Global Advanced Research Journal of Medicine and Medical Science (ISSN: 2315-5159) Vol. 3(6) pp. 106-110, June 2014
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Case Report

Computed Tomography Based Agatston Scoring in the Diagnosis of Coronary Artery Disease: A Case Report

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Accepted 23 June, 2014

Coronary heart disease is the most common cause of death in the general population. Modern Computed Tomography (CT) systems meet the needs of sufficient resolution for imaging of the heart and coronary arteries. The detection of coronary artery calcium (CAC) is simple and is applied to detect and quantify subclinical coronary atherosclerosis even in asymptomatic individuals. This case of Coronary Artery Disease was studied during the period from January 2014 up to February 2014 using MSCT scanning. Volume Rendering Technique, Maximum Intensity Projection and axial cuts were obtained. Results from the study suggest that MDCT technology not only offers the possibility to visualize intracoronary stenosis non-invasively, but also to differentiate plaque morphology and the site of calcification. Contrast-enhanced MDCT is a promising non-invasive technique for the detection, visualization and characterization of stenotic artery disease.

Keywords: Coronary artery disease, Computed Tomography, Calcium scoring

INTRODUCTION

Cardiovascular disease is the leading cause of morbidity and mortality in the Western world. Early detection of coronary artery disease (CAD) is of vital importance as timely treatment may significantly reduce morbidity and mortality (Sun Z, Jiang W, 2006)

CT has been established as a non-invasive imaging modality for the detection and quantification of coronary calcium using the Agatston scoring algorithm (Agatston A et al 1990, Sheppard R, Eisenberg MJ, 2001). The calcium score, as proposed by Agatston, is determined on the basis of the product of the total area of a calcified plaque and an arbitrary scoring system for those pixels with an attenuation greater than 130 Hounsfield units (HU). This multisection data set should give a clear representation of the amount of calcification in the major coronary arterial tree, yet high interscan variability up to 60% has impaired the ability to measure coronary arterial calcification precisely and repeatedly (Ohnesorge Bet al, 1999). Spiral multislice CT holds promise to diagnose the disease by using retrospective gating with volumetric imaging as well as ECG-gated volume. The reliability of coronary calcium quantification especially for small plaques was found to significantly improve (Carr JJ, Danitschek JA, Goff DC, et al, 2001) (Ohnesorge B, 2000).

Detection of plaques may be escaped by conventional coronary angiography and may lead to potential underestimation of the extent of coronary artery disease when conventional coronary angiography is used.

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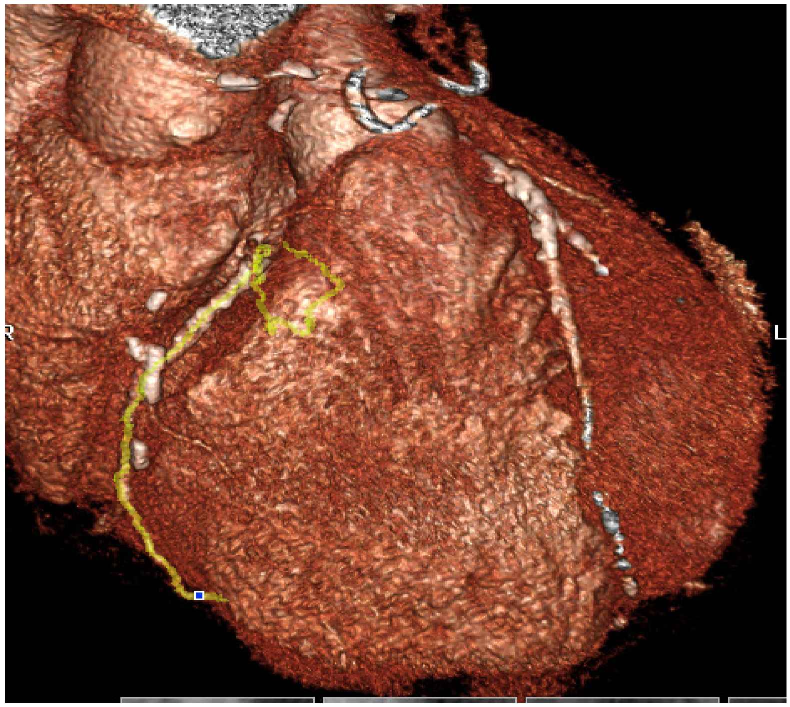


Figure1. Volume Rendering Technique image for a male 58 years old heart showing outer surface

However, CT coronary angiography allows for the detection of early changes before narrowing of the luminal diameter. This is an absorbing potential of the cross-sectional imaging modalities

Based on mean CT attenuation, differentiation between predominantly lipid-rich plaques from predominantly fibrous-rich plaques can be achieved. Thus, this new technology holds promise to allow for the non-invasive detection of rupture-prone soft coronary lesions and may have the

option to lead to early onset of therapy (Schro¨ der S, Flohr T, Kopp AF, et al. 2001)

CASE REPORT

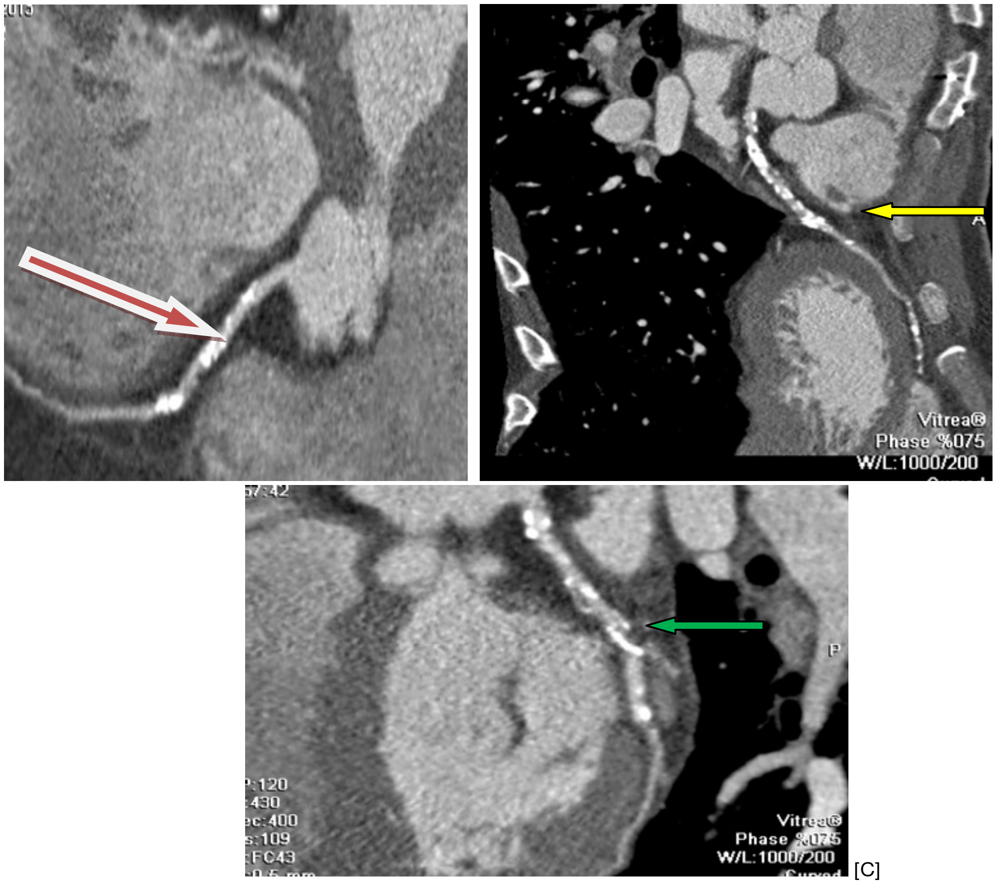
A 58 years old male was referred to the radiology department with chest pain. His past medical history reported high blood pressure, high cholesterol level. Cardiac Coronary CT (CACS) examination was requested ,Calcium scoring (Agatston score) and post contrast cuts for coronary CTA using MDCT with MIP,VR and CMPR were obtained .CACS showed that LMA was 148,RCA =860,LAD=1087,LCX=363,PDA=0 with total Calcium score of (2458) Agatston

Coronary CTA showed right sided dominant circulation. The RCA showed multiple severe mixed stenotic lesions through proximal and mid segments with mild lesions at proximal portions of distal segment. Faint flow could be seen at PDA and PLA. Flow could be seen at Conus, SA nodal and right ventricular branch .Faint flow at acute marginal was seen. LMCA showed moderate mixed stenotic plaques before bifurcation into LAD and LCX (figure 1).

The LAD showed severe stenotic lesions due to mixed plaques at proximal and mid segments. Distal segments showed multiple calcified plaques with positive remodeling with minimal stenotic effects and flow seen as low as cardiac apex. It gives three diagonal branches showing proximal calcified plaques and flow seen at distal portions. The LCX showed severe stenotic lesions due to mixed plaques mainly at mid segments. It gives three OM branches: the largest is OM2 and distal LCX fades at AV groove close to crux (figure 2).

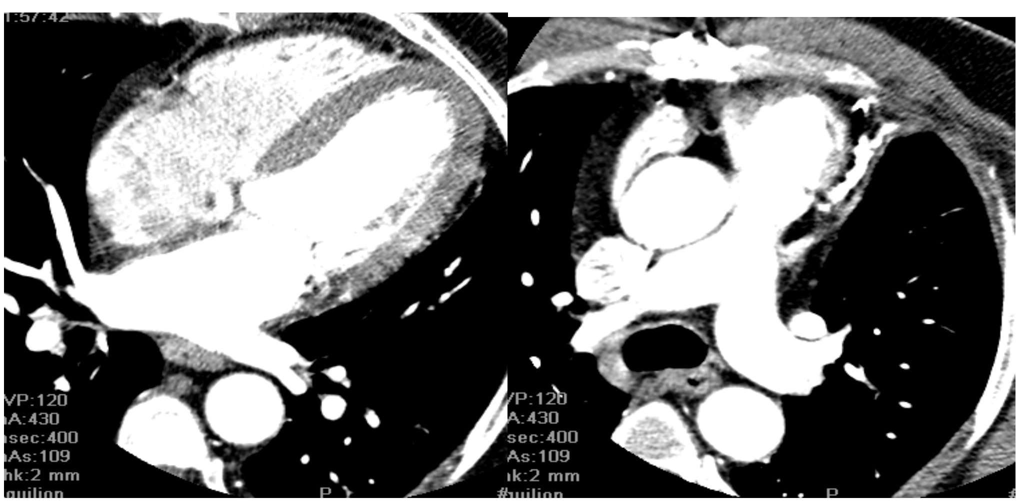
Left ventriculgram showed unremarkable myocardial CT density and morphology. No focal atrophy, bulge or calcifications. Few spots of calcifications were seen at aortic valve and ascending aorta. No pleural or pericardial effusion. No aneurysm or dissection of the thoracic aorta.

The pulmonary arterial trunk is of normal diameter, no pulmonary thrombo- embolism with normal pericardium. The final opinion is that the three vessels disease are in the form of severe stenotic lesion at proximal and mid segments with reasonable flow distally (figure 3).



[A] [B] [C]

Figure 2. Coronary CT angiography in a 58 years old male patient with a right coronary artery RCA calcium scoring=860. In Maximum intensity projection in a transaxial orientation, the RCA showed multiple severe mixes stenotic lesions through proximal and mid segments with mild lesions at proximal portions of distal segment [A](*red arrow*).Curved multiplanar reconstruction of the left anterior descending coronary artery (yellow *arrow*). LAD calcium scoring=1087 The LAD showed severe stenotic lesions due to mixed plaques at proximal and mid segments. Distal segments showed multiple calcified plaques were with positive remodeling with minimal stenotic effects and flow seen as low as cardiac apex [B]. The LCX showed severe stenotic lesions due to mixed plaques mainly at mid segments, LCX calcium scoring =363[C](*green arrow*).



[A] [B]

Figure 3. [A]Left ventriculgram showed unremarkable myocardial CT density and morphology. Normal pericardium, No focal atrophy, bulge or calcifications. No pleural or pericardial effusion. No aneurysm or dissection of the thoracic aorta.[B]The pulmonary arterial trunk is of normal diameter, no pulmonary thrombo- embolism.

DISCUSSION

During the past two decades, a number of advanced diagnostic cardiology techniques have been established for characterization of obstructive CAD (Robert A et al, 2000). The multi detector computed tomography (MDCT) technology is a more recent development. (Matthew J. Budoff Jerold S. Shinbane,2010) A non-invasive imaging modality was introduced for the detection and quantification of coronary calcium using the Agatston scoring algorithm. (Sheppard R, Eisenberg MJ ,2001)

Coronary calcium is defined as a lesion above a threshold of 130 Hounsfield units; the original calcium score developed by (Agatston et al. 1990) is determined by the product of the calcified plaque area and maximum calcium lesion density based upon Hounsfield units. Standardized categories for the calcium score have been developed with scores of 1–10 considered minimal, 11–100 mild, 101–400 moderate, and >400 severe. (Callister TQ, Cooil B, Raya SP, et al,1998)

The relationship of CAC to obstructive disease has been extensively investigated, by the American College of Cardiology/American Heart Association (O'Rourke RA, Brundage BH, Froelicher VF, et al,2000) which focused on the low specificity as a critical flaw. While the presence of CAC is nearly 100% specific for atherosclerosis, it is not specific for obstructive disease since both obstructive and non-obstructive lesions have calcification present in the intima. Comparisons with pathology sampling have shown that the degree of luminal narrowing is weakly correlated with the amount of calcification, (Simons DB, Schwartz RS, Edwards WD, et al ,1992, Detrano R, Tang W, Kang X, et al.1995, Mautner GC, Mautner SL, Froelich J, et al,1994) whereas the probability of significant obstruction increases with the total CAC score. (Budoff MJ, Georgiou D, Brody A, et al ,1996, Wexler L, Brundage B, Crouse J et al ,1996, Guerci AD, Spadaro LA, Popma JJ, et al,1997).

Studies have mentioned that higher calcium scores have relations with obstructive disease (Rumberger JA, Sheedy PF, Breen FJ, et al,1997) A threshold score of 368 was 95% specific for the presence of obstructive CAD.CAC scanning purpose is to detect subclinical atherosclerosis in its early stages, for which it is almost 100% specific. (Matthew J. Budoff Jerold S, 2010) Individuals with zero CAC scores may be considered to have an early stages of plaque. (Tuzcu EM, Kapadia SR, Tutar E, et al,2001). The Framingham Risk Score (Wilson PWF, D'Agostino B, Levy D, et al,1998) can assist the physician in making decisions regarding the use of medications.

MRA has shown promising results in the diagnoses of CAD (Schaller BJ, 2007). However the Digital Subtraction Angiography invasiveness, it can also be used (Wasserman, Wityk, Trout et al., 2005). Doppler ultrasound is widely used clinically to measure lumen stenosis in carotid arteries and also to measure or identify atherosclerotic plaque site, and character (Saba L, Sanfilippob R, Montisci R, et al, 2010). Nowadays MDCTA sensitivity in the evaluation of stenosis degree has achieved fewer risks and excellent sensitivity results (Bartlett ES et al, 2006).

MDCT angiography might allow detection and assessment of non-calcified, lipid plaques (Schro¨ der S, Kopp AF, Baumbach A, et al ,2001, Schro¨ der S, Flohr T, Kopp AF, et al 2001- Kopp AF, Ohnesorge B, Flohr T,1999). MDCT can be considered as the gold standard non-invasive investigation method, for the detection of coronary plaques and plaque composition (Schro¨ der S, Kopp AF, Baumbach A, et al, 2001).

CONCLUSION

Cardiac calcium scoring and CT angiography of the coronary arteries are noninvasive imaging modality related to the recent development and had significant impact on cardiac imaging .The validation of CAC scanning as a precise risk assessment tool for the vast majority of patients intended to suffer acute cardiac events, which allows for significant reduction of cardiovascular mortality by increasingly effective treatment of the underlying disease process.

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