Original Article

Pak Armed Forces Med J 2016; 66(Suppl):S166-70

CORONARY CT ANGIOGRAM IN THE ASSESSMENT OF SUSPECTED ACUTE CORONARY SYNDROME

Usman Iqbal, Muhammad Nadir Khan*, Qamar uz Zaman Bhatti

Armed Forces Institute of Cardiology/ National Institutes of Heart Diseases Rawalpindi Pakistan, *Army Cardiac Centre (ACC), Lahore Pakistan

ABSTRACT

Objective: To determine the association of CT angiography results in ACS patients with adverse cardiac events till 30 days post presentation and to establish safety of this tool.

Study Design: Descriptive cross sectional study.

Place and Duration of Study: The study was conducted at Armed Forces Institute of Cardiology from July 2013 to June 2014.

Material and Methods: Six hundred and forty seven personals of armed forces were enrolled in the study. The patients presenting into emergency department of AFIC, with suspicion of acute coronary syndrome, were categorized into low, intermediate and high pretest probability of acute coronary syndrome. Those having low or intermediate pretest probability underwent coronary computer tomographic angiography within 24 hrs of their presentation. Persons with either normal coronary arteries or insignificant coronary artery disease (stenosis of less than 50%) were immediately discharged and were contacted 30 days later for any adverse cardiac event. T test and Chi square test was applied to compare numeric and categorical variables respectively.

Results: Among 647 patients, 486 (75.1%) had normal coronary arteries and 123 (19%) had insignificant coronary artery disease. None of these 609 patients, undergoing coronary CT angiogram, had any adverse cardiac event within 30 days of initial presentation, indicating statistically significant results.

Conclusion: Coronary CT angiogram is safe and effective tool for the evaluation of patients suspected to have acute coronary syndrome, with low to intermediate pretest risk, particularly in emergency settings.

Keywords: Acute coronary syndrome, Coronary artery disease, Coronary angiography.

INTRODUCTION

Acute pain chest is one of the most common reasons for emergency department visits worldwide, accounting for 506 million visits annually[1]. However, only 15 to 25% are found to have acute coronary syndrome (ACS) after diagnostic workup[2]. Fifty to seventy percent of these fall into low and intermediate risk population[3]. Conversely, 2% cases of ACS are misdiagnosed in emergency department[4], hence mistakenly sent home resulting in dire consequences; for example, short term mortality of acute myocardial infarction rises to twofold if the patient is erroneously discharged from emergency department[5]. Fear of misdiagnosing ACS oftenly results in over stay of patients in emergency department and unnecessary admissions in hospitals, at an estimated cost of $3 billion annually[6]. The situation is further confused in the settings of equivocal ECG changes and normal initial biomarkers of cardiac injury particularly when the diagnosis of ACS is suspected. It is highly desirable to devise effective strategy for the evaluation of such patients in emergency department, leading to early and safe discharge from the hospital.

Coronary computer tomographic angiography (CCTA) is a non invasive test with 87 to 99% sensitivity and 93 to 99% specificity for the diagnosis of coronary artery disease[7]. Objective of the study was to determine role of this modality for safe discharge of the patients, suspected to have acute coronary syndrome, in emergency settings. Primary hypothesis tested was; patients with either normal coronary arteries or with insignificant coronary artery disease (which was defined as stenosis of less than 50% in any of the major coronary arteries

Correspondence: Dr Usman Iqbal, Armed Forces Institute of Cardiology (AFIC), Rawalpindi, Pakistan
(*Email:usmaniqbal76@gmail.com*)

or their first order branch) would have 30 day major adverse cardiac event rate i.e. sudden cardiac death, myocardial infarction or coronary revascularization of less than 1%.

MATERIAL AND METHODS

It was an observational study that was carried out at Armed Forces Institute of Cardiology (AFIC) from July 2013 to June 2014. Personal of Armed Forces, coming to emergency department (ER) for the evaluation of pain chest presumably of cardiac origin, with low and intermediate pre test probability of coronary artery disease as assessed by HEART score of 0 to 6, were enrolled in the study. Patients with preexisting coronary artery disease or those with high pretest probability of coronary artery disease as evidenced by HEART score of greater than 6 were excluded from enrolment. Similarly, those with contraindication of coronary CT angiogram like cases of persistent tachycardia, cardiac arrhythmias, contrast allergy, renal impairment i.e serum creatinine greater than 1.5 mg/dl or high calcium score i.e score greater than 400 Agatston units, were also not enrolled in the study. Moreover, patients presenting with pain chest, having considerable evidence of non coronary origin of their pain based on history, examination and investigations were precluded from enrolment.

Sample size was calculated using Raosoft calculator with margin of error 5% and confidence interval 99%. Having taken approval from hospital research ethical committee and informed consent, patients presenting into emergency department of AFIC, with suspicion of acute coronary syndrome, were categorized into low, intermediate and high pretest probability of acute coronary syndrome, based on history, examination, findings of initial ECG and results of cardiac biomarkers (Troponin T or CK MB). Moreover, all patients underwent serial ECGs, at least three sets, timings were decided by the attending physician, 2 D Echocardiography and repeat cardiac biomarkers, 6 to 12 hrs apart, in some of cases, for safety reasons, to rule out myocardial infarction. Those having low or intermediate pretest probability underwent coronary computer tomographic angiography within 24 hrs of their presentation. Patients found to have significant coronary artery disease on CT angiogram, which was defined as stenosis of 50% or greater in left main stem, left anterior descending, left circumflex, or right coronary artery or their any first order branch, underwent subsequent invasive coronary angiogram and revascularization as required. Persons with either normal coronary arteries or clinically insignificant coronary artery disease (stenosis of less than 50%) were immediately

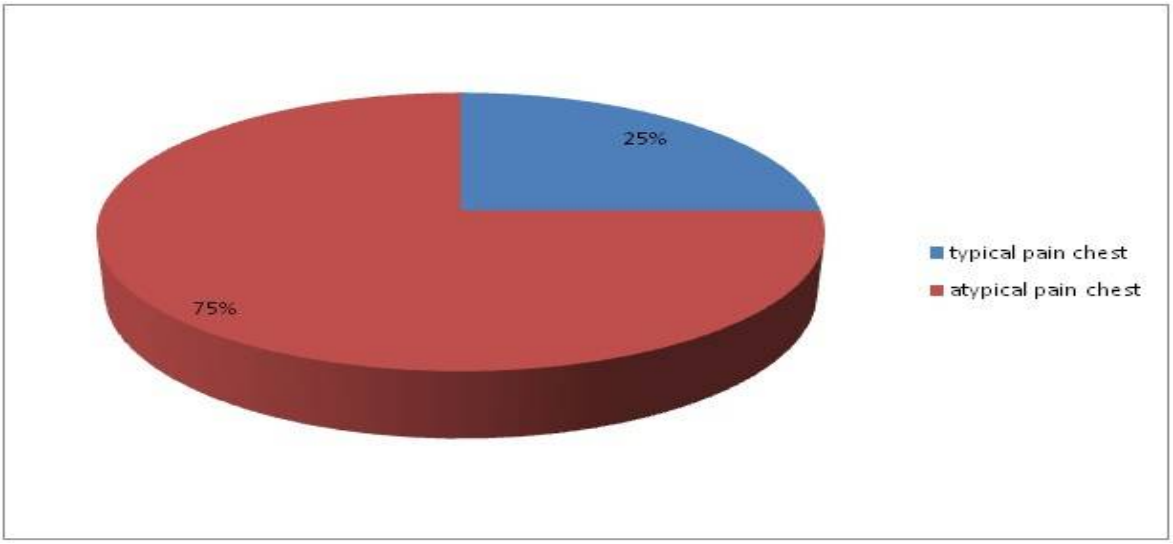

Figure-1: Patients presenting with chest pain in emergency department (n=647).

discharged either from the emergency department or from the ward with the medical advice as per the standard practices. These patients were contacted 30 days after the discharge, either through their cell numbers or unit address which were noted at the time of enrollment, for any major adverse cardiac event i.e death presumably of cardiac origin or occurrence of myocardial infarction or coronary revascularization.

Coronary computer tomographic angiography was performed through 64 slice multidetector CT scanner. The examination included a noncontrast ECG triggered acquisition of calcium scoring and a post contrast ECG synchronized acquisition of coronary images. Patients received beta blockers for control of their heart rates and nitroglycerines for dilation of coronary arteries. Results were reported according to the Society of Cardiovascular Computer Tomography guidelines, with the use of American Heart Association coronary segment model and included the calcium score and the cardiac findings6. Readers had to meet the criteria for level 3 cardiac CT training[7]. Data was analyzed using predictive analysis software (PASW) version 18.0

RESULTS

Six forty seven patients were enrolled in the study. Among these, 639 (98.7%) were male and 8 (1.23%) were female. Minimum age was 20 years, maximum was 59 years with mean age of 39 + 10.7 years. One sixty two (25%) patients had pain typical of angina, as shown in fig-1. Distribution of typical risk factors for coronary artery disease among study population is shown in fig-2. Among 647 patients who underwent coronary computer tomographic angiography, 486 (75.1%) had normal coronary arteries and 123 (19%) had insignificant disease. These two groups were discharged from the hospital without further investigation and were contacted 30 days later for any predefined adverse cardiac event. However, remaining 38 patients who were found to have significant coronary artery disease underwent subsequent invasive coronary angiogram with view of revascularization; hence precluding those from 30 days follow up. These results are summarized in fig-3. At 30 day follow up, none of 609 (94.1%) patients, who previously had either normal coronary arteries or insignificant coronary artery disease on CT angiogram, had any adverse cardiac event i.e sudden death presumably of cardiac origin, myocardial infarction or coronary revascularization, indicating statistically significant results ($p < 0.05$).

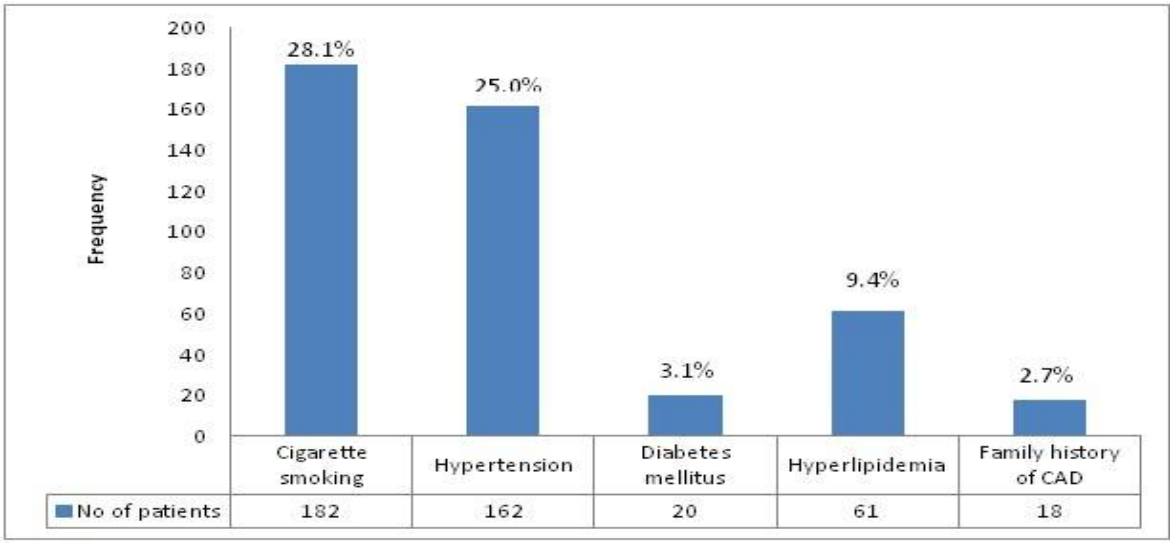

Figure-2: Distribution of risk factors for coronary artery disease among study participants.

DISCUSSION

It was found in the study that coronary CT angiogram based strategy was safe for the

evaluation of acute pain chest presumably of cardiac origin with low and intermediate pretest probability of coronary artery disease. This study supports the findings of other studies suggesting the benefits of CT angiogram based strategy for the evaluation of low to intermediate risk patients whose symptoms warrant admissions or further evaluations[8-9]. Moreover, this strategy results in early discharge from the emergency department and economic constrains were implicated in their case as they were entitled to free of cost investigations. Scanty female representation (1.2%) was seen in the trial owing to their lesser proportion in armed forces. 75% patients had normal CT angiogram and thus were safely discharged from the emergency department. These results are comparable with other studies on the subject[14].

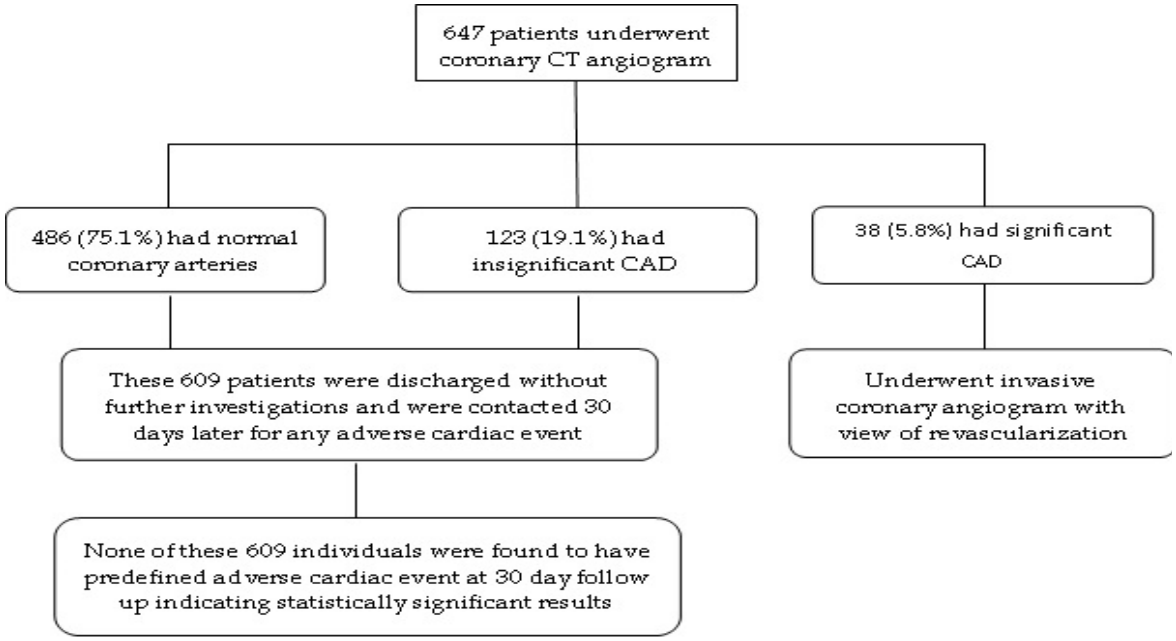

Figure-3 : Results of coronary CT angiogram.

over all reduced hospital stay without increase in cost[10-11]. Contemporary practices also employ investigations like exercise tolerance test or myocardial perfusion scan to diagnose coronary artery disease but their biggest limitation is the fact that the exercise tests are usually not performed in the settings of acute chest pain syndromes. Moreover, exercise stress test has low sensitivity and specificity for the diagnosis of coronary artery disease[12]. Conversely, myocardial perfusion scan is more time consuming and usually not employed in emergency settings though having similar sensitivity and specificity as compared to coronary CT angiogram[13].

We tried CT based strategy in order to find its safety in our settings. Only patients of armed forces were included in the study as it was easier to follow them up. Moreover, no

CT based strategy is not devoid of side effects and objections. It does result in excessive radiation exposure ranging from 4 mSv to 10 mSv depending upon the technique used, almost more than 100 times the radiation exposure encountered in routine chest X-ray[15]. It is said that the exposure of 10 mSv had been projected to lead to 1 death from cancer per 2000 persons[16]. However, recent technological advances have reduced radiation exposure to the point that the average exposure is typically less than that from nuclear myocardial perfusion imaging[17]. Moreover, not all patients can undergo CT angiogram either due to persistently elevated heart rate or deranged renal profile. Furthermore, critique of the strategy argue its utility in certain low risk groups as the event rate in this population is already less than 1%[18]. That is why some

authors advocate strongly against employing this strategy to all patients with low to intermediate risk of acute coronary syndrome[19].

CONCLUSION

Despite all pros and cons, discussed above, we have found coronary CT angiogram as safe and effective tool for the evaluation of patients suspected to have acute coronary syndrome, with low to intermediate pretest risk, particularly in emergency settings. However,long term risk of radiation exposure and its utility in all patients do need further evaluation.

CONFLICT OF INTEREST

This study has no conflict of interest to declare. Abstract and results of this study were accepted and presented in an oral presentationat the International conference on Medical Education, organised by Association for Excellence in Medical Education(AEME) and held on 07th-09th March 2014 at University of Health Sciences(UHS) Lahore, Pakistan. No funding was received from any agency or institution.

REFERENCES

1. Almas A, Parkash O, Hameed A, Muhammad I. Emergency Evaluation of Acute Chest Pain. Journal of the College of Physicians and Surgeons Pakistan 2010, Vol. 20 (2): 74-78
2. Lindsell CJ, Anantharaman V, Diercks D et al: The internet tracking registry of acute coronary syndrome: A multicenter registry of patients with suspicion of acute coronary syndromes reported using the standardized reporting guidelines for emergency department chest pain studies. Ann Emerg Med 48:666, 2006.
3. Chase M, Robey JL, Zogby KE, et al. Prospective validation of the thrombosis in myocardial infarction risk score in emergency department chest pain patients population. Ann Emerg Med 2006; 48:252-9.
4. McCarthy BD, Beshansky JR, D'Agostino RB, et al. Missed diagnoses of acute myocardial infarction in the emergency department: results from a multicenter study. Ann Emerg Med 1993;22:579-582.
5. Sabatine MS, Cannon CP. Approach to the patient with chest pain. In: Bonow RO, Mann DJ, Zipes DP, Libby P. Braunwald's Heart Disease: A text book of cardiovascular medicine. 9th ed. India: Elsevier 2012; 1076.
6. Agency for Health Care Research and Quality. Health Care Cost and Utilization Project (http://www.hcup-us.ahrq.gov)
7. Mowatt G, Cook JA, Hillis GS, et al: 64 slice computer tomography angiography in the diagnosis and assessment of coronary artery disease: systematic review and meta-analysis. Heart 94: 1386, 2008.
8. Raff GL, Abidov A, Achenbach S, et al. SCCT guidelines for the interpretation and reporting of coronary computer tomographic angiography. J Cardiovasc Comput Tomogr 2009; 3: 122-36.
9. Budoff MJ, Cohen MC, Garcia MJ, et al. ACCF/AHA clinical competence statement on cardiac imaging with computer tomography and magnetic resonance. Circulation 2005; 112: 598-617.
10. Hollander JE, Chang AM, Shofer FS, et al. One-year outcomes following coronary computerized tomographic angiography for evaluation of emergency department patients with possible acute coronary syndrome. Acad Emerg Med 2009; 16:693-8.
11. Goldstein JA, Channaiyan KM, Abidov A, et al. The CT-STAT (coronary computerized tomographic angiography for systematic triage of Acute Chest Pain Patients to Treatment) trial. J Am Coll Cardiol 2011;58:1414-22.
12. Hoffmann U, Bamberg F, Chae CU, et al. Coronary computed tomography angiography for early triage of patients with acute pain chest: the ROMICAT (Rule Out Myocardial Infarction using Computer Assisted Tomography) trial. J Am Coll Cardiol 2009;53:1642-50.
13. Litt HI, Gatsonis C, Synder B, et al. CT angiography for safe discharge of patients with possible acute coronary syndromes. NEJM 2012;366;15:1393-1403.
14. Jolly MA. Exercise Electrocardiographic Testing. In: Griffin BP, Callahan TD, Menon V. Manual of Cardiovascular Medicine. 4th ed: New Delhi: Wolters Kluwer 2013; 772.
15. Oommen SS. Nuclear Cardiac Imaging. In: Griffin BP, Callahan TD, Menon V. Manual of Cardiovascular Medicine. 4th ed: New Delhi: Wolters Kluwer 2013; 791.
16. Hoffmann U, Nagurney JT, Moselekski F, et al. Coronary multidetector computer tomography in the assessment of patients with acute pain chest. Circulation 2006; 114:2251.
17. Patel PR, Desei M. Cardiovascular Computer tomography. In: Griffin BP, Callahan TD, Menon V. Manual of Cardiovascular Medicine. 4th ed: New Delhi: Wolters Kluwer 2013; 850.
18. Berrington A, Mahesh M, Kim KP, et al. Projected cancer risks from computed tomographic scans performed in United States in 2007. Arch Inter med 2009;169:2071-7.
19. Gerber TC, Carr JJ, Arai AE, et al. Ionizing radiations in cardiac imaging: a science advisory from the American Heart Association Committee on cardiac imaging of the council on clinical cardiology and committee on cardiovascular imaging and intervention of the council on cardiovascular radiology and intervention. Circulation 2009; 119: 1056-65.
20. Body R, Carley S, McDowell G, et al. Rapid exclusion of myocardial infarction in patients with undetectable troponin using a high sensitivity assay. J Am Coll Cardiol 2011;58:1332-9.
21. Regberg RF. Editorial: Coronary CT angiography for acute chest pain. NEJM 2012;367;4:375-6.