Computed Tomography Coronary Angiography Experience at a Tertiary Care Cardiac Centre

Yasir Bashir[1], Shabeer Ahmad Mir[2], Farooq Ahmad Ganie[3], Bilal Musharaf[4], Khurshid Iqbal[5], Feroze Shaheen[6], Asif Ahmad[7], Nusrat Bashir[4]

ABSTRACT

Introduction: Ischemic heart disease (IHD) causes more death and disability and incurs greater economic costs than any other illness in the developed world. The aim of study was to highlight the role of computed tomographic scanning (CT) and coronary angiography (CTCA) as a diagnostic tool in patients with low and intermediate risk coronary artery disease (CAD) and as a part of study to assess coronary calcium score as a risk factor for CAD.

Material and methods: This study was a prospective as well as retrospective study for a period of 3 years and was conducted as a comparative study on age, sex and risk matched two different groups of 40 patients each. The group 1 of patient was those who underwent invasive angiography and group 2 were those who were taken for CTCA. The data for group 1 was taken retrospectively prior to availability of CTCA at our center. The patients were subjected to CTCA after their consent and institutional ethical clearance.

Results: The prevalence of CAD in CTCA group in our study was 14.37% and the prevalence of CAD in invasive angiography group was 16.87%. Patients with CAC>100 showed higher prevalence of significant and severe disease, the positivity rates of CAC increased with age and were more common in males.

Conclusion: Computed tomographic coronary angiography has become a valuable tool to screen low and intermediate risk cardiac disease. Patients who test positive on CTCA should go for invasive angiography for definitive opinion. Those who test negative on CTCA can be managed conservatively. CTCA is not recommended for high risk patients. They should directly go for invasive angiography.

Keywords: Angiography, Computed Tomography, Coronary

INTRODUCTION

Ischemic heart disease is the most common, serious, chronic, life threatening illness in the United States where 13 million persons have IHD, 6 million have angina pectoris and >7 million have sustained myocardial infarction(MI).

High fat and energy rich diet, smoking, sedentary life style, obesity, insulin resistance and type 2 diabetes mellitus are increasing and are powerful risk factors for IHD. Given the projection of large increases in IHD throughout the world, IHD is likely to become the most common cause of death worldwide by 2010.

Central to pathophysiology of myocardial ischemia is the concept of myocardial supply and demand. Under normal conditions, for any given level of a demand for oxygen, the myocardium will be supplied with oxygen-rich blood to prevent under perfusion of myocytes and subsequent development of ischemia and infarction. By reducing the lumen of coronary arteries, atherosclerosis limits appropriate increase in perfusion when the demand for flow is augmented, as occurs during exertion or excitement.

Coronary arteriography is the method which outlines the Lumina of the coronary arteries and can be used to detect and exclude serious coronary obstruction. However coronary arteriography provides no information regarding arterial wall, and severe atherosclerosis that does not encroach on the lumen may go undetected.[1]

CTCA is a noninvasive imaging modality which can be used to evaluate anatomy of coronary arteries. Over last 5 years there has been a dramatic improvement in multi detector CT(MDCT). The abilty to non-invasively image the coronary artery lumen and wall may obviate need for invasive coronary arteriography. CTCA also has the ability to detect small amounts of non-obstructive plaques in the walls of arterial lumen that might not be detected by stress testing or even invasive angiography.[2] The aim of study was to highlight the role of computed tomographic scanning (CT) and coronary angiography (CTCA) as a diagnostic tool in patients with low and intermediate risk coronary artery disease (CAD) and as a part of study to assess coronary calcium score as a risk factor for CAD.

MATERIAL AND METHODS

This study was conducted both prospectively and retrospectively in Sher I Kashmir institute of medical sciences, Srinagar, J&K, India over a period of 3 years. Prospectively 40 patients with low and intermediate risk for CAD underwent CTCA and results were interpreted as;

- Normal (No luminal irregularities seen).
- Non-obstructive coronary disease (<50% stenosis).

[1]Department of Critical Care Medicine, [2]General Surgery, [3]Cardio Vascular and Thoracic Surgery, [5]Cardiology, [6]Radiology, Sheri – Kashmir- Institute of Medical Sciences, Soura, Srinagar, Kashmir, [7]Department of Paediatrics, Sheri-Kashmir Institute of Medical Sciences, Medical College, Srinagar, J&K, [4]Department of pathology, Government Medical College, Srinagar, J&K, India.

Corresponding author: Nusrat Bashir, Department Bof Pathology, Government Medical College, Srinagar, India

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- Significant coronary artery disease (>50% stenosis).
- Very severe disease (>75% stenosis).
- Non-diagnostic study.

MSCT examination was performed with a 64-slice scanner (Siemens Somatom Sensation Scan) with collimation thickness of 3.0mm Acq 64x0.6mm, scan rotation time of 14.09S (delay of 4 s) tube voltage of 120KV and tube current of 900mAs eff (reconstruction slice-0.75mm).

First a non-contrast enhanced scan was performed prior to Multi slice CT coronary angiography (MSCT-CA) to assess the total calcium burden (scoring was done by AGATSTON scoring system ;> 100-positive, 0-negative and >0 <100 indeterminate.) The total amount of contrast used was 80-100ml followed by saline flush of 40ml. Contrast was injected at the rate of 6ml/s. In patients with heart rate >65bpm, b blocker metoprolol 15mg was used prior to scan. Retrospectively 40 patients who were age, sex and risk matched with prospective arm and had undergone invasive angiography prior to the advent of CTCA were taken and there angiographic results was studied and compared with prospective arm.

Inclusion criterion

Patients with low and intermediate risk for CAD as per NCEP guidelines[3] were selected for the study.

Further individual risk stratification was done as per Framingham Risk Score and individuals were classified as low and intermediate risk as per the scoring system.

Clinically patients had chronic stable angina and TMT results were either equivocal or patients were unable to exercise.

Risk factors

1. Cigarette smoking(10 or more cigarettes/day)
2. Hypertension (>or =140/90mmhg or use of antihypertensive medication[4])
3. Hypercholesterolemia(total cholesterol>or=5mmol/l or on hypolipidemic drugs[5])
4. HDL cholesterol (<or=40mmol/dl)
5. Diabetes(BSF >or=7mmol/L or on insulin or OHA'S (oral hypoglycemic agents))[6]
6. Positive famiy history of CAD; defined as CAD in first degree relatives younger than 55 (Men)or 65 (Women) years of age.[7]

Exclusion criterion

1. Patients with the history of prior percutaneous intervention.[3]
2. Coronary artery bypass surgery.
3. Myocardial infarction.
4. Presence of significant stenosis > or = 50% in one or more vessels in previous angiogram.
5. Contrast allergy and other contraindication for contrast use.
6. Unstable angina.

STATISTICAL ANALYSIS

Descriptive statistics like mean and percentages were used for the analysis.

RESULTS

The prevalence of CAD in CTCA group in our study was 14.37% and the prevalence of CAD in invasive angiography group where patients were age, sex and risk matched was 16.87%.The results in two groups were comparable with slight increased prevalence in invasive angiography group. The results were at par with other international studies. The prevalence of diseased coronaries increased with increasing age, in our study 0% prevalence was seen in patients < 45years age compared to 33% in those>60 years of age. In CTCA group 26% patients among diseased group had non-obstructive lesions and rest 74% showed significant and severe disease.(Table-1)

Patients with CAC>100 showed higher prevalence of significant and severe disease (Table-2), the positivity rates of CAC increased with age and were more common in males. Negative calcium scores although showed less prevalence of significant disease but does not reliably exclude severe disease especially in young because of presence of non

	Lesion				
	Normal	**Non-obstructive**	**Severe stenosis**	**Very Severe stenosis**	**Total**
Vessel					
RCA	33(82.5%)	2(5%)	5(12.5%)	0(0%)	40(100%)
LMCA	38(95%)	2(5%)	0(0%)	0(0%)	40(100%)
LAD	29(72.5%)	2(5%)	5(12.5%)	4(10%)	40(100%)
LCX	37(92.5%)	0(0%)	2(5%)	1(2.5%)	40(100%)

Table-1: Distribution of various types of lesions in different vessels in CTCA group.

	Lesion				
	Normal	**Non-obstructive**	**Severe stenosis**	**Very Severe stenosis**	**Total**
Vessel					
RCA	6/33(18.2%)	0/2(0%)	1/5(20%)	0/0(0%)	7/40(17.5%)
LMCA	7/38(18.4%)	0/2(0%)	0/0(0%)	0/0(0%)	7/40(17.5%)
LAD	1/29(3.4%)	1/2(50%)	3/5(60%)	2/4(50%)	7/40(17.5%)
LCX	4/37(10.8%)	0/0(0%)	2/2(100%)	1/1(100%)	7/40(17.5%)
Total	18/137(13.13%)	1/6(0%)	6/12(50%)	3/5(60%)	28/160(17.5%)

Table-2: Distribution of various types of lesions in different vessels versus vessels with positive calcium score(>100).

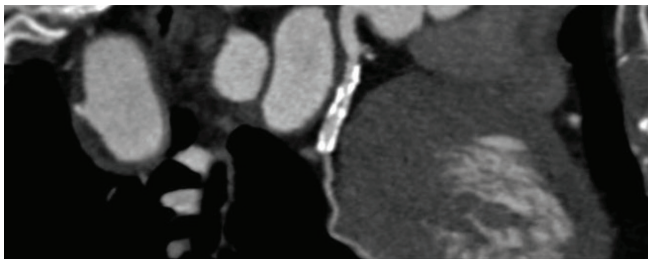

Figure-1: This dipicts the lcx stenosis with calcified plaque.

Figure-2: Delnates the lad myocardial bridging

calcified plaques leading to acute coronary syndromes.

DISCUSSION

This study was conducted on two groups of patients viz CTCA group and invasive angiography group, in the departments of Cardiology and Radio-diagnosis at Sher-I-Kashmir Institute of Medical sciences, Srinagar, Kashmir for a period of 3-years from Nov 2008 to 2011.

CTCA group comprised of 40 patients with mean age of 51.57 years, with range of 30-65years.Out of 40 patients 26(65%) were males and 14(35%) were females. Twenty two patients (55%) belonged to low risk and 18(45%) were in the intermediate group.

Similarly invasive angiography group comprised of 39 patients with mean age of 57.8 years. The youngest patient was 30 year old and the eldest was 69 year old. Twenty seven (69%) patients were males and 13(31%) were females in this group. In this group 19(48%) belonged to low risk and 20(52%) were in intermediate risk group.

The patients who were subjected to CTCA group showed 23 diseased segments out total of 160 segments studied, which comprised 14.37% of total. The prevalence of diseased segments was comparable to that seen by Daniel R Obaid et al.[8] wherein they showed prevalence of 13.9%. Similar disease segment prevalence was seen in invasive angiography group. The prevalence of disease was 16.87% in angiography group.

In our study prevalence of normal coronaries was higher in young (<45 years) with prevalence of 12.5% abnormal segments. In individuals >60 years of age the prevalence of disease was 33%.Similar results were reported by Maureen et al.[9] in 2008, who reported that 65% of patients <50 years of age had normal coronaries compared to 38% and 14% in patients aged 50-60 and >60 years of age respectively.

Again in CTCA group 26% of diseased individuals had non-obstructive (<50%) lesions, 52% had significant (50-75%) lesions and 22% showed very severe (>75%) lesions. Meijboom et al.[10] in Aug 2008 showed prevalence of 68% of at-least one significant stenosis in their study involving 360 patients. Similar severity distribution of non obstructive (37%), significant (29.6%) and severe disease(33%) was seen in invasive angiography group.

In this study coronary artery calcium (CAC)>100(positive) was seen in total of 28(17.5%) of vessels, out of total of 160. Vessel and segment wise analysis of RCA, LMCA, LAD and LCX(Fig-1) (all showed positivity of CAC in 17.5%.RCA and LAD (Fig-2) had 17.5% and 27.5% of disease prevalence when seen individually. The prevalence of diseased segments in LMCA and LCX was lower than their respective calcium scores. LMCA and LCX had disease prevalence of 5% and 7.5% respectively with CAC of 17.5% in each. Thus the positivity is associated with higher incidence of disease(significant and severe) but necessarily does not mean significant or severe disease. Henneman Maureen et al.[11] in 2008 in their study showed that the absence of CAC has been proposed to rule out significant CAD. This data holds true only for chronic stable angina and not for the acute coronary syndromes where in non-calcified plaques are highly prevalent, The absence of CAC does not reliably exclude the presence of significant atherosclerosis. Plaque rupture and acute thrombosis (PRAT) is thus a concern in individuals with no calcification

Plaque rupture occurs in atherosclerotic plaques with a thin fibrous cap overlying a necrotic core that is rich in lipids,[12] and it is the most important mechanism of plaque instability that leads to coronary thrombosis.[13,14] Angiographic studies have firmly established the association of thrombosis as an important mechanism of unstable angina and acute myocardial infarction.[15] Not all severely narrowed segments identified by angiography, however, have evidence of previous acute thrombosis, and a few angiographic studies that have demonstrated plaque progression in the short term have suggested that thrombosis is the cause.

Age group wise CAC positivity increased with age groups. Patients under age of 45 years had 0% and those over 60years showed positivity of 100%. Thus CAC and prevalence of significant and severe lesions increased with increasing ages both in males as well as females although females showed delay in the development of calcification and lesions. Similar results were seen by Maureen et al in 2008.

Also in our study CAC score >100 (positive) was seen in 17.5%. Females showed 14.3% positivity and males 19.2%. The results were comparable to that seen by Taylor AJ et al.[16] They showed total positivity of 22.4% in men and 7.9% in females. In our study among those who were positive for CAC 71.42% were men.

CONCLUSION

Computed tomographic coronary angiography has become a valuable tool to screen low and intermediate risk cardiac disease. Patients who test positive on CTCA should go for invasive angiography for definitive opinion. Those who test negative on CTCA can be managed conservatively. CTCA is

not recommended for high risk patients. They should directly go for invasive angiography.

REFERENCES

1. Harrison's principles of internal medicine 17th edition vol ii chap 237 page 1514, 1515, 1520.
2. Leber et al. Quantification of obstructive and non obstructive coronary lesions by 64 slice CT:A comparative study with quantitative coronary angiography and intravascular USG. Journal of American college of cardiology. 2005;46;147-154.
3. Grundy SM et al. For the co-ordinating committee of the NCEP Panel III guidelines. Circulation 2004;110: 227-239. J Am Cardiol. 2004; 44;720-732.
4. European Society of Hypertension-European Society of Cardiology.Guidelines for the management of arterial hypertension. J Hypertens. 21;1011-1053:203.
5. Executive summary of the third report of the National Cholesterol Education Programme(NCEP) Expert Panel on Detection Evaluation and Treatment of high blood cholesterol in adults(Adult Treatment Panel III). JAMA. 2001; 285;2486-2479.
6. Report of expert committee on the diagnosis and classification of Diabetes Mellitus.Diabetic Care. 1997; 20;1083-1197.
7. Taylor AJ, Bindeman J, Feuerstein I, Cao F, Brazaitis M, O'Maley PG. Coronary calcium independently predict incidence premature coronary heart disease over measured CV-risk factors: Mean three year outcome in the Prospective Army Calcium(PACC) Project. J Am Coll Cardiol. 2005;46:807-814.
8. Daniel R Obaid, Scott W Murray, Nick D Palmer, James H F Rudd. Contemporary Coronary imaging from patient to plaque: part 3 cardiac computed tomography. 2010;17:235-9.
9. Maureen M Henneman, Joanne D.Schuijf, Jacob M, Van Werkhoven.Multislice computed angiography for ruling out suspected coronary artery disease:what is the prevalence of a normal study in a general clinical population?European Heart Journal. 29(16);2006-2013:2008
10. W. Bob Meijboom, Matthijs F.L Meijs, Joanne D. Schuijf, Maarten J. Cramer. Diagnostic accuracy of 64-slice CTCA. J Am Coll Cardiol, aug 2008;52:2135-2144.
11. Henneman Maureen M, Schuijf Joanne D, Pundziute Gabija, Van Werkhoven Jacob M et al.Non invasive evaluation with multislice computed tomography versus coronary calcium score.J Am Coll C ardiol 2008;52: 216-222.
12. Fuster V. Elucidation of the role of plaque instability and rupture in acute coronary events. Am J Cardiol. 1995;76:24C–33C.
13. Falk E, Shah P, Fuster V. Coronary plaque disruption. Circulation. 1995;92:657–671.
14. Davies MJ. Anatomic features in victims of sudden coronary death: coronary artery pathology. Circulation. 1992;85:I-19–I-24.
15. DeWood MA, Leimgruber PP, Shields JP, et al. Thrombosis in acute myocardial infarction and sudden death: angiographic aspects. Cardiovasc Clin. 1987;18:195–211.
16. Taylor AJ, Bindeman J, Feuerstein I, Cao F, Brazaitis M, O Malley PG.Coronary calcium independently predicts incident premature coronary heart disease over measured cardiovascular risk factors;mean three year outcomes in the prospective army coronary calcium(PACC) project.J Am Coll Cardiol. 2008;46:807-14.

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