart disease

CS = Coronary sinus

CT= Computed tomography

CVD= cardiovascular disease

EBCT= Electron beam CT

ECG= Electrocardiogram

ESC= European society of cardiology

GRACE =Global registry of acute coronary event

IMB = Inferior marginal branch

LA = Left atrium,

LAD = Left Anterior descending artery

LCA= left coronary artery

LCx = Left circumflex artery

LDL= Low density lipoprotein

LV= Left ventricle

MCV = Middle cardiac vein

MDCT= Multi-detector CT

MIP=Maximum intensity projection

NSTEMI= non-ST-elevation myocardial infarction

OM =Obtuse marginal

PDA = Posterior descending artery

PLB = Posterior lateral branch

RCA = right coronary artery..

RV= Right ventricle

STEMI= ST-elevation myocardial infarction

TEE= Transesophageal echocardiogram

TIMI= Thrombolysis in myocardial infarction

VR= Volume rendering

Introduction

Atherosclerosis resulting in coronary heart disease is the single leading cause of death in the United States. Atherosclerosis is a heterogeneous disease that can manifest as stable fibrous lesions, unstable lipid-rich lesions, or mixtures of both in the vessel wall. Plaque composition is an essential predictor of plaque rupture and acute clinical complications **(Virmani R et al., 2000).**

Atheromas with areas of extracellular lipid and necrotic cores under a fibrous cap are most likely to cause death. Because >50% of patients die from coronary heart disease within hours of symptom onset, early detection of unstable plaques followed by aggressive risk-reduction therapy to prevent events appears to be the ideal therapeutic approach **(Fishman E K, 2004)**.

The reference standard for diagnosing coronary artery disease is selective cardiac catheterization with angiography using iodinated contrast media (CM), which provides high spatial resolution of the vessel lumen. However, this procedure requires arterial access. While arterial penetration allows percutaneous intervention to be performed immediately if necessary, it is also associated with a small risk of adverse events including bleeding, hematoma, infection, stroke, coronary artery dissection, and death **(Berry C et al., 2004).**

Moreover, angiography effectively demonstrates thrombotic occlusion or vessel stenosis, but does not elucidate the size or composition of atherosclerotic plaques. If a plaque is not obstructive-as many plaques prone to rupture are not-it may not be detected. Indeed, it is estimated that nearly two thirds of all myocardial infarction (MI) originate with atherosclerotic lesions that do not obstruct blood flow prior to rupture **(Madjid M et al., 2004).**

Thus, it is reasonable that 20% to 40% of patients considered at risk for cardiovascular disease have normal angiograms **(Kugelmass A et al., 2001).**

MSCT is the most accurate non-invasive angiographic modality for the detection or exclusion of coronary artery disease. All procedures can be performed within 10 minutes at 64MDCT. The absence of coronary artery calcification does not rule out CAD because atherosclerotic plaque detected by MSCT may represent different stages of coronary arterosclerosis. In 5-10% of patients with a calcium score of zero, investigators found a soft plaque only. MSCT angiography with iodinated contrast medium can demonstrate non-calcified atherosclerotic plaque.

It is well established that non-calcified soft plaque could be more likely to rupture and lead to acute vessel occlusion with unstable angina or myocardial infarction than plaque that is stabilized by calcifications **(De Ross A et al., 2006).**

Coronary CTA has several important advantages: it is noninvasive, can be performed quickly, and provides both intra and extraluminal information. Its disadvantages include radiation exposure, the need for intravenous (IV) contrast administration, and the need for beta-blockade in most patients **(Jacobs J E, 2006).**

Key technical requirements for coronary CTA are high temporal resolution (which minimizes motion artifacts and is achieved through fast gantry rotation), high spatial resolution (which enables detailed depiction of the coronary anatomy and is achieved through thin collimation), fast continuous coverage (which enables imaging of the entire heart in one comfortable breath-hold and is achieved through multislice CT), and synchronization to the heartbeat (which enables imaging during a consistent cardiac phase and is achieved through ECG gating) **(Jacobs J E, 2006).**

With the advances in multidetector computed tomography (MDCT) technology, CT angiography (CTA) of the coronary arteries using 64-slice or dual-source CT systems has evolved into a robust, alternative, noninvasive imaging technique to rule out acute coronary syndrome as the cause of acute chest pain. Reported sensitivities and specificities of coronary CTA can compete with those of catheter angiography. However, other life-threatening causes of acute chest pain, including vascular factors, such as pulmonary embolism and aortic dissection, and nonvascular factors, such as extensive pneumonia, may be missed by catheter angiography and dedicated cardiac CTA **(Hein P A et al., 2009).**

320-Detector Row, Single-Source, Single Focal Spot: has the largest z-axis detector coverage. It was released shortly after experiments with a 256-detector row MDCT prototype. Each detector element is 0.5 mm wide, yielding a maximum of 16-cm z-axis coverage. This configuration allows three-dimensional volumetric whole heart imaging during the diastole of one R-R interval. In 320-detector row CT, the entire heart is imaged with temporal uniformity (i.e., at the same time point without temporal delay from the base to apex). Furthermore, if the x-ray beam is turned on for a longer period, the scanner can capture the heart over one or more cardiac cycles. This has been described as four-dimensional CT or volumetric cine imaging **(Hsiao E M et al., 2010).**

Radiological anatomy of the coronary artery

The anatomy of the coronary vessels has been described in detail for at least 3 centuries. Strict anatomic descriptions of the coronary vessels are available from standard textbooks of gross anatomy. However, most of the textbook descriptions are based on views and perspectives obtained from tissue, until recently, most radiographic and clinical descriptions of the coronary arteries have been based on cine coronary arteriograms. Cardiac computed tomography (CT) provides detailed anatomic information, but its use requires a firm understanding of gross coronary anatomy **(Fiss, 2007) (**Fig.1,3).

Normal Radiological Anatomy of the Coronary Arteries

The right and left coronary arteries originate from the right and left sinuses of Valsalva of the aortic root, respectively. The posterior sinus rarely gives rise to a coronary artery and is referred to as the “noncoronary sinus: The right sinus is actually anterior in location and the left sinus is posterior. The myocardial distribution of the coronary arteries is somewhat variable, but the right coronary artery supplies the right ventricle (RV), and the left coronary artery (LCA) supplies the anterior portion of