

DIAGNOSTIC ACCURACY OF CT CORONARY ANGIOGRAPHY.

Cardiology

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ABSTRACT

Coronary Artery Disease (CAD) is an emerging and commonest type of heart disease resulting in morbidity and mortality globally. Coronary angiography is a diagnostic modality used to diagnose the coronary artery disease or the extent of blockage of coronary arteries. The multi-slice computed tomography (MSCT) technology such as 64-slice, 128-slice, 256-slice, and now 320-slice MSCT has produced a high diagnostic accuracy of CT coronary angiography. This prospective-cross sectional study was done in Department of Cardiology in Medanta, the Medicity, from November 2017 to December 2018 with the aim to evaluate the diagnostic accuracy of 256 slice CT coronary angiogram in measuring the percentage diameter stenosis compared to invasive angiography and to determine the sensitivity and specificity of CT coronary angiography in detection of coronary artery stenosis among symptomatic patients. A total of 60 patients presented with acute or chronic chest pain with risk for CAD were included. The mean age of the participants was 57.35 ± 10.16 years and 88.3% participants were male and 11.7% participants were females. 56.6% participants had BMI >25 , 11.7% were alcoholic, 40% were smoker, 16.7% had diabetes and 38.3% had hypertension. The study concluded that CCTA should be considered initial test of choice in patients presenting with chest pain with low to intermediate probability of CAD because the time required for diagnosis is significantly shorter, high sensitivity, specificity, PPV and NPV on per vessel and per segment basis, determination of LVEF and has the ability to rule out causes of atypical chest pain including pulmonary embolism and aortic dissection.

KEYWORDS

CAD, CCTA, CAG, Angiography and Heart disease.

INTRODUCTION

Coronary artery disease is an emerging and commonest type of heart disease resulting in morbidity and mortality globally. According to the Global burden of the disease study, the developing countries contribute almost half of the CAD-related deaths in 1990.

Coronary angiography is a diagnostic modality used to diagnose the coronary artery disease or the extent of blockage of coronary arteries. The multi-slice computed tomography (MSCT) technology such as 64-slice, 128-slice, 256-slice, and now 320-slice MSCT has produced a high diagnostic accuracy of CT coronary angiography.

Computed Tomographic Coronary Angiography (CTCA) is a recent advancement with high resolution generating three dimensional images, to determine the atheromas in the coronary arteries. Computed tomography or CT scan in association with X-ray and computer generates cross sectional views of the heart.

CTCA is a non-invasive modality for imaging the coronary arteries to diagnose CAD, in-stent restenosis and in evaluation of coronary bypass graft patency. The American College of Cardiology/American Heart Association recommends that coronary angiography should be done before valve surgery in men aged >40 years and women aged >35 years with coronary risk factors and in postmenopausal women. Various researchers have found that the incidence of angiographically detected CAD in acquired valvular diseases vary widely from 9% to 41%. 37% rate of incidence was reported in aortic stenosis.

Several studies have agreed on the high negative predictive value of CCTA especially in ruling out CAD in a population with low to intermediate pretest likelihood of CAD and coronary stenosis. It is further showed that CCTA is a superior technique than other non-invasive imaging techniques and other physiological testing such as myocardial perfusion imaging and stress echocardiography used for diagnosis of sub-clinical CAD. In some patients, both imaging and physiological tests may be necessary as some positive CCTA may not correlate well with ischemic finding or other physiological tests.

Aims And Objectives Of The Study

- To evaluate the diagnostic accuracy of 256 slice CT coronary angiogram in measuring the percentage diameter stenosis compared to invasive angiography.
- To determine the sensitivity and specificity of CT coronary angiography in detection of coronary artery stenosis among symptomatic patients.

MATERIAL AND METHODS

This prospective-cross sectional study was done in Department of Cardiology in Medanta, the Medicity, from November 2017 to

December 2018 after obtaining the permission from ethical committee.

A total of 60 cases presented with acute or chronic chest pain with risk for CAD were included in the study after obtaining the informed consent. All of them were haemodynamically stable.

Inclusion Criteria:

- Patients with low or intermediate probability of coronary artery disease were included in the study.
- Patients presented with the complaint of angina equivalent to persistent
- Chest pain of at least duration of 5 minutes but with normal sinus rhythm was selected for the study.
- Patients who were hemodynamically stable were included.
- Patients whose initial troponin test is negative were included in the screening.
- Age >25 years.

Exclusion Criteria:

- Patients presented with acute MI.
- Patients with renal insufficiency.
- Patients with any history of allergy from the contrast dye.
- History of previous Coronary Artery Bypass Grafting (CABG) or PCI and stenting.
- Any signs of arrhythmia in patients as evident from ECG (AF or frequent VPCs).
- Patients with contraindication to beta blocker.
- A calcium score greater than 2000 Agaston unit was taken as a contraindication to CTCA.
- Pregnant women.

Before procedure and after procedure a detailed assessment was done. The HEART score for chest pain was used in emergency department for risk stratification.

The heart rate was maintained to ≤ 65 beats / minute. An initial scan was performed to determine the extent of calcium deposition in coronary arteries by calculating the calcium score. Contrast enhanced scan was done using 80 ml of contrast at the rate of 5 ml per second followed by 50 ml NS chaser injected into the ante cubital vein.

The data was collected and tabulated. The results were interpreted and correlated statistically by software SPSS version 2.0. Quantitative values were expressed in median. Data was analyzed by applying percentage statistics and presented by means of bar and pie diagrams. Chi – square test was used to measure association. The level of significance was P value <0.05 .

OBSERVATIONS AND RESULT

The present study was prospective, cross-sectional, comparative study conducted at the Department of Cardiology, Medanta the Medicity hospital.

The mean age of the participants was 57.35 ± 10.16 years and 88.3% participants were male and 11.7% participants were females. 56.6% participants had BMI >25, 11.7% were alcoholic, 40% were smoker, 16.7% had diabetes and 38.3% had hypertension.

Table 1. Clinical Manifestations Of Patients

Clinical manifestations	Frequency	%age
Angina	56	93.3
Breathlessness & Angina	8	13.3
Tachycardia	14	23.3
Bradycardia	13	21.7
Hypertension	13	21.7

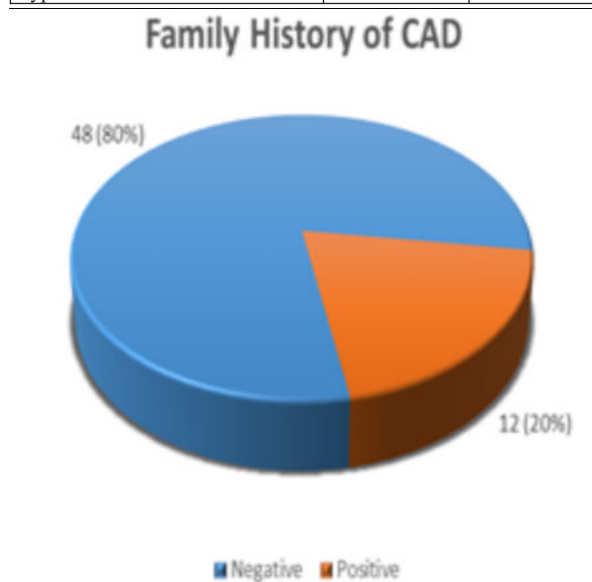


Figure 1. Family History Of CAD

It was reported that the minimum hemoglobin concentration was the 10 grams per dL and the maximum was 14.30 grams per dL with a mean of 11.703 ± 1.24 grams per dL. The TLC was found to be between 4500 to 10500 cells per microlitre with a mean of 7482.66 ± 1520.18 cells per microlitre. The PC value was found to be between 160 and 98.00×10^3 cells per microliter with a mean of $4.7402 \pm 12.29 \times 10^3$ cells per microliter.

The random blood sugar value was found to be between 74.00 mg/dL to 191 mg/dL with a mean of $110.55 \text{ mg/dL} \pm 33.608 \text{ mg/dL}$. The blood urea level was 14 to 43 mg/dL with a mean of $27.96 \pm 6.53 \text{ mg/dL}$. Serum creatinine level was found between 0.40 to 1.10 mg/dL with a mean of $0.75 \pm 0.15 \text{ mg/dL}$.

And, mean triglyceride level was found to be $165.43 \pm 66.40 \text{ mg/dL}$, cholesterol level was $179 \pm 46.70 \text{ mg/dL}$, Low-Density Lipoprotein (LDL) was $110.86 \pm 23.04 \text{ mg/dL}$, High-Density Lipoprotein (HDL) was $30.88 \pm 6.44 \text{ mg/dL}$, VLDL (Very Low-Density Lipoprotein) was $15.85 \pm 5.37 \text{ mg/dL}$ and Lipoprotein an (LPA) level was $29.6 \pm 7.87 \text{ mg/dL}$.

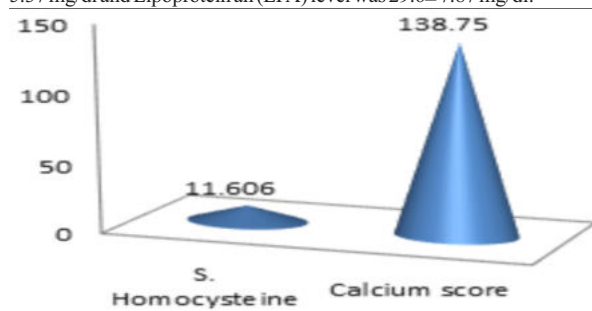


Figure 2. S. Homocysteine And Calcium Score

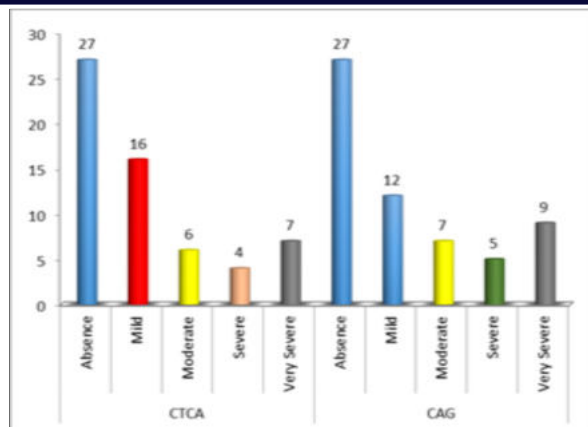


Figure 3. Evaluation Of Complete LAD Profile By CTCA And CAG by

Figure 3 depicts the complete LAD by both coronary angiogram and by CT coronary angiogram for the presence of stenosis. CTCA detected a total of 9 patients without stenosis compared to CAG who had detected 10 patients without stenosis. Presence of less than 50% stenosis was detected in 12 patients by CAG whereas 13 patients showed less than 50% stenosis with CTCA. Similarly, in comparison with CTCA where 15 patients were detected with 50% to 75% of stenosis 11 patients were detected in CAG. Total of 13 patients was detected with stenosis ranging from 76% to 90% in CAG compared to 11 in CTCA. CAG detected 14 patients who had more than 90% stenosis present whereas, CTCA showed 12 patient in this category. And the data of complete LAD evaluation by CTCA and CAG. 100% sensitivity and 90% specificity was calculated after the analysis was done.

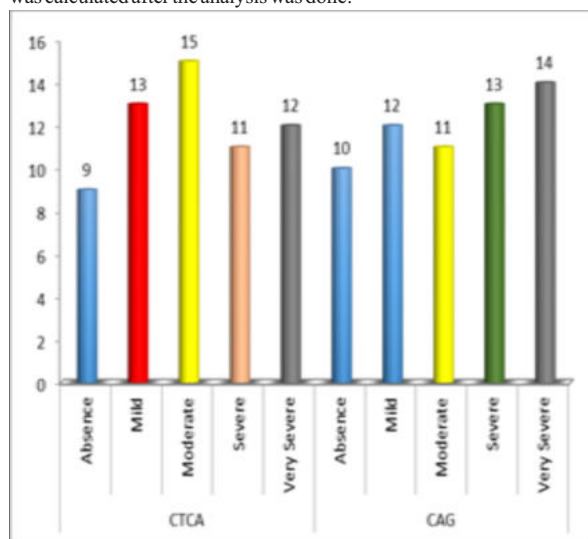


Figure 4. Evaluation Of LCX Profile By CAG & CTCA

Figure 4 depicts the complete LCX by both coronary angiogram (CAG) and by CT coronary angiogram (CTCA) for the presence of stenosis. CTCA and CAG detected a total of 27 patients without stenosis. In contrast, the presence of less than 50% stenosis was detected in 12 patients by CAG whereas 16 patients showed less than 50% stenosis with CTCA. Similarly, in comparison with CTCA where 6 patients were detected with 50% to 75% of stenosis 7 patients were detected in this category by CAG. Total of 5 patients was detected with stenosis ranging from 76% to 90% in CAG compared to 4 in CTCA. CAG detected 9 patients who had more than 90% stenosis present whereas, CTCA showed 7 patients in this category. In this analysis 100% sensitivity, 100% specificity, 100% positive and 100% negative predictive value were detected. Moreover, 100% accuracy was also calculated from this analysis.

Figure 5. depicts the CTCA detected 24 patients without stenosis in comparison with CAG that detected 23 patients without stenosis. In contrast, the presence of less than 50% stenosis was detected in 6 patients by CAG whereas 7 patients showed less than 50% stenosis

with CTCA. Similarly, in comparison with CTCA where 7 patients were detected with 50% to 75% of stenosis 6 patients were detected in this category by CAG. Total of 13 patients was detected with stenosis ranging from 76% to 90% in CAG compared to 12 in CTCA. CAG detected 12 patients who had more than 90% stenosis present whereas, CTCA showed 10 patients in this category. And 97.30% sensitivity, 100 % specificity, 100% positive and 95.83% negative predictive value were detected. Moreover, 98.33% accuracy was also calculated.

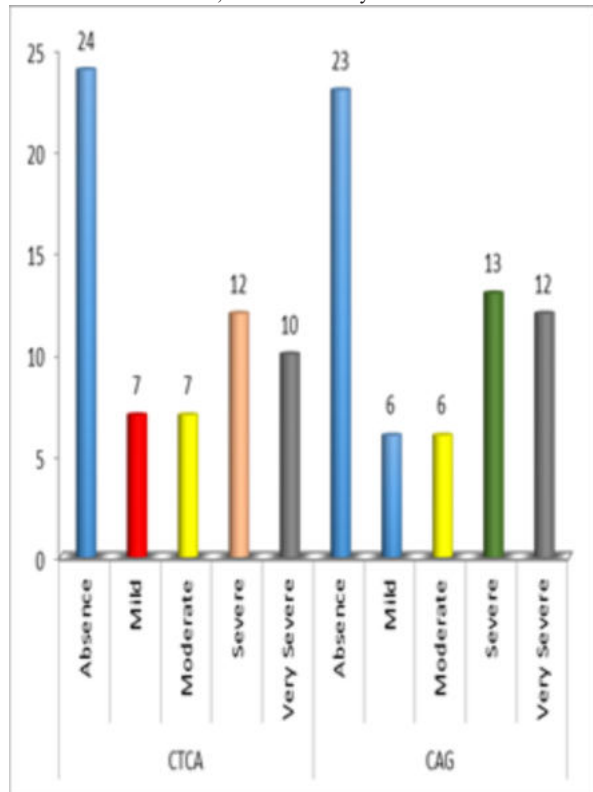


Figure 5. Evaluation Of Complete RCA Profile By CTCA And CAG

It was observed that 81% patients diagnosed with CAD with significant stenosis as confirmed by CAG were advised revascularisation. 11(22%) patients were advised to undergo CABG and 38(77%) underwent Percutaneous transluminal coronary angioplasty plus stenting.

DISCUSSION

In this prospective, cross-sectional, comparative study, the mean age of study participants was 57.35 ± 10.16 years. Similarly Jackson et al. reported that middle age males had 2 to 3 times more risk than females. 20% of study participants had family history of CAD. In another study conducted by Nasir et al. (2004), observed a highly significant association exist between the family history of premature CHD.

The maximum coronary calcium score reported in this study was 405 with a mean of 138.75. Similarly Nasir et al. (2004), reported the presence of coronary artery calcium in asymptomatic patients.

The mean value of blood sugar level observed in the study was 110.55 ± 33.608 mg/dL, which is in the normal range. However, in some of the patients, a higher sugar level was reported and in 16.7% patients type 2 Diabetes was found. Similar to the previous studies this present study also has shown a significant association of CAD with dyslipidemia. Dyslipidemia was defined according to the National Cholesterol Education Program (NCEP) guideline as to the presence of cholesterol level higher than 200 mg/dl, high triglyceride level more than 150 mg/dl, low HDL cholesterol level (<40 mg/dl) and high LDL cholesterol level (>100 mg/dl) (144). In the present study, we have observed a higher mean triglyceride level (165.43 ± 66.40 mg/dl), higher total cholesterol level (179 ± 46.70 mg/dl), high LDL level (110.86 ± 23.04 mg/dl), and low HDL level (30.88 ± 6.44 mg/dl). Similar findings were reported by Gupta et al (2012) in their Jaipur Heart Watch study. Various studies has recommended that using lipoprotein (a) level less than <50 mg/dl as an indicator to measure the

risk of cardiovascular diseases.

In the present study 40% of subjects were be smokers and 11.7% were alcoholic regularly. Total of 38.3% of subjects had hypertension and 56.6% subject had a BMI of more than 25. This result signifies that the maximum of the subjects was overweight. In a study by Gupta et al (2012) it was reported that apart from the other factors lifestyle disorders like cigarette smoking or any other form of non- smoked tobacco consumption, lack of physical activity, unhealthy food habit including huge intake of monounsaturated and trans fat intake, low dietary intake of fruits and vegetables was associated with increased risk of CAD.

The present study showed that CTCA was able to detect the presence of stenosis in LAD with high specificity and sensitivity. Similarly, in LCX and RCA also CTCA was accurate enough to detect the presence of stenosis. In vessel wise diagnosis the present study showed that a maximum number of patients have no stenosis present in the left main artery. the sensitivity and specificity were also high in detecting stenosis in this artery.

Similarly, a high sensitivity ranging from 75% to 96% was reported in detecting the presence of stenosis in all the LAD branches except the D2 branch where a lower sensitivity (33.33%) was calculated. However, a high specificity (90.2%) and high negative predictive value (88.46%) was reported for this vessel. Evaluation LCX showed a sensitivity of 67% to 90% in detecting the stenosis. In a similar way, high sensitivity and specificity were reported for RCA also. Similarly Herzog et al (2007) have reported that CTCA can diagnose the presence of stenosis with an accuracy of 89%. On a per vessel basis assessment it was also reported that CTCA has an accuracy of 89%, sensitivity of 100% and 83% of specificity.

Previous studies have reported that CTCA has a high negative predictive value in ruling out CAD in a population with low to intermediate pre-test likelihood of CAD and coronary stenosis. Budoff MJ et al (2008) performed a multicentre study showing the diagnostic sensitivity and specificity of 64-slice CTCA to be 95% and 83% respectively. The same study revealed that CTCA has a 99% negative predictive value whereas the positive predictive value is 44%. In accordance with the previous studies, the present study has also shown a high negative predictive value of CTCA in detecting arterial stenosis.

The present study reported that CTCA was able to detect the presence of stenosis in all the major coronary arteries with a statistically significant result (P-value=0.001). In the present study coronary angiography was taken as the reference method for validating the result obtained by CTCA. In a similar study among patients with acute chest pain, Hoffmann et al (2012) have reported incorporating the CTCA in primary evaluation improves the efficiency of decision making clinically.

CONCLUSION

This prospective study concluded that 256 slice-CT coronary angiography has high sensitivity specificity, PPV and NPV in the detection of coronary stenosis in symptomatic patients. When compared to other non-invasive diagnostic modality such as stress echocardiography and SPECT, CCTA has a higher efficacy in detecting the onset of CAD in patients with chest pain. 49 patients, 81% of the study subjects were advised revascularisation after confirming the findings of CCTA on CAG in this study. 11 patients were advised to undergo CABG for TVD and 38 patients underwent Percutaneous transluminal coronary angioplasty plus stenting at our centre.

Apart from detecting the presence of stenosis with great accuracy the CCTA was able to detect presence of Aortic dissection in the patient with initial diagnosis of ACS. Despite having high accuracy in detecting stenosis both at vessel and segment level as also proven by other large randomised trials and also in our study, CCTA is still underutilized in large parts of the country.

CCTA should be considered initial test of choice in patients presenting with chest pain with low to intermediate probability of CAD.

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