

Review Article

Role of Coronary Computed Tomography Angiography in the Evaluation of Structural Heart Diseases

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Article History

Received: 18.11.2024

Accepted: 23.12.2024

Published: 26.12.2024

Journal homepage:

<https://www.easpublisher.com>

Quick Response Code



Abstract: The benchmark for noninvasive anatomic examination for the coronary arteries is now Coronary computed tomography angiography (CCTA). CCTA has a strong positive predictive value and an even greater negative predictive value, making it possible to quickly determine whether coronary plaque is present in a patient and to prioritize which patients require more invasive testing and treatment. From the standpoint of an interventional cardiologist, CCTA is useful in establishing whether invasive therapy is necessary, more so than stress testing. The anatomic evaluation from CCTA more closely resembles the anatomical assessment of a coronary angiography when combined with functional assessments than any other noninvasive evaluation.

Keywords: Coronary computed tomography, coronary artery disease, computed tomography, calcium scoring, cardiac heart disease.

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INTRODUCTION

Radiography plays a vital role in cardiac team care patient with a suspected heart attack or myocardial infarct required access to provide high quality and appropriate imaging in order to diagnose the problem and provide treatment [1]. From birth to adulthood, congenital cardiac lesions can present with symptoms at any point. Lesions like secundum arterial septal defect (ASD) and congenitally corrected transportation of great arteries (a condition in which the aorta and pulmonary artery are transposed, as the ventricles, resulting in congenital correction of circulation) are present in at least 10% of people with congenital heart disease (CHD) but are usually not diagnosed until adulthood [2]. Adults with suspected congenital heart disease can undergo diagnostic imaging procedures such as cardiac catheterization and angiography, magnetic resonance imaging (MRI), cardiac-gated computed tomography (CT), echocardiography, and chest radiography [3]. Accurate assessment of hemodynamics and function in addition to intra- and extracardiac anatomy was frequently necessary for the evaluation of CHD.

Acquired comorbidities, such as hypertension, atherosclerosis, occlusive coronary artery disease, pulmonary disease, and renal illness, are additional clinical issues for adults with CHD that may make medication or surgical treatment more difficult [4].

Cardiac Structures

The muscular organ that pumps blood into the vessels is called the heart. Through the systemic circulation and lungs, there are 4 chambers of heart that combined in atrio-ventricular pairs connected by valve system (Fig-1) [5].

Pulmonary circulation sends deoxygenated blood from the heart to the lungs. During inhalation the blood have highest concentration of CO₂ as compared to lungs. CO₂ diffuses from the blood to lungs to be exhaled. O₂ has a greater concentration in the lungs as compared to blood. Thus, O₂ diffuses from lungs to the blood then lungs become oxygenated. After the lungs, blood then flows back to the heart and enters systemic circulation where it sends out to the body.

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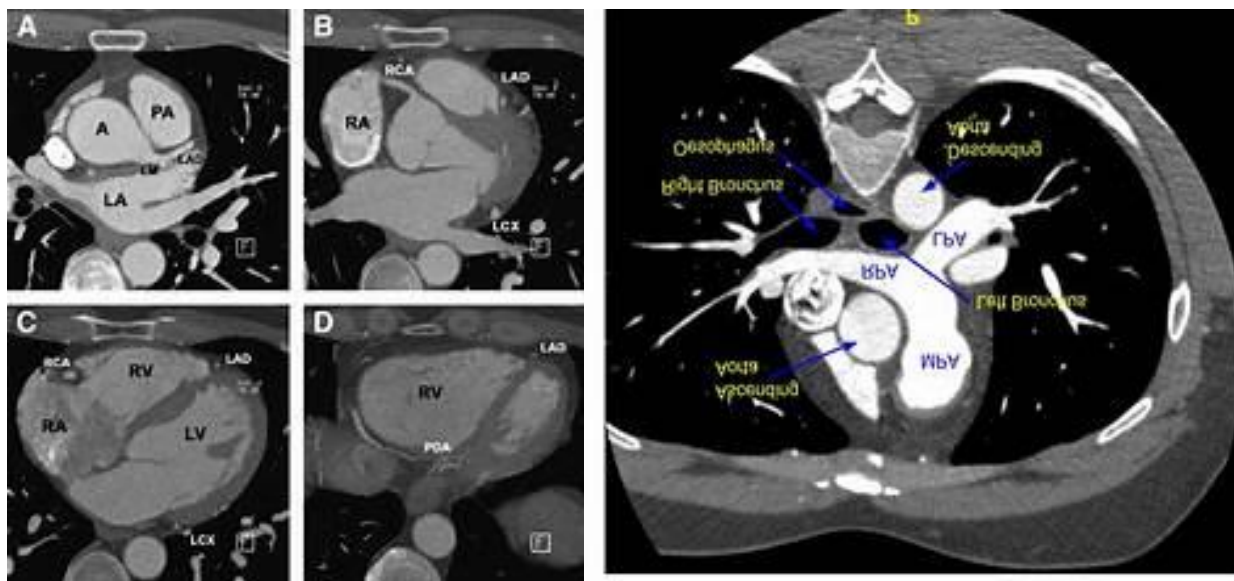


Fig. 1: CT image showing the different chambers of heart

Imaging Modalities for Angiography

- CT SCAN (Coronary Angiography)
- MRI (Cardiac MRI)
- ECHOCARDIOGRAPHY
- CATHETER ANGIOGRAPHY

CCTA [Coronary Computed Tomography Angiography]

It is a non-invasive, widely used method that is done with the help of a CT scanner machine along with the use of iodinated contrast media that is injected into the veins through high pressure by using pressure injector, also it is very painless method and does not take more time to complete. CT scan provides high contrast resolution and quality information about the blood vessels and cause of stenoses, heart diseases. The information that is received from the scan can be seen in multiple planes [coronal, axial, sagittal] and in 3D view through VRT [volume rendering technique].

CCTA has become more and more important in recent years for diagnosing and planning surgery for congenital heart problems and for adults who need to have surgery again to figure out how the heart and sternum are connected [6].

When someone has had multiple surgeries, the formation of strong cardio-sternal adhesions increases the risk of bleeding during the chest closing phase. As a result, CCTA imaging is an important tool for planning the reopening process and allowing doctors to choose a strategy with lower surgical risk [7].

Technical Parameters

The patient should be instructed about the procedure and advice not to take a heavy breakfast before the procedure. For the scan patient RFT should be normal

[0.3 – 1.5]. Vitals should be taken before the scan and in patients with heart rate of >60 b.p.m. up to four doses of 5 mg of metoprolol [beta blocker] were administered intravenously to lower the heart rate of the patient. And for dilation of vessels nitroglycerin is given sublingually.

IV contrast should be given to the patient according to the weight and height of the patient and also according to the age group. There were 16-0.75 mm of collimation with a 16-slice CT scan and 32-0.6 mm of collimation with a 64-slice CT scan that used a rotating electron beam to make two parallel X-ray beams. The oscillating electron beam (z-flying focal spot) makes the spatial precision better, which is the same as a 64-0.3 mm detector [8].

After everything is done, watch the patient to see if there is any contrast response. The patient should also be told to drink more water or other fluids.

Diagnostic Performance Coronary CT Angiography

The diagnostic accuracy of Coronary CT angiography to detect coronary artery stenosis compared with invasive coronary angiography is more. CCTA was expected to provide better prognostic information than other modalities in asymptomatic populations. Identification of the NCP component; and direct visualisation of the coronary arteries, which lets doctors find important stenosis like left main stenosis and 3-vessel disease, as well as the amount of plaque present. But as of now, there are no studies that show that CCTA is better at predicting the future than other methods. To begin, this is because CCTA was just recently introduced, so the number of heart events that have happened after the study has been limited. This is because the rate of cardiovascular events in people with no symptoms is very low (Fig 2) [9].

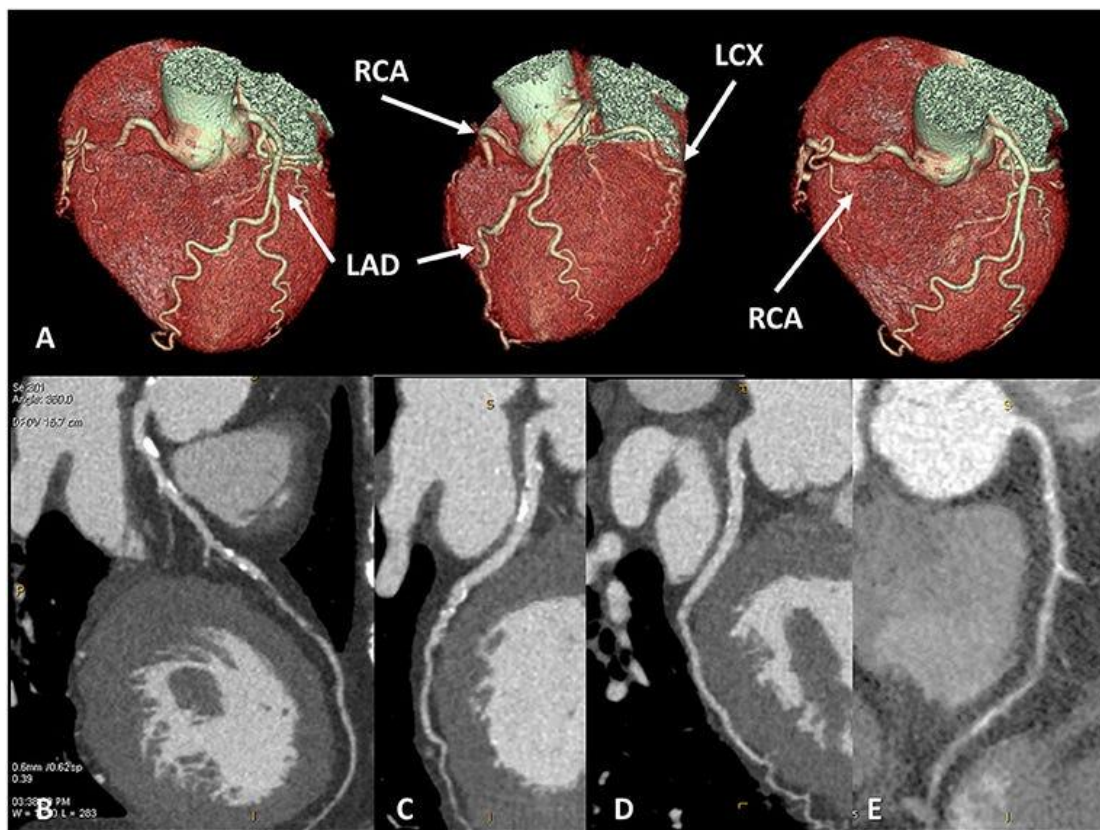


Fig. 2: Shows Coronary Arteries with the help of CT scan Reconstruction methods

Calcium Scoring Technique Used in Angiography

Calcium Scoring is a simple, reliable, and cheap way to find out if and how much calcified coronary artery plaque is present and it is also called Agaston’s score. It can be done on anyone who can hold their breath for 5–10 seconds and doesn't need contrast [10]. Guidelines for acquiring images for CAC testing have already been released. Apart from practicing holding their breath and staying motionless during the inspection, patients do not

need to make any extra preparations or obtain an IV [INTRA VENOUS]. While most clinics don't give any medication before CAC scanning. In computed tomography, the CAC score is calculated using axial slices that are 3 mm thick, don't overlap or have gaps, and are only of the heart. These slices are taken forwards in sync with the electrocardiogram at a set point in the R-R interval, usually in the middle to late diastole, and no intravenous contrast medium is used (Table-1) [11].

Table 1: Grading of CAD According to Calcium Score

Calcium Score	Presence of CAD
0	No evidence of CAD
1-10	Minimal evidence of CAD
11-100	Mild evidence of CAD
101-400	Moderate evidence of CAD
Over 400	Extensive evidence of CAD

What the future holds for CT scans in cardiovascular disease

With the development of CT technology. Interest in using this technology for non-coronary cardiac applications has grown. All cardiac CT can detect the stroke volume, ejection fraction, regional wall motion abnormalities by taking motion pictures of heart throughout the cardiac cycle [12]. Also, the CT has some limitations like high radiation exposure, availability, cost of cardiac CT is more than the other scans and modalities.

CONCLUSION

This is a critical time in cardiovascular treatment as new developments in cardiac CT and atherosclerosis imaging have transformed the early identification and accurate diagnosis of CAD. By modern facilities technologies, physicians can now accurately diagnose CAD in its early phases, leading to better risk assessment and customized treatment plans. These discoveries lead to better patient outcomes and open up the possibility for an evolution in a non-invasive manner. Agaston’s score also play a very vital role to

diagnose coronary arteries disease and reduce the occurrence of heart attack.

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Cite This Article: Mohd Arfat & Urooj Fatima (2024). Role of Coronary Computed Tomography Angiography in the Evaluation of Structural Heart Diseases. *EAS J Radiol Imaging Technol*, 6(6), 110-113.
