



# **Evaluation of Coronary Artery Disease Among Population With Fatty Liver Disease Using Multi-slice Computed Tomography**

## **Thesis**

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بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

قالوا

سبحانك لا علم لنا  
إلا ما علمتنا إنك أنت  
العليم العظيم

صدق الله العظيم

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## **List of Contents**

<i><b>Subject</b></i>	<i><b>Page No.</b></i>
<b>List of Abbreviations.....</b>	<b>i</b>
<b>List of Tables .....</b>	<b>iv</b>
<b>List of Figures.....</b>	<b>vi</b>
<b>Introduction.....</b>	<b>1</b>
<b>Aim of the Work.....</b>	<b>4</b>
<b>Review of Literature</b>	
Anatomy of the Coronary Vessels .....	5
Pathophysiology of Coronary Artery Disease .....	28
Pathogenesis of Coronary Atherosclerosis .....	35
Pathogenesis of Fatty Liver Disease .....	52
Technique of Fatty Liver Measurement .....	58
Multidetector CT Of Coronary Arteries “Physical principles and techniques” .....	64
<b>Patients and Methods.....</b>	<b>89</b>
<b>Results.....</b>	<b>95</b>
<b>Discussion .....</b>	<b>161</b>
<b>Summary.....</b>	<b>169</b>
<b>Conclusion .....</b>	<b>171</b>
<b>References.....</b>	<b>172</b>
<b>Arabic Summary .....</b>	<b>—</b>

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## **List of Abbreviations**

<b>Abbr.</b>	<b>Full-term</b>
<b>AHA</b>	: American Heart Association
<b>ATP</b>	: Adenosine tri phosphate
<b>AV groove</b>	: Atrioventricular groove
<b>AVN</b>	: Atrioventricular node
<b>CAD</b>	: Coronary artery disease
<b>CHD</b>	: Coronary artery disease
<b>CRP</b>	: C-reactive protein
<b>CT</b>	: Computed tomography
<b>CTA</b>	: CT angiography
<b>CVD</b>	: coronary vascular disease
<b>EBCT</b>	: Electron beam CT
<b>ECG</b>	: Electrocardiogram
<b>FFA</b>	: Free fatty acids
<b>FGF</b>	: Fibroblast growth factor
<b>FL</b>	: Fatty Liver
<b>FLD</b>	: Fatty liver disease
<b>HDL</b>	: High density lipoprotein
<b>HUs</b>	: Hounsfield units
<b>IGF-1</b>	: Insulin-like growth factors IGF-1 and IGFBP-3
<b>IHD</b>	: Ischemic heart disease
<b>IL-1</b>	: Interleukin 1
<b>IMB</b>	: Inferior marginal branch
<b>KVp</b>	: Kilovoltage peak
<b>LA</b>	: Left atrium
<b>LAD</b>	: Left anterior descending
<b>LCA</b>	: Left coronary artery

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## List of Abbreviations

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<b>LCx</b>	: Left circumflex artery
<b>LDL-C</b>	: Low density lipoprotein cholesterol
<b>LDLs</b>	: Low-density lipoproteins
<b>LM</b>	: Left main coronary artery
<b>LV</b>	: Left ventricle
<b>LVH</b>	: Left ventricular hypertrophy
<b>mAs</b>	: Milliampere second
<b>MDCT</b>	: Multidetector computed tomography
<b>MI</b>	: Myocardial infarction
<b>MIP</b>	: Maximum intensity projection
<b>MPR</b>	: Multi-planar reformation
<b>MRI</b>	: Magnetic resonance image
<b>MS</b>	: Metabolic syndrome
<b>MSCT</b>	: Multislice computed tomography
<b>NASH</b>	: Non-alcoholic steatohepatitis
<b>NHLBI</b>	: National Heart, Lung, and Blood Institute
<b>OM</b>	: Obtuse marginal
<b>PDA</b>	: Posterior descending artery
<b>PDGF</b>	: Platelet-derived growth factor
<b>PLB</b>	: Posterior lateral branch
<b>RA</b>	: Right atrium
<b>RCA</b>	: Right coronary artery
<b>ROI</b>	: Region of interest
<b>RV</b>	: Right Ventricle
<b>RVOT</b>	: Right ventricular outflow tract
<b>TNF</b>	: Tumor necrosis factor
<b>US</b>	: Ultrasound
<b>VRT</b>	: Volume rendering technique

## List of Tables

Table No.	Title	Page No.
<b>Table (1):</b>	Demographic data distribution of the study group .....	95
<b>Table (2):</b>	Risk factors distribution of the study group ....	96
<b>Table (3):</b>	Percentage of diabetic & non diabetic patients with coronary artery disease .....	97
<b>Table (4):</b>	Percentage of hyperlipidemic & non hyperlipidemic patients with coronary artery disease .....	98
<b>Table (5):</b>	Percentage of Hypertensive & non Hypertensive patients with coronary artery disease .....	99
<b>Table (6):</b>	Percentage of Smokers & non Smokers patients with coronary artery disease .....	100
<b>Table (7):</b>	Coronary artery disease distribution of the study group .....	101

## List of Figures

Figure No.	Title	Page No.
<b>Fig. (1):</b>	Anatomy of the left coronary artery.....	6
<b>Fig. (2):</b>	Anatomy of the right coronary artery .....	10
<b>Fig. (3):</b>	Coronary artery segments according to the American Heart Association classification. ....	15
<b>Fig. (4):</b>	American Heart Association 17-segment model of coronary artery territories, anticlockwise manner.....	15
<b>Fig. (5):</b>	Axial maximum intensity projection CT image of aortic root .....	19
<b>Fig. (6):</b>	Volume-rendered images of anterior view of heart in left anterior oblique projection .....	20
<b>Fig. (7):</b>	LAD artery course & branches.....	21
<b>Fig. (8):</b>	Distal right coronary artery anatomy .....	23
<b>Fig. (9):</b>	Volume-rendered image.....	24
<b>Fig. (10):</b>	3D volume rendering of the inferior surface of the heart .....	25
<b>Fig. (11):</b>	Volume-rendered images of posterior view of heart.....	27
<b>Fig. (12):</b>	Pathophysiology of coronary artery disease.....	31
<b>Fig. (13):</b>	Different types of vulnerable plaque.....	34
<b>Fig. (14):</b>	Diagrammatic representation of the atheroma formation and the arbitrarily delineated consecutive stages. ....	38
<b>Fig. (15):</b>	Simplified schema of diversity of lesions in human coronary atherosclerosis .....	39
<b>Fig. (16):</b>	Pathogenesis of non-alcoholic steatohepatitis The traditional 2-hit hypothesis.....	54



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## List of Figures

---

<b>Fig. (17):</b>	Pathogenesis of non-alcoholic steatohepatitis. ....	56
<b>Fig. (18):</b>	Normal appearance of the liver at unenhanced CT.....	61
<b>Fig. (19):</b>	Computed tomography evaluation of hepatic steatosis using computed tomographyL-S index. ....	63
<b>Fig. (20):</b>	Godfrey N. Hounsfield, the father of computed tomography. ....	65
<b>Fig. (21):</b>	Single vs. Multidetector CT geometry .....	66
<b>Fig. (22):</b>	The dual source CT scanner .....	69
<b>Fig. (23):</b>	Relation of table travel with respect to gantry rotation & beam pitch.....	75
<b>Fig. (24):</b>	Patient positioning for cardiac CT .....	80
<b>Fig. (25):</b>	Sex distribution of the study group.....	95
<b>Fig. (26):</b>	Bar chart risk factors distribution of the study group.....	96
<b>Fig. (27):</b>	Percent of diabetic & non diabetic patients with Coronary atherosclerosis & significant CAD.....	97
<b>Fig. (28):</b>	Percent of hyperlipidemic & non hyperlipidemic patients with Coronary atherosclerosis & significant CAD.....	98
<b>Fig. (29):</b>	Percent of hypertensive & Normotensive patients with Coronary atherosclerosis & significant CAD. ....	99
<b>Fig. (30):</b>	Percent of smokers & Non smokers patients with Coronary atherosclerosis & significant CAD.....	100
<b>Fig. (31):</b>	Pie chart coronary artery disease distribution of the study group.....	101

## List of Cases

Case No.	Title	Page No.
Case (1)	.....	102
Case (2)	.....	108
Case (3)	.....	114
Case (4)	.....	121
Case (5)	.....	127
Case (6)	.....	132
Case (7)	.....	137
Case (8)	.....	137
Case (9)	.....	149
Case (10)	.....	155

## Introduction

**C**oronary artery disease (CAD) is a complex chronic inflammatory disease, characterized by remodeling and narrowing of the coronary arteries supplying oxygen to the heart. It can have various clinical manifestations, including stable angina, acute coronary syndrome, and sudden cardiac death. It has a complex etiopathogenesis and a multifactorial origin related to environmental factors, such as diet, smoking, and physical activity, and genetic factors II that modulate risk of the disease both individually and through interaction (*Sayols-Baixeras et al., 2014*).

Fatty liver disease (FLD) is increasingly recognized as the most common liver disorder in Western countries. It is the most common cause of liver enzyme abnormalities in clinical practice, with a prevalence of 15%–20% in the general population and increases steadily to 70%–90% in obese or type 2 diabetic patients (*Assy et al., 2000*).

Risk factors for atherosclerosis, such as obesity, diabetes & dyslipidemia, are frequently associated with FLD (*Akahoshi et al., 2001*).

Fatty liver is blamed to play a role in development of atherosclerosis. However, few clinical studies have examined the association between fatty liver disease and subclinical

coronary atherosclerosis in patients with low to intermediate cardiovascular risk factors (*Hamaguchi et al., 2007*).

Moreover, FLD has been included among the components of metabolic syndrome, a clinical condition with a high risk of coronary artery disease (CAD) (*Malik et al., 2004*).

Recognition of a role for FLD in development of CAD will allow more individuals from the general population with subclinical CAD to be detected at earlier stages when fatty liver is identified. Presence of fatty liver may help in cardiovascular risk stratification and assessment (*Assy et al., 2010*).

The standard of reference for diagnosis of CAD is still the conventional coronary angiography, however, it is an invasive technique associated with non negligible complication. Moreover, this procedure offers little information on coronary artery wall changes associated with the early stage of coronary artery disease (*Lefebvre et al., 2007*).

Computed tomography (CT) has evolved continuously since its introduction to medical imaging in the early 1970s. Over the years, all major aspects (e.g., spatial resolution and acquisition speed) have improved, through changes in both hardware and software. A recent stage in the development of

CT is the introduction of multislice computed tomography (MSCT) (*Flohr et al., 2005*).

Multislice CT coronary angiography has been proposed as a noninvasive modality to help detect coronary plaques and classify coronary artery disease (CAD) (*Akabame et al., 2008*). It has been used successfully to quantify coronary artery calcium, which helps to predict the presence of coronary artery disease (*Shavelle et al., 2000*).

Current results, using the 64- channels scanners show that MSCT angiography is a good non-invasive coronary imaging modality that is able to evaluate the coronary anatomy and early detect and grade coronary lesions competing with other non invasive examinations used to detect CAD (*Pugliese et al., 2006*).

Coronary CT angiography (CTA) can evaluate both calcified plaque and non calcified plaque. Coronary CTA is able to show the lumen of the coronary arteries as well as the vessel wall, analogous to intravascular sonography (*Leber et al., 2005*).

Multiple studies have shown coronary CTA to have a high negative predictive value for the detection of coronary atherosclerosis: greater than 95% for significant stenosis and approximately 90% for any plaque (*Kelly et al., 2008*).

## **Aim of the Work**

**T**he aim of this study is to evaluate the presence & the severity of coronary artery disease among FLD population & to evaluate the association of FLD and CAD using MSCT and the possibility of considering FLD as a predictor for CAD.

# Anatomy of the Coronary Vessels

## Gross anatomy of coronary arteries

The two coronary arteries arise from the aortic sinuses, which are three small dilatations lie opposite the cusps of the aortic valve, in the initial portion of the ascending aorta & supply the muscle & other tissues of the heart. They encircle the heart in the coronary sulcus & send marginal & interventricular branches in the interventricular sulci, which ultimately converge toward the apex of the heart (*Drake et al., 2009*).

Coronary arteries & their major branches are distributed over the surface of the heart lying within subepicardial connective tissue. The right coronary artery (RCA) arises from the right aortic sinus of the ascending aorta, while the left main coronary artery (LMCA) arises from the left aortic sinus of the ascending aorta (*Snell, 2004*).

### ➤ Left coronary artery (LCA):

The left main (LM) coronary artery courses for a variable distance from the left coronary sinus before giving rise to the left anterior descending (LAD) and circumflex (LCX) arteries (Figure 1). The length of the LM artery has been reported to vary from 5 to 20 mm. In approximately 15% of cases, a third vessel, the ramus intermedius (RI) artery (Figure 1B), arises from the LM artery between the