STUDY OF ANGIOGRAPHIC ANATOMY AND PATHOLOGY OF LEFT MAIN CORONARY ARTERY

THESIS

SUBMITTED FOR PARTIAL FULFILLMENT
OF THE DEGREE OF MASTER OF
Cardiology

By

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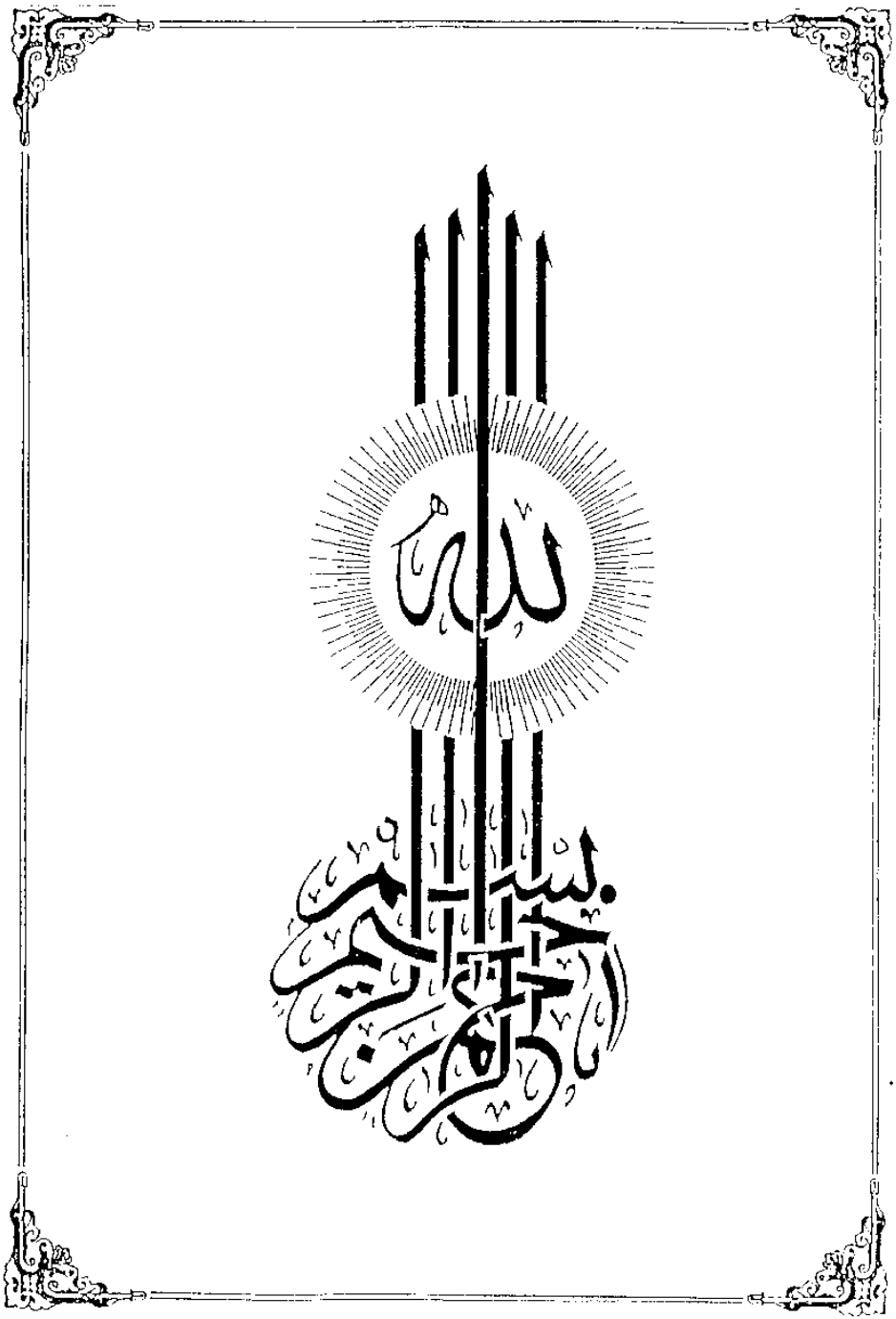
ACKNOWLEDGMENTS

This work was made possible by the generous support and assistance of Prof. Dr. Mohamed Khairy Abdel-Dayem and Prof. Dr. Amal Ayoub. I want to express my gratitude to them.



C O N T E N T S

INTRODUCTION AND AIM OF STUDY

Coronary artery disease is a major entity in cardiovascular medicine. It is the leading cause of death in men aged 45-64 years in most countries all over the world especially the most affluent of them such as the United States of America, England, and Sweden. In approximately 60% of those who die of coronary artery disease death occurs suddenly. Angina pectoris and myocardial infarction which are the two major manifestations of the disease have a tremendous impact on the mode of life of patients who are afflicted with them both physically and psychologically besides the appreciable mortality rates that they carry.

Since the left main coronary artery is the main source of blood supply to the left ventricular myocardium, its study both in health and disease is always worth conducting.

Coronary angiography which is the most sensitive, specific, and reliable diagnostic procedure in coronary artery disease has come a long way since its invention in the late 1940s and early 1950s. The first coronary arteriographic study was performed by Radner and associates who used the flooding technique for the

opacification of the coronary arteries. This crude method has been refined later by the use of other techniques such as the phasic technique and the semi-selective technique which was introduced by Sven Paulin. However all these earlier procedures produced incomplete and inadequate opacification of the coronary arteries and it was obvious that more selective approach for the radiographic visualization of the coronary arteries was needed. In 1957 the selective technique for the opacification of the coronary arteries was first introduced by F. Mason Sones, Jr., in the Cleveland Clinic, Cleveland, Ohio. Therefore by the late 1960s all the non-selective and semiselective methods were abandoned as they could not compete with the already well established selective methods[61].

This work aimed at studying the left main coronary artery both anatomically and pathologically from the radiological point of view.

The length of the left main coronary artery has been measured in the different radiological projections with the intention of - on the one hand - drawing a comparison between these views as regard their ability to exhibit the LMC artery with minimal foreshortening, and - on the other hand - formulating an idea about the

frequency and correlations of a short left main coronary artery.

A study of left main coronary artery disease - angiographically - has been another major target of this work. Its frequency, extent, location, and associated lesions in the other coronary arteries besides its effect on the ejection fraction and pattern of segmental left ventricular wall motion have been assessed.

Also a thorough review of the 100 coronary angiograms and left ventriculograms included in this work has been made. One-, two-, and three-vessel diseases have been identified and their effect on the left ventriculograms (judged by the calculation of the ejection fraction values and pattern of left ventricular segmental wall motion) have been recognized and compared to the corresponding effects produced by left main coronary artery disease.

PART I - REVIEW OF LITERATURE

CHAPTER I

Angiographic Anatomy of Coronary Arterial System with Special Emphasis on the Left Main Coronary Artery

The systematic description of the anatomy of coronary arteries is difficult because only the left main trunk, the anterior descending artery, the proximal segment of the circumflex artery, and the first half of the right coronary artery are constant branches, while the remaining arteries exhibit a number of normal variations. In order to describe the coronary arteries from the radiological point of view, there are three basic factors that should be kept in mind, namely the position of the heart within the thorax; relationship between the different radiological views used in coronary arteriography with the position of the heart within the thorax, and the general anatomy of coronary arteries and their normal variants[4,5,61].

POSITION OF THE HEART WITHIN THE THORAX AND ITS RELATIONSHIP TO RADIOLOGICAL VIEWS:

In horizontal body section at the level of the thorax we see that the heart is angulated to the left and anteriorly, forming with the sagittal plane an angle which ranges from 45° to 60°. Thus from a LAO view we see the heart from the apex, while from a RAO view we see it from its lateral wall i.e. along its longitudinal axis. These views (LAO 60° and RAO 30°) allow us to see the heart along its transverse and longitudinal planes, so that they are often used in coronary arteriography[4,5,61].

GENERAL ANATOMY OF THE CORONARY ARTERIES:

The majority of coronary arteries main trunks follow the heart's sulci. If we consider the right and left atrioventricular sulci, we see that together they form a circle or ring, from which perpendicularly, the interventricular sulcus emerges, forming a loop or hook[22]. Over the inferobasal wall of the heart, the atrioventricular sulcus meets the interatrial sulcus and its continuation, the posterior interventricular sulcus. Where they meet a cross is formed, and is called the crux cordis. In the RAO view the interventricular sulcus is parallel to the filming plane throughout its course, but the atrioventricular sulcus is seen to be very much foreshortened. In the LAO view the situation is the opposite and the interventricular sulcus is very much foreshortened. In the left lateral view, the foreshortening of the left main trunk is complete so that it appears as a dot, but the beginning of the interventricular sulcus and the initial third of the left atrioventricular sulcus are well seen[4,31,33,61].

RIGHT CORONARY ARTERY:

The main stem of the right coronary artery occupies the right half of the circle, corresponding to the right atrioventricular sulcus[22]. Just before meeting the crux

cordis, the right coronary trunk is divided into the posterior descending artery (right dominance) and the right atrioventricular artery. After a short diagonal run along the inferobasal surface of the right ventricle, the posterior descending artery goes through the posterior interventricular sulcus. The right atrioventricular artery is also called the right posterolateral segment when the right coronary artery is divided into segments for purposes of analysis. It makes an inverted U-turn when passing under the posterior descending vein which ends in the coronary sinus. This inverted U-turn is barely seen in some hearts, but in others it is extremely well developed. It is a useful anatomic landmark because it shows the crossing of the interventricular and the atrioventricular sulci at the crux of the heart. The right atrioventricular artery follows a variable course through the left atrio-ventricular sulcus, giving rise to one or more posterior ventricular branches that supply the inferobasal wall of the left ventricle. In some hearts, from the distal third of the right atrioventricular artery, a small atrial branch arises and surrounds the inferior wall of the left atrial myocardium near the mitral annulus. From the vertex of the inverted U-turn a small artery (very rarely two or three) emerges which supplies the atrioventricular node and is therefore called the

atrioventricular node artery[4,5,31,61].

The right coronary artery, while occupying the right atrioventricular sulcus is parallel to the filming plane in the LAO position, thus its visualization is adequate. On the other hand, the posterior descending artery, which goes through the interventricular sulcus would now be almost perpendicular to the filming plane and therefore its projection would be very much foreshortened, this makes its study difficult because several narrowings may not be visualized. If the patient is rotated to the RAO position, the posterior descending artery remains parallel to the filming plane and it is seen without foreshortening. Frequently, however, its analysis is hindered because of overlapping with the posteroventricular branches, even though the posterior septal perforators make it possible to identify the posterior descending artery. This problem may be solved by using different degrees of RAO angles, usually very shallow ones, or by taking angulated views[54,61,71].

The first minor branch of the right coronary artery is usually the conus artery, which goes forward and upward, surrounding the pulmonary artery; in pathological cases it originates Vieussen's annulus when it connects to a branch of the anterior descending artery. This

branch may emerge from an independent ostium in the right sinus of valsalva[5]. The second branch emerging from the right coronary artery is the sinus node artery. This artery goes backwark and upward along the epicardium of the right atrium, to the sinus node, where it is divided into a superior and an inferior branch. In 40% of the patients, this artery originates in the proximal circumflex artery. In the RAO position it is clearly seen that all atrial arteries go backward (dorsally) opposite in direction to the conus branch, which goes forward (ventrally) as do all the remaining ventricular branches. In this projection there is no difficulty in distinguishing the atrial branches from the ventricular ones. On the other hand, in the LAO position, these branches are perpendicular to the filming plane and it is impossible to determine accurately if they are atrial or ventricular branches[4,31,61]. The sinus node artery is almost always the longest and stoutest atrial branch of the right coronary artery. During its course it supplies a significant part of the atrial myocardium, including its thickest part, the crista terminalis. It frequently has a branch that reaches the left atrium, the majority of atrial infarcts are caused by its obstruction. As it arises from the first centimeters of the right coronary artery or the left circumflex, in

case of diaphragmatic or lateral infarcts, the presence of an atrial infarct or arrhythmias would indicate that this artery is occluded, and as a consequence, that the obstruction of the main stem is very proximal; therefore the infarct would be large[61]. After the sinus node artery has arisen, the right coronary artery gives origin to a variable number of branches that supply the right ventricle. They are called right ventricular branches. Frequently one of these branches is more important than the others and arises midway between the ostium of the right coronary artery and the acute margin i.e. at the junction of the proximal and middle segments of the right main stem. The acute marginal artery is the most important and constant right ventricular branch. This artery is so-called because it runs along the acute margin of the right ventricle i.e. over its postero-lateral surface. The acute margin is where the right coronary main stem makes a rather sharp bend from a caudal course to a left lateral one in the LAO view. The length of the right ventricular branches varies significantly and they may extend up to the anterior interventricular sulcus, supplying collateral circulation to the anterior descending artery in case of disease. In some hearts an important right ventricular branch arises almost at the origin of the right coronary artery,

or even in a separate orifice in the right sinus of valsalva. Then it may be catheterized superselectively. At the beginning of the right ventricular branches, a sort of loop is observed, since the right coronary artery goes deeply into the fat tissue of the A-V sulcus and these branches have to make such a curve in order to reach the epicardium. Thus in coronary angiography it may be foreseen at which depth of the A-V sulcus the surgeon will find the trunk of the right coronary artery[10,61]. Another interesting characteristic of the right A-V sulcus is that it is filled with fat tissue which is more radiolucent than the myocardium, this fat stripe is easily visualized in RAO fluoroscopy and shows a brisk movement with systole and diastole, thus it indicates the origin and course of the right coronary artery, and is a useful landmark that aids in its selective catheterization[10]. The main stem of the right coronary artery is divided into three segments: proximal, middle and distal - in order to facilitate its angiographic analysis. The proximal segment begins at the ostium of the right coronary artery and ends half-way between the ostium and the acute margin. Usually but not always an important right ventricular branch arises at this site. The middle segment ends at the acute margin and the distal segment goes from the