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Evaluation of coronary artery disease using dynamic volume CT

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Abstract: Background: Dynamic volume CT (DVCT) is a recent development in the MDCT that allows ECG-gated complete coronary coverage in a single gantry rotation. Patient with cardiac chest pain may have either coronary artery disease (CAD) or non-CAD related etiologies. MDCT angiography plays an important role in patients with chest pain, where etiologies other than CAD are also in question. It can access accurately CAD, anomalous coronary artery and pericardial disease. Objectives: The aim of this study is to evaluate the role of Dynamic volume CT (640-MSCT) coronary angiography in patients presenting with chest pain suspected for CAD and to detect its ability to exclude significant CAD. Methods: This study included 50 patients suspected for CAD; Conventional angiography was considered the reference standard technique for 20 cases. Results of both modalities were compared on per-segment basis Results: Out of the 50 cases 9 (18%) patients were normal, 18 (32%) cases showed non-significant CAD and 19 (38%) cases showed significant coronary artery disease and 7 (14%) cases showed anomalous coronary arteries. Zero calcium score was detected in 16 cases (32%) including one case showing significant CAD. Calcium score below 100 in 20 cases (40%) and above 100 in 14 cases (28%). Dynamic volume CT coronary angiography compared to CCA as reference standard showed sensitivity, specificity, PPV, NPV& accuracy; 98%, 97.7%, 90.5%, 99.5, 97.7% respectively. Conclusion: our results show that non invasive dynamic volume CT coronary angiography is a reliable technique to detect coronary stenos is in patients with suspected CAD and suggest that this noninvasive technique can now be considered an alternative to invasive diagnostic coronary angiography in this group of patients. Key words: Coronary artery disease (CAD) – 640-Multi-Slice Computed Tomography (640-MSCT) – Dynamic volume CT (DVCT).

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Key words: Coronary artery disease (CAD) –320-Multi-detectors computed tomography (320-MDCT) – I Dynamic volume CT (DVCT) 0.6

1. Introduction

Because coronary artery narrowing or obstruction owing to atherosclerosis underlies myocardial ischemia in the vast majority of cases, Ischemic heart diseases (IHDs) are often termed Coronary artery disease (CAD) (**Bhatia, 2010)**

Cardiac chest pain may be caused by either coronary artery disease (CAD) or non-CAD related etiologies.

Various disorders, other than atherosclerotic CAD, can reduce or interrupt coronary blood flow:

- Congenital coronary artery anomalies
- Coronary aneurysm
- Coronary arteritis
- Coronary artery dissection
- Coronary artery thrombosis without underlying atherosclerotic plaque (thrombosis in situ):
- Coronary fistula
- Coronary emboli **(Jinnouchi et al., 2018)**

CTbased evaluation for significant coronary artery stenosis has been shown to decrease the number of unnecessary hospital admissions without reducing the rates of appropriate admissions by ruling out the absence of acute coronary syndrome.

CT atherosclerosis imaging is a major area of imaging research with CTA. By simultaneously assessing luminal stenosis and plaque burden, CTA allows the description of atherosclerotic disease patterns **(Pundziute et al., 2007).**

Multi-slice CT coronary angiography is a rapidly developing non-invasive diagnostic technique that can be used to detect coronary stenosis **(De Feyter, 2007).**

Challenges in evaluating the coronary arteries at CT are the small size and tortuous courses of the vessels and their continuous movements being intimately related to the cardiac chambers. Controlled heart rate and good breath-holding help to reduce cardiac and respiratory motion artifacts respectively. Retrospective ECG gating and proper choice of the reconstruction window would significantly improve the examination quality.

To date, the central basis of CT angiography has been the noninvasive detection and grading of coronary artery stenosis, assessment of coronary artery anomalies and follow up after coronary bypass surgery.

Contraindications to CTCA include irregular heartbeats (arrhythmias), contra-indications to iodinated contrast material including allergy, renal insufficiency and hyperthyroidism, contra-indications to radiation exposure; pregnancy, respiratory impairment and marked heart failure.**(Dewey et al., 2009).**

With the introduction of wide-range detector CT systems, the traditional principles of helical scanning by combining volume data from subsequent spiral acquisitions to cover the whole heart are not needed. Wide-range MDCT imaging allows the entire heart to be acquired in a single gantry

rotation without the need for table movement, which enables dynamic volume imaging. Wide-range detectors overcome the problem of stair- step artifacts that occur when adjacent volumes are acquired at two different heartbeats. As the entire volume of the heart is acquired in a single heartbeat, beat-to-beat variations in heart rate do not present a problem **(Dewey et al., 2009).**

The single gantry rotation ensures temporal uniformity of the acquired volume data and thereby equal contrast distribution (contrast uniformity) throughout the cardiac data set, which facilitates interpretation of diagnostic findings **(George al., 2009).**

Dynamic volume acquisition with wide-range detector CT system can reduce the radiation exposure by 4-5-fold, compared with traditional helical imaging, because over-scanning and over ranging are not required **(Dewey et al., 2009).**

Aim of the Work

The aim of the study is to evaluate the role of computed tomography coronary angiography using Dynamic volume CT system (640-MSCT), in assessment of patients with coronary artery disease.

2. Patients and Methods

Study population

A total number of 50 patients with suspected CAD were scheduled for elective multislice CT coronary angiography between June 2015 and November 2018.

Our patients represented by dyspnea on exertion, fatigue on mild effort or atypical chest pain.

They were referred to the radiology department at Nasser Institute hospital and to the CT unit in radiology centers asking for CT coronary angiography for the possibility of CAD

Patients included in our study (22 males and 28 females) ranging in age between 39 and 73 years old, with a mean age of 58 years.

Other risk factors in patients with coronary artery disease:

Hypertension
Dyslipidaemia
Smoking
Positive family history of CAD

Exclusion criteria:

Pregnant women
Proven CAD (previous myocardial infarction, coronary artery bypass surgery, and percutaneous coronary intervention)
Patients with calcium score more than 1000.
Contraindications to iodine contrast
Renal insufficiency (creatinine level ≥1.5 mg/dL)
Inability to sustain a breath hold for 8 seconds
Inability to comply with the protocol requirements
Morbid obesity.

Based on the results of MDCT coronary angiography cases with significant coronary artery disease were followed by CCA for further evaluation.

Methods

All patients were subjected to the following:

Full history:

Including history of cigarette smoking, systemic hypertension, dyslipidaemia, family history of CAD and diabetes mellitus duration.

1. Revision of previous laboratory and cardiac investigations
2. **Preparation of the patient:**

All patients were instructed to fast 4-6 hours prior to the examination with no discontinuity of their medications.

Reassurance of the patient was done and all steps of the study were explained in details to each patient. To evaluate patients ability of breath with holding for relatively long time; they were required to perform a deep inspiration and to continue to hold their breath without pushing (i.e. Valsalva maneuver). During this trial, the patient was observed for compliance and the electrocardiogram for significant changes.

Patients who couldn’t withhold breathing for the presumed scanning time were instructed to hyperventilate for a period of 5 minutes and are re-evaluated. In some patients; this action was repeated several times till the patient can withhold breath for the aimed period.

Mild oral sedation with diazepam (5 mg) was sometimes given in particularly to anxious individuals.

Beta blockers were not administrated to all our patients; only those with heart rate above 65 bpm were given beta blockers (100 mg of Metoprolol or atenolololorally 1 hour before the study to obtain a stable low heart rate provided that contraindications to B blockers are excluded). This leads to increasing the diastolic phase of the cardiac cycle; which facilitates the acquisition process

0.5 mg Nitroglycerin sublingually 3 min before scanning was administered. All the patients signed informed consent and were informed with the scanning process.

Statistical analysis

Findings of the multi-detector row CT coronary angiography were compared to those of the corresponding conventional coronary angiograms. Evaluation was performed on a per segment basis. Using the results of selective coronary angiography as gold standard; statistical cross tables were created after determination of the true positive and negative as well as false positive and negative values, sensitivity specificity, positive predictive value (PPV), negative predictive value (NPV), and overall accuracy of MSCT coronary angiography were calculated. When the coronary segment was interpreted as normal or mildly atherosclerotic, here it was considered as negative, and when was interpreted as significant lystenotic or totally occluded segment, it was considered as positive.

3. Results

This study included 50 patients enrolled for 640-MSCT angiography of the coronary arteries. Twenty of them (40%) underwent conventional angiography as a gold standard technique for evaluation of coronary artery disease due to detection of significant CAD by CT angiography in 19 cases of them. In only one case CT coronary angiography was requested after CCA was done.

The rest of cases (31), their CT showed on-significant findings with diagnostic image quality which were accepted by the physician and not necessitate further investigations.

Cardiovascular risk factors for the 50 patients included positive family history for coronary artery disease in 25 cases (50 %), diabetes mellitus in 15 cases (30 %) , hypertension in 22 (44 %), smoking in 18 cases (32 %) and dyslipidemia in 12 cases (24 %) .

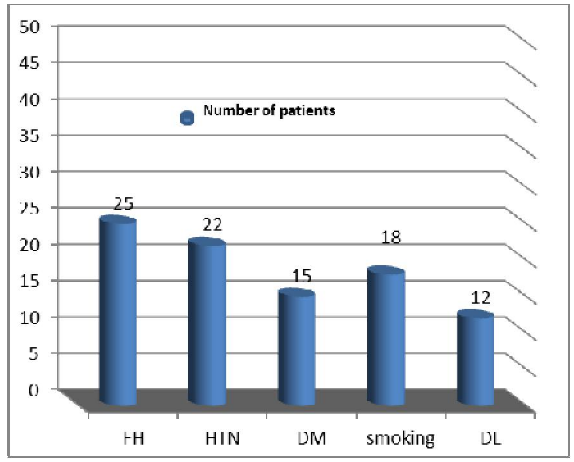

Figure (1)

The mean heart rate during the MDCT was 63 ± 9 bpm (range, 52-84 bpm). The average decrease in HR in the patients was 11 bpm when compared to the baseline heart rate after administrating the beta blocker.

All CT angiographies performed were of diagnostic image quality (image quality: 70% good, 24% moderate, and6% poor). The reasons for the CT angiographies with poor image quality included tachyarrhythmia, extensive calcification of the vessel wall of all coronary segments and marked obesity.

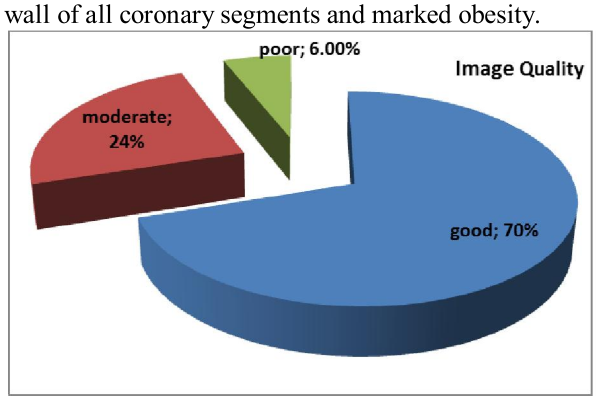

Figure 2:3D chart showing distribution of different CT image qualities.

Based on the results of MDCT coronary angiography the cases were classified into 4 groups

Group 1(9 cases): showed completely normal coronary arteries. 3They were 7 females and 2 males with mean age 45 years ranging from 39 to 55years. Three of them showed positive family for coronary artery disease, two were hypertensive, one was diabetic. No known risk factors were detected in 5 cases. Two of these cases showed incidental findings which may explain the cause of the chest pain and these were; dissecting aneurismal dilation of aorta in one of them and a small hiatus hernia in the other.

Group 2(7 cases): showed anomalous coronary arteries.

Myocardial bridging **(4 cases)** All of them occurred in mid segment of LAD. 3 were superficial and one was deep with no significant systolic diameter reduction in any of them. An associated non obstructive coronary artery disease was associated in 2 of these cases.

Anomalous origin of RCA from left coronary sinus (2 cases): malignant inter-arterial course was detected in both.

Single coronary artery (1 case) it showed mild atherosclerotic changes as well.

Group3 (18 cases): showed non-significant atherosclerotic disease. Anomalous coronary arteries were detected as well in three of them. They all showed tortuous vessel course with intimal wall irregularities. Ectatic segments were detected in 10 cases of them, non-obstructive calcified plaques in 11 and non-calcified in 8.

Group 4(19 cases) showed significant coronary artery disease with the following distribution: one vessel disease in 8 cases, 2 vessel disease in 9 cases, 3 vessel disease in 2.

Zero calcium score was detected in 19cases (38%) including all cases showing normal coronary arteries and anomalous coronary arteries not associated with atherosclerotic disease, one case showing significant CAD and 5 cases showing non-significant CAD. Calcium score below 100 in 15 cases (30%) and above 100 in 16 cases (32%). In the second group significant CAD was detected in 7 (46%) cases while in the third group it was detected in11(68.7%) cases.

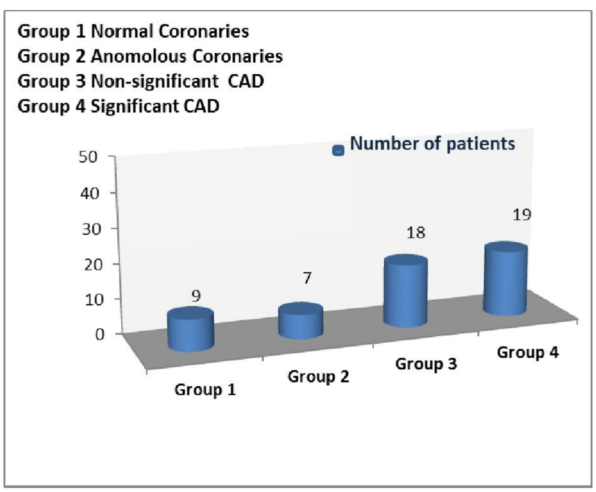

Figure (3) 3D chart showing the number of patients of each group, and their distribution among the population of the study.

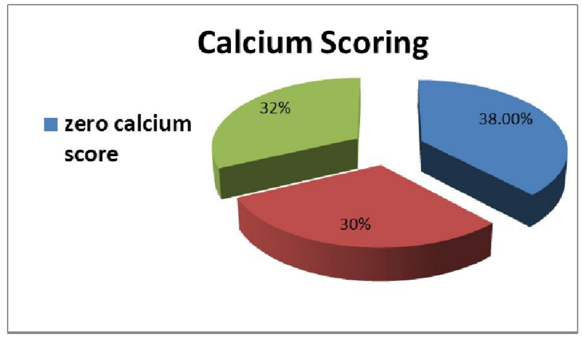

Figure (4):3D pie chart showing distribution of calcium scoring among the population of the study.

In the 20 cases that underwent both CCTA and conventional coronary angiography(19 cases with significant coronary artery disease and one case with anomalous coronary artery), findings of the 640-MSCT coronary angiography were compared to those of the corresponding conventional coronary angiograms. Evaluation was performed on a per segment basis using the results of selective coronary angiography as gold standard. When the coronary segment was interpreted as normal or mildly atherosclerotic it was considered as negative, and when was interpreted as significantly stenotic or totally occluded segment, it was considered as positive.

Out of 300 segments studied 30(10%) segments were excluded from the study. The causes of exclusion were true absence of vessel segment in12 segments (4%) and non-evaluable segment by MDCT in 18 (6%) which was related to small vessel size, heavy calcification, poor contrast opacification and cardiac motion artifacts.

As regards to the results of CCA, out of the 20 cases evaluated one case showed anomalous coronary artery and 19 cases showed significant coronary artery disease with the following distribution: one vessel disease in 10 cases, 2 vessel disease in 8 cases, 3 vessel disease in one) and out of 270 segments evaluated, 220 segments were considered negative and 50 segments were considered positive (42 significantly stenotic, 8 occluded).

As regard to results of MDCT out of 270 segments. 54 segment were considered positive (44 significantly stenotic, 10 occluded) and 216 segments were considered negative.

When comparing the results MDCT coronary angiography with that of the gold standard CCA, we found that out of 54segments that were diagnosed by MDCT as positive, only 49 were confirmed with CCA. The cause of the 5 false positive values were due to a false positive diagnosis involving2 segments in the same artery (proximal and mid RCA), which were shown to be occluded by MDCT, as a result of poor contrast opacification, and were revealed to be patent by CCA, and3stenotic lesions falsely overestimated by MDCT to be significantly stenotic due to the presence of dens calcification and were revealed by CCA to be non-significant. It was also noted that in 4 other lesions showing calcified plaques (obstructive in 3 and non-obstructive in 1) there was some overestimation of the resultant stenotic lesion by MDCT due to the calcium blooming effect, however it did not affect the classification of the lesion as being significantly stenotic or not.

Out of the 216 segment diagnosed by MDCT coronary angiography as negative only 215 segment was confirmed by CCA, resulting into one false negative value, which was diagnosed by CCA as significantly stenotic lesion and was missed by CT angiography due to the presence of motion artifact caused by respiratory movement. Another significantly stenotic lesion was also detected by CCA in one of the non-evaluable segments by MDCT (not included in the study).

From the previous data, sensitivity, specificity, positive predictive value, negative predictive value & accuracy of MDCT coronary angiography was calculated compared to the gold standard CCA and were as follow; 98%, 97.7%, 90.5%, 99.5, 97.7% respectively.

Table (3): Comparison between positive findings of MDCT angiography and CCA among the studied cases.

MDCT	**CCA**	
	Negative (n= 220)	**Positive (n= 50)**
Negative (n=216)	215	1
Positive (n=54)	5	49

Table (4): Sensitivity, specificity, PPV, NPV, and accuracy of MDCT angiography in detection of significant CAD.

	Sensitivity	**Specificity**	**PPV**	**NPV**	**Accuracy**
MDCT angiography	49/50 (98%)	215/220 (97.7%)	49/54 (90.7%)	215/216 (99.5%)	264/270 (97.7%)

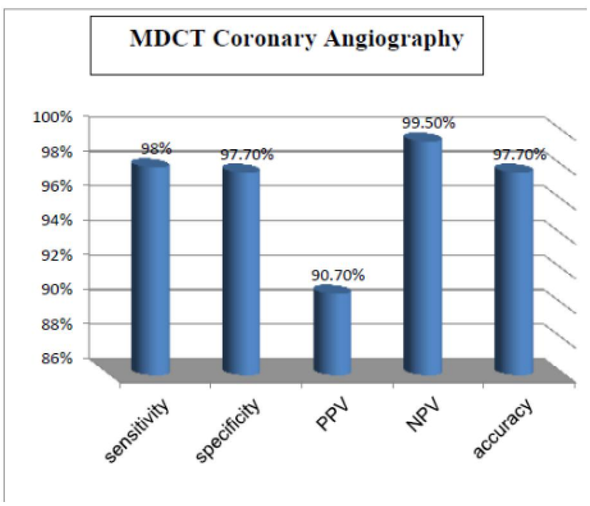

Figure (5) 3D chart showing the sensitivity, specificity, PPV, NPV, and accuracy of MDCT angiography in detection of significant CAD

4. Discussion

The rapid rise of coronary computed tomography (CT) angiography from a research application to widely embraced clinical tool over the last decade has very few parallels in medicine. We currently observe a convergence of factors that has the potential of making coronary CT angiography a pivotal cornerstone in cardiovascular disease management, deserving of the highest level of attention of our field. Factors with critical influence on the clinical implementation of coronary CT angiography are related to the scope and importance cardiovascular disease, rapidly evolving technology, widening use of coronary CT angiography for established indications, emerging new applications, fundamental changes in clinical cardiovascular disease management, and increased emphasis on cost-effectiveness in health care **(Bastarrika et al., 2009)**.

There is a sharp decline in cardiovascular disease mortality which has been mainly attributed to substantial improvements in primary and secondary prevention and medical disease management. However, the fact remains that cardiovascular disease continues to be the most important health problem globally; particularly in the westernized world **(Bastarrika et al., 2009).**

Initially, patient selection and indications for cardiac CT were variable and largely institutionally driven. However, with more wide spread use, the need for defining patient selection and appropriate use has become more apparent. Recommendations confirm a number of traditional indications for cardiac CT, such as the assessment of coronary artery anomalies and bypass grafts. There is consensus that the use of coronary CT angiography is appropriate in symptomatic individuals, especially if symptoms, sex, and age suggest a low to intermediate probability of significant coronary artery stenosis. There is also consensus that coronary CT angiography to date has no role for general screening for coronary atherosclerosis in asymptomatic individuals **(Bastarrika et al., 2009).**

Early investigations using four- and 16- row CT scanners reported sensitivity, specificity, positive predictive value, and negative predictive value of 75%–90%, 90%–95%, 70%–90%, and80%–90%, respectively, for the detection of hemodynamically significant stenosis **(Nieman et al., 2002).**

However, these early results were substantially limited by motion artifacts or extensive calcification which frequently necessitated the exclusion of coronary artery segments, vessels, or patients from data analysis and to some extent overstated the diagnostic performance that was achievable at that time. Subsequently, a more systematic analyses demonstrated a sensitivity of about 89% (range, 85%–92%), concluding that the sensitivity obtainable with these scanner generations may not be completely satisfactory to reliably rule out coronary artery stenosis **(Dikkers et al., 2006).**

The subsequent introduction of 64-rowCT technology led to substantial improvements in spatial and temporal resolutionthat resulted in increased sensitivity andspecificity for detecting significant coronary stenosis when compared with conventional coronary angiography.

Most important, with the exception of a single, study performed by **(Miller et al., 2008)** that showed lower sensitivity than specificity, allinvestigations performed with current generations of multi-detector CT scanners including DSCT have consistently reported high negative predictive value that approach or reach100% on a per-patient basis. This exceedingly high negative predictive value, which allows reliable exclusion of significant coronary artery stenosis following a normal or near-normal noninvasive coronary CT angiogram, is the cornerstone for the use of cardiac CT in the management of symptomatic patients suspected of having CAD. In this patient population, a normal or near-normal coronary CT angiogram can effectively obviate further testing **(Min et al., 2007).**

The presence of excessive coronary artery calcium, particularly in combination with motion or low signal-noise ratio, reduce the specificity in differentiating clinically significant from non-clinically significant coronary artery lesions. Thus, in symptomatic patients with inconclusive results at coronary CT angiography, further evaluation is advised so that hemodynamically significant lesions are not missed and the hemodynamic effect of borderline (i.e., 30%–70%) lesions can be assessed **(Bastarrika et al., 2009)**.

In a study carried out by **Schoenhagen et al. (2004)** which enrolled 65 subjects giving history of atypical chest pain, 42 (64.6%) had no CT-angiographically detectable coronary artery lesion, 8 patients (12.3%) had non-significant lesions, and 15 (23.1%) had significant stenosis. Of the 15 patients with significant coronary artery disease, a single-vessel disease was shown in 12 patients (18.5%),a two-vessel disease in 2 patients (3.1%), and a three vessel disease in 1 patient (1.6%).Forty-three(66.2%) of these patients out of 65 had zero Cascoring,14 (21.5%) had <100 Ca-scores, and 8(12.3%) had ≥100 Ca-scores. In the first group (Ca-score=0), only one had significant stenosis, while patients in the second (Ca-score <100) and third (Ca -score≥100) groups had 50% and 87.5% significant coronary artery stenosis, respectively.

In the present study which enrolled 50 patients, presenting with atypical chest pain and initial negative ECG and troponin enzyme,9 (18%) patients were normal, 18 (32%)cases showed non-significant CAD and 19 (38%) cases showed significant coronary artery disease and 7 (14%) cases showed anomalous coronary arteries. Of the 19 cases as detected by CCA; single-vessel disease was shown in 10 patients (20%), a two-vessel disease in 8 patients (16%), and a three vessel disease in 1 patient (2%). Zero calcium score was detected in 16 cases (32%) including one case showing significant CAD, 5 cases showing non-significant CAD and in all cases showing normal coronary arteries and anomalous coronary arteries not associated with atherosclerotic disease. Calcium score below 100 in 20 cases (40%) and above 100 in 14 cases (28%).In the second group significant CAD was detected in 7 (46%) cases while in the third group it was detected in 11 (68.7%) cases.

The diagnostic accuracy of MSCT coronary angiography-using the 64-channel systems-has been further evaluated by **Mollet et al. (2005)**, it showed that significant coronary stenoses were detected with a sensitivity of 99% and a specificity of 95% compared with conventional coronary angiography. These results were obtained in patients with a wide spectrum of clinical settings, including atypical chest pain, stable or unstable angina, which had varying degrees of coronary artery disease, ranging from normal coronary systems to obstructive disease of 1, 2, or 3 vessels as proved by the conventional angiography.

Another study performed by **Sung-Min et al., 2008** which included sixty-four patients with atypical chest pain or suspected coronary artery disease who underwent a MDCT and a subsequent CCA to evaluate the diagnostic accuracy of a 64-slice multi-detector CT coronary angiography against a conventional coronary angiography (CCA) for the detection of significant stenosis (≥50% lumen diameter narrowing).Out of the 885 coronary segments examined (15 segments per patient, 59 patients), 76 (8.6%) were excluded from the analysis, 20 cases due to true absence of the segment and 56 (63.2%) were non-evaluable by MDCT Of these 56 segments, 8 (14%) were significantly stenoticat CCA. Small vessel size was the main reason for exclusion of stenosis assessment. However, stenosis in vessel segments with a diameter of ≤1.5 mm rarely constitutes targets for revascularization therapy. Stenosis of 50% or greater was detected by sensitivity, specificity, accuracy, positive predictive value, and negative predictive value on a per segment basis (89%, 99%, 97%, 90%, and98%, respectively)

In the same study heavy calcification of vessel walls was the main reason for both false positive and false negative CT results in (43%) of false lesions. Heavy calcification of a coronary segment leads to overestimation of the stenos is degree in the lesion due to calcium blooming and blurring of the vessel lumen. A higher heart rate caused 9 segments to be excluded from further analysis. In addition, 4 segments were either under-estimated or overestimated due to blurring and double contouring of a vessel with a heart rate greater than 75.

In the present study; Out of 300 segment studied (15 segment in 20 patients who underwent both conventional and CT angiographic study) 30(10%) segment were excluded from the study the causes of exclusion were true absence of vessel segment in12 segments (4%) and non-evaluable segment by MDCT in 18 segments (6%). Of these 20 segments one showed significantly stenotic lesion by CCA.MDCT coronary angiography compared to CCA as reference standard detect stenosis of 50% or greater with sensitivity, specificity, accuracy, positive predictive value, and negative predictive value on a per segment basis of 98%, 97.7%, 97.7% ,90.5%, 99.5, respectively.

Heavy calcification was responsible for 3 false positive results and in over estimation of the stenosis in further 4 segments while poor contrast opacification was responsible for 1 false positive result. Motion artifact was responsible for the only false negative result.

The analysis, interpretation, and documentation of coronary CT examinations are complex and not sufficiently standardized. Reviewing the axial images is an important step in interpretation of the CTCA, but because of the tortuous course of coronary arteries, reviewing the acquired transverse sections alone is often not sufficient. Multi-planner image reformation at the sagittal, coronal and oblique planes can be displayed. Reformatted images following the major cardiac axes or the course of individual coronary artery (curved plane) are also possible. Coronary arteries are typically divided into smaller segments according to accepted angiographic classifications. These segments are then individually analyzed in longitudinal and cross-sectional planes. Diagnosis of luminal stenosis and vessel wall changes relies on these two-dimensional projections. Advanced image procession permits display of the entire three-dimensional data set of coronary arteries. Volume- rendered images facilitate the assessment of spatial orientation but provide only limited information about the arterial lumen and the vessel wall **(Schoenhagen et al., 2004).**

In this study, there was no attempt to determine the relative contributions of the different image post-processing tools to the final diagnosis. To start with, each segment was evaluated at the axial images at the proper R-R interval, and then different post-processing techniques, including multi-planner and curved reformations, maximal intensity projection and volume rendering, some or all of them were employed in an integrated manner to reach the diagnosis.

The role of CT in the assessment of acute thoracic great vessels such as pulmonary embolism and acute aortic syndromes as well as non-cardiac causes of acute chest pain is well established. CTbased evaluation for significant coronary artery stenosis has been shown to decrease the number of unnecessary hospital admissions without reducing the rates of appropriate admissions by ruling out the absence of acute coronary syndrome **(Hoffmann et al., 2006).**

In patients with atypical chest pain, nonobstructive calcified and noncalcified coronary atherosclerotic plaques may be detected. Such findings may indicate the absence of acute coronary syndrome and may be important for long-termrisk stratification **(Hoffmann et al., 2006).**

In our study non-obstructive calcified and non-calcified coronary atherosclerotic plaques were detectedin11 (22%) and 8 (16%) cases who were diagnosed to have non-significant CAD respectively.

A variety of cardiac conditions may also mimic the symptoms of obstructive coronary artery disease and present with history of atypical chest pain including myocarditis, pericarditis, aortic and subaorticvalvular disease, aortic dissection, thoracic aortic aneurysm, intra-myocardial compression (“bridging”) of a coronary artery segment, primary pulmonary hypertension, cardiomyopathies, mitral valve prolapse, and a ruptured sinus of Valsalva aneurysm.

Myocardial bridging is a congenital coronary anomaly in which a segment of a coronary artery or its major branch travels through the myocardium instead of on the surface of the myocardium.

MDCT coronary angiography has been accepted for the noninvasive imaging technique of choice for the diagnosis of myocardial bridging. MDCT coronary angiography clearly showed the presence, the course, and the anatomical features of myocardial bridging and the concomitant coronary atherosclerotic stenosis. The 64-row MDCT and dual source CT may allow clearly assessing phasic lumen narrowing as well as the length, depth, and precise location of the tunneled coronary segment and help to reveal the relationship of the type of myocardial bridging and ischemic chest pain. In general myocardial bridging may be a accidental finding. Since normally the majority of myocardial blood flow is in diastole, systolic compression of the tunneled segment alone cannot sufficiently explain ischemia and associated symptoms. However, the deep myocardial bridging could compromise coronary diastolic flow and result in ischemia compared with the superficial bridging.

In a study done by **Sung Mi et al., 2007** with MDCT coronary angiography, 23 (5.7%) cases of my ocardial bridging were detected among 401patients.Eight patients had symptoms suggestive of CAD and fifteen patients had atypical chest pain. Twenty-one (5.2%) myocardial bridging cases were located at the middle third of the LAD, 1(0.25%) case at the distal third, and 1 (0.25%) case at the proximal third of the LAD. Superficial bridging was identified in 15 patients and deep bridging in 8. In 4 (17%) of 23 patients, myocardial bridging was assumed to be the cause of chest pain and no one had significant coronary atherosclerotic stenosis. These four patients we retreated with a beta-blocker, and chest pain was no longer present. In 13 (57%) patients, chest pain was not associated with myocardial bridging. These 13patients had alternative causes of chest pain. In six patients (26%), the correlation between myocardial bridging and chest pain was not certain because of accompanying significant coronary artery stenosis. Out of four patients whose chest pain was assumed to be associated with myocardial bridging, three patients had deep bridging and one patient had superficial bridging.

In the present study myocardial bridging was identified in 4(8%) cases out of 50 cases of atypical chest pain. All the cases occurred in mid segment of LAD.3 were superficial and one deep with no significant systolic compression in any of them. An associated non obstructive coronary artery disease was detected in 2 of these cases.

Given a clinical history of chest discomfort suggestive of angina, the diagnosis depends as much upon the probability that the given individual has coronary artery disease as upon the exact nature of the symptoms. The main predictors of coronary artery disease are age, male gender, family history, tobacco smoking, diabetes mellitus, hypertension and hyperlipidemia. Thus somewhat atypical chest pain in a 60-year-old male smoker with a strong family history is more likely to represent angina than is typical exertional pain in a 20-year-old woman with no risk factors **(Davies, 2007)**.

In the present study the characteristics of cases showing normal coronary arteries were as follow; 77% were females with mean age 45. No known risk factors were shown in 55% of them. In general these characteristics reflect lower probability for CAD in this group of patients than that of the whole study group.

Cardiogenic chest pain in young people (under the age of 40) is often atypical. Actually, cardiogenic causes, with the exception of carditis, can be excluded with over 70%probability, if only shooting chest pain dependent on the breathing or position is observed in thoracic palpation of a patient with no significant risk factors (including age) for coronary disease **(Swap et al.,2005)**.

Conclusion:

Our results show that noninvasive dynamic volume CT coronary angiography is a reliable technique to detect coronary stenos is in patients with suspected CAD and suggest that this noninvasive technique can now be considered an alternative to invasive diagnostic coronary angiography in this group of patients. Key words: Coronary artery disease (CAD) – 640-Multi-Slice Computed Tomography (640-MSCT)–Dynamic volume CT (DVCT)

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