Original Research Article

"A Comaparitive Study on MSCT Coronary Angiographywith Conventional Coronary Angiography in Diadgnosis of Coronary Artery Disease in A Tertiary Care Center"

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Received: 20-10-2021 / Revised: 28-11-2021 / Accepted: 23-12-2021

Abstract

Background: The evolution of multi slice computed tomography (MSCT) in recent years has generated interest in its ability to detect the extent of obstructive CAD. The use of high-speed tube rotation, coupled with simultaneous acquisition of multiple slices and fast post processing imaging software has created the opportunity to acquire high-quality images of the entire heart within one breath-hold. **Aim:** To evaluate the diagnostic accuracy between dual source CT coronary angiography and invasive catheter coronary angiography with respect to site and degree of stenosis. **Material & Methods:Study Design:** Prospective comparative study. **Study area:** The study was done in the Department of Radiodiagnosis, Yashoda Hospital, Hyderabad. **Study Period:** 1st Feb. 2010 to 30th June 2010. **Study population:** patients who were recommended and referred for angiographic evaluation of suspected CAD by the Department of Cardiology. **Sampling method:** Purpose or convenient sampling method. **Study tools:** MSCT scan protocol, coronary angiography. **Statistical analysis:** The diagnostic performance of coronary angiography by MSCT for detecting obstructive CAD was compared to catheter angiography. The results were calculated as the sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV) of the investigation. **Results:** Out of 33 patients, 11 (33%) patients were females and 22 (67%) patients were males. The age of the study subjects ranged between 28 years to 80 years. In our study, most 27(81.8%)of the study population were having right dominant circulation, followed by 3 (9.09%) in left dominant circulation and remaining 3 (9.09%) were presented with codominance circulation.

Keywords: MSCT, CAD, CT angiography, stenosis.

Introduction

Cardiovascular diseases, especially coronary heart disease (CHD), are epidemic in India. The Registrar General of India reported that CHD led to 17% of deaths in 2010-2013. The World Health Organization (WHO) and Global Burden of Disease Study also have highlighted increasing trends in years of life lost (YLLs) and disability-adjusted life years (DALYs) from CHD in India. In India, studies have reported increasing CHD prevalence over the last 60 years, from 1% to 9%-10% in urban populations and <1% to 4%-6% in rural populations[1].

In the past decade, the usefulness of non-invasive imaging for the detection of coronary artery disease (CAD) has been explored using various modalities, such as magnetic resonance imaging (MRI) and electron beam computed tomography[2].However, despite encouraging early results, none of them has been able to provide consistent and reliable results with regard to evaluation of CAD in routine clinical practice. The evolution of multislice computed tomography (MSCT) in recent years has generated interest in its ability to detect the extent of obstructive CAD. The use of high-speed tube rotation, coupled with simultaneous acquisition of multiple slices and fast post processing imaging software has created the opportunity to acquire high-quality images of the entire heart within one breath-hold[3,4].

For ages Catheter Angiography has been the gold standard of coronary angiography. It also carries risk in patients with coagulation disorders and conditions related to increased vessel fragility. Catheter angiography is contraindicated in some patients[5].This makes it necessary to have a safe and reliable screening modality for evaluation of coronary arteries[6,7].With the advancement in technology efforts have been made to increase the accuracy in diagnosing coronary heart disease. Cardiac Imaging is the challenge of 21st century and it is being answered by dual source CT as it has good temporal resolution, high scanning speed as well as low radiation dose. The dose values of the dual source Siemens CT scanner thus lie far below that of an intracardiac catheter examination. A scan of the entire heart can be performed in only 250 milliseconds, which is less than half a heartbeat.With this background we have undertaken the study, to find out the experiences with the use of 64-slice MSCT to define the extent of CAD in a group of patients, using catheter angiography as the gold standard.

Aim: To evaluate the diagnostic accuracy between dual source CT coronary angiography and invasive catheter coronary angiographywith respect to site and degree of stenosis.

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Material & Methods

Study Design: Prospective comparative study

Study area: The study was done in the Department of Radiodiagnosis, Yashoda Hospital, Hyderabad.

Study Period:1st Feb. 2010 to 30th June 2010.

Study population: patients who were recommendedand referred for angiographic evaluation of suspected CADby the Department of Cardiology.

Sample size: All the patients who were referred for angiographic evaluation of suspected CAD by the Department of Cardiology within the study period.

Sampling method: Purpose or convenient sampling method.

Inclusion criteria: Subjects > 18 years old with clinical symptoms recruited from the Department of Cardiology and willing to participate in our study.

Exclusion criteria:1. Age below 18 years, 2. Non sinus rhythm,3. Breast feeding, 4. Pregnancy, 5. Serum creatinine > 1.5 mg /dL, 6. Allergy to iodinated contrast and not willing to participate in the study.

Study tools:

MSCT scan protocol

Pateint position: supine head first.
Iv line—antecubital vein -18 g .
Contrast -iomeprol-75-85 cc 400mg/ml.
Flow rate-5.5-6ml/sec
Saline-45cc
Flow rate-4..5ml /sec.
Direction -craniocaudal.

Coronary Angiography

A typical range of 12cm is predefined

Kv120	
Mas/rot./	
Qual. Ref. Mas/rot.	530
Rotation time	0.33sec
Acquisition	64 x 0.6mm
Slice collimation	0.6mm
Slice width	3.0mm
Feed/rotation	Auto
Pitch factor	Auto
Increment	3.0 mm
Kernel	b30f/b26f
Temp.resolution	83ms

Ethical consideration: Institutional Ethical committee permission was taken prior to the commencement of the study.

Data collection procedure: After obtaining institutionalEthical clearance, the purpose of the study was explained to the patients and their consent was taken in this regard.

Preparing for the CT coronary angiography : The patient recommended for CT coronary angiography will have a fasting time of 2 hours prior to the study. The patient will be asked to complete a safety questionnaire to identify any allergies to foods, drugs and iodine. All patients need a blood test to assess kidney function and in certain condition, Ultrasonography / urine pregnancy test to exclude pregnancy prior to the scan. Patients on Metformin are requested to discontinue the drug for 72hours prior and post investigation in elective cases.

Dual source computed tomography analysis: Coronary segments were defined according to the scheme of the AHA[8]. The right coronary artery (RCA) was defined to include segments 1–4; the left main artery (LM) to consist of segment 5, the left anterior descending artery (LAD) to include segments 6–10, and the left circumflex artery (LCX) to include segments 11–15. The intermediate artery was designated as segment 16, if present, and considered to belong to the LAD.The grading of stenoses is done as mild (<30%), mild to moderate (30-40%), moderate (40-60%), moderate to significant (60-70%), significant (70-90%) and critical (>90%). In the case of multiple stenoses in a given segment, the segment was classified by the most severe stenoses. In the case of multiple abnormal segments per artery, the vessel was classified by the most stenotic segment.

Image interpretation: CT Images will be interpreted by radiologist who is aware of the clinical profile of the patient.

Coronary angiography: A 75-85mL dose of nonionic iodinated contrast material is injected intravenously at approximately 3.5mL/sec for CT angiography. A saline solution bolus is given following contrast material injection to decrease artifact from contrast material in the right heart. Scanning is triggered once contrast material is seen in the ascending Aorta by using bolus tracking method.

Conventional coronary angiography analysis: All evaluable segments were classified as normal (smooth borders), as having non-significant disease (luminal irregularities resulting in narrowing up to 50%), or as having significant stenoses (luminal narrowing >50%). In the case of multiple irregularities in a given segment, the segment was classified by the most severe irregularity. In the case of multiple abnormal segments per artery, the vessel was classified by the segment with the most severe irregularity.

Image interpretation: Study will be interpreted by cardiologist who is aware of the clinical profile of the patient and blinded for CT report.

Statistical analysis: The diagnostic performance of coronary angiography by MSCTfor detecting obstructive CAD was compared to catheter angiography. The results were calculated as the sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV) of the investigation.

Observations & Results

A total of 33 patients were included and evaluated observing the inclusion and exclusion criteria and following full written consent by patients. Each patient received a cardiac CT examination within 1 to 2 days prior to the conventional angiography examination.in our study. Out of 33 patients, 11 (33%) patients were females and 22 (67%) patients were males. The age of the study subjects ranged between 28 years to 80 years.

The mean age of the study population was 61 years, where 61 years was mean age for females and 61.6 years was the mean age for males. Most 14 (42.4%) of the patients were noted in the age group between 61 – 70 years, whereas only 1 (3.03%) patient was presented with 28 years of age. The most common presenting compliant was Chest pain 22(66.6%), followed by breathlessness 10 (30.3%). Only 1(3.1%) patient presented with palpitations.

In our study, most 27(81.8%)of the study population were having right dominant circulation, followed by 3 (9.09%) in left dominant circulation and remaining 3 (9.09%) were presented with codominance circulation.

Table 1: Grading of Stenoses In Rca Ct Vs Cath Findings

Stenoses	Number of patients
<30%	7
30% to 40%	4
40% to 60%	4
70% to 90%	5
Critical	4
Normal	9

Stenoses	Number of patients
<50%	14
>50%	5
Critical	4
Normal	10

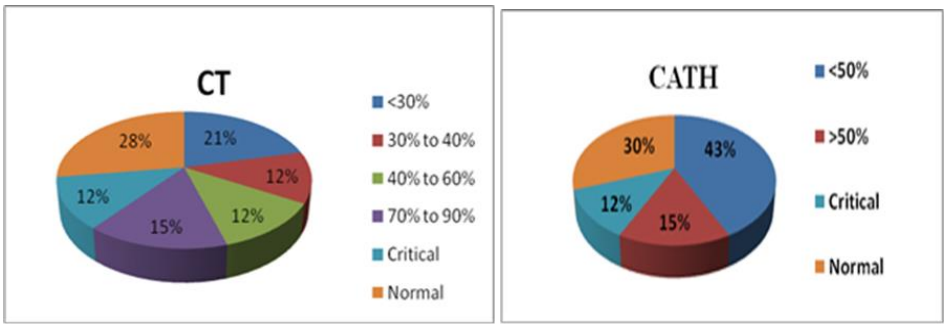

Fig 1: Grading Of Stenoses In Rca Ct Vs Cath Findings

In our CT angiography study 24 patients were found to have RCA disease and advised further evaluation with conventional invasive angiography 23 patients were diagnosed as having RCA disease. One patient diagnosed as having 30 to 40% stenoses in CT study was diagnosed as normal in invasive angiography. 4 patients (12%) are given critical disease in both CT and conventional angiography (fig 6). 9 patients (27%) were diagnosed as having RCA stenoses > 50% in both CT and conventional angiography.

Table 2: Grading Of Stenoses In Lad Ct Vs Cath Findings

LAD Stenoses	No. of patients
<30%	4
30% to 40%	2
40% to 60%	5
60% to 70%	4
70% to 90%	6
Critical	6
Normal	6

LAD Stenoses	No. of patients
<50%	11
>50%	9
Critical	6
Normal	7

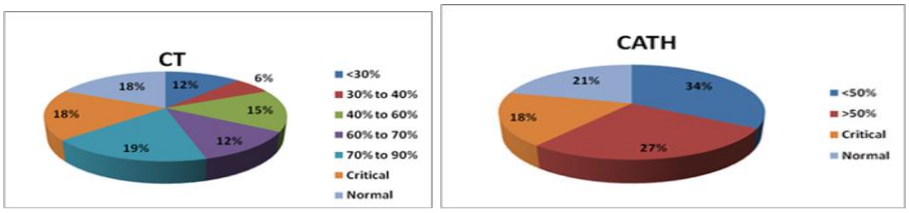

Fig 2: Grading of Stenoses In Lad Ct Vs Cath Findings

In our CT angiography study 27 (82%) patients were found to have LAD disease, underwent further evaluation with conventional invasive angiography and 23 patients were confirmed as having LAD disease. Six patients (18%) were diagnosed as having critical stenoses in CT study and the same confirmed on conventional angiography.

Table 3: Comparing Stenoses in Major Coronary Arteries Ct Vs Cath Findings

CT Coronary	No. of arteries
<30%	18
30% to 40%	7
40% to 60%	12
60% to 70%	6

70% to 90%	17
Critical	13
Normal	59

CATH Coronary	No. of arteries
<50%	36
>50%	22
Critical	13
Normal	61

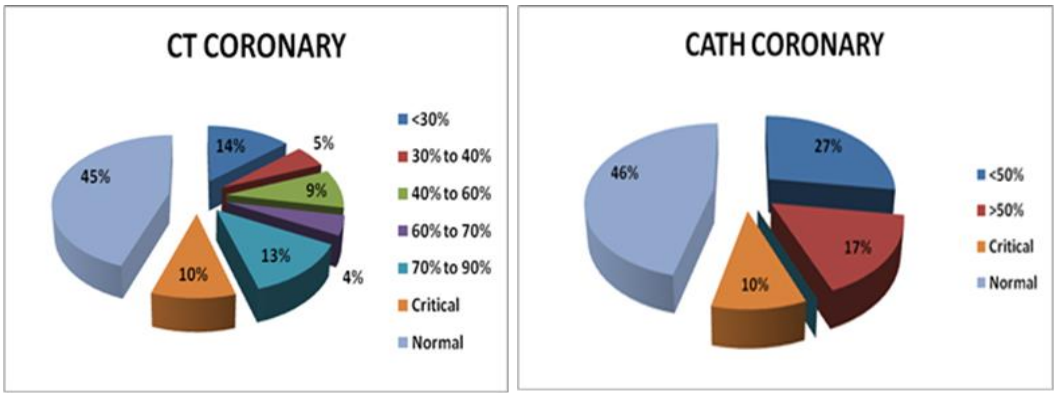

Fig 3: Comparing Stenoses In Major Coronary Arteries Ct Vs Cath Findings

The degree of stenoses of four main coronary arteries in 33 patients who underwent both CT and conventional angiography. 59 of 132 (45%) arteries were diagnosed as normal in CT. 58 corresponding arteries are diagnosed as normal on conventional angiography. In one patient where CT angiography was reported as no vessel disease Conventional angio detected >50% stenoses. 13 arteries were diagnosed as having critical stenoses in CT angiography and the corresponding arteries are confirmed to have the same in conventional angiography.

Diagnostic accuracy of MSCT: In the present study, the overall sensitivity, specificity, positive predictive value and negative predictive values are 98.5%, 95%, 95% and 98% respectively.**And the accuracy of MSCT in our study was 96.94%** which has good yield in the present study.

Discussion

CAD continues to be a major public health problem in India. Recent surveys indicate an incidence of nearly 10% (96.7/1000) of ischaemic heart disease[9]. Although catheter angiography is the gold standard for the diagnosis of CAD, only one-third of catheter angiographies are followed by an intervention, with the remaining being done only for verifying the presence and degree of CAD. These data strongly emphasize the need for a reliable, non-invasive tool for the early diagnosis of CAD[10].With MSCT, coronary artery images with sub-millimetre thickness and higher spatial and contrast resolution can be obtained in a short scan timE[11]. The use of retrospective ECG gating and lowering the heart rate further improves the temporal resolution. This has resulted in a lower number of non-interpretable coronary segments (due to motion artefacts) compared to initial studies. Vessel evaluation can be improved with better heart rate control (reducing cardiac motion), acquiring thinner slices (increasing the number of detectors) and decreasing the tube rotation time.

In the present study, the overall sensitivity, specificity, positive predictive value and negative predictive values are 98.5%, 95%, 95% and 98% respectively. And the accuracy of MSCT in our study was 96.94%. These parameters were in agreement with the study done by Lieuwe H. Piers et al[12]. Ropers et al[13]reported their results with 16-slice CT (vessel diameter >1.5 mm) which showed 92% sensitivity, 93% specificity, 79% PPV and 97% NPV, which was also in favour of study. Kuettner et al[14]reported rates of 72%, 97%, 72% and 97%, respectively, which contradicted our study slightly. Mollenbruch et al[15]reported a sensitivity of 87%, specificity of 95%, PPV of 75% and NPV of 98%, where sensitivity and PPV were not agreed with our study.

The report on 16-slice CT by Mollet et al.[16] showed sensitivity, specificity, PPV and NPV values of 95%, 98%, 87% and 99%, respectively, which was quite agreement with our study. The improved image quality compared to 4-slice scanners, and the fact that fewer proximal and mid-coronary segments were affected by motion artefacts, can be explained by the higher spatial and temporal resolution of 64-slice scanners.Out of 132 vessels evaluated for detection of CAD , CT identified disease in 73(55%) vessels. 70 (53%) corresponding vessels were identified as diseased by conventional angiography. 3 (2%) diagnosed by CT as having < 40% stenoses are identified as normal by conventional angiography. One patient given as having no vessel disease in CT angiography was found to have > 50 % stenoses in conventional angiography.Most commonly diseased artery in our study population was LAD (81%) and RCA (72%).27 out of 33 patients (82%) have right dominant circulation correlating with the study done by Baim DS et al[17].The focus in most reported investigative studies has been on

determination of the sensitivity and specificity of MSCT in the assessment of each coronary artery or segment, regardless of the individual patient[13,14].By reporting our results with respect to patients with or without disease in at least one coronary artery, it can be projected that MSCT may be a very useful tool in deciding upon the need for subsequent angiography, particularly in patients with a low pretest probability of the disease.

Limitations of MSCT: As reported by previous authors and in our study, the accuracy of 64-slice CT is still limited by the presence of calcification, distal location of disease, irregular cardiac rhythm and motion-related artefacts, all of which hamper accurate assessment of the coronary arteries compared with catheter angiography.

Conclusion

We would like to conclude by saying that the high negative predictive value observed in this study (98%) suggests that 64- slice MDCT coronary angiography is a good screening modality for evaluation of patients with equivocal stress test results who might otherwise require invasive angiography.CT coronary angiography has a notably high sensitivity and negative predictive value for the detection of coronary disease. It may be uniquely suited to clinical situations in which the exclusion of coronary disease is of paramount concern. Potential applications of multi–detector row CT angiography include non-invasive diagnosis of plaques and coronary artery stenoses. CT coronary angiography is highly accurate in detecting stent patency and residual disease in post stenting patients.

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Conflict of Interest: Nil
Source of support:Nil