ANATOMY AND DISTRIBUTION OF THE CORONARY ARTERIES

THESIS

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BY

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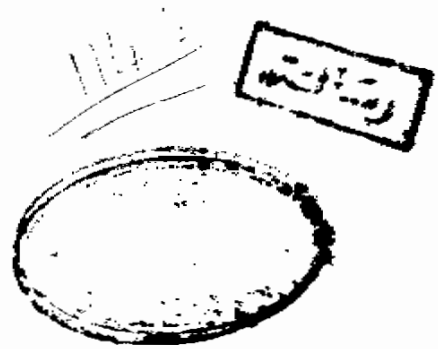

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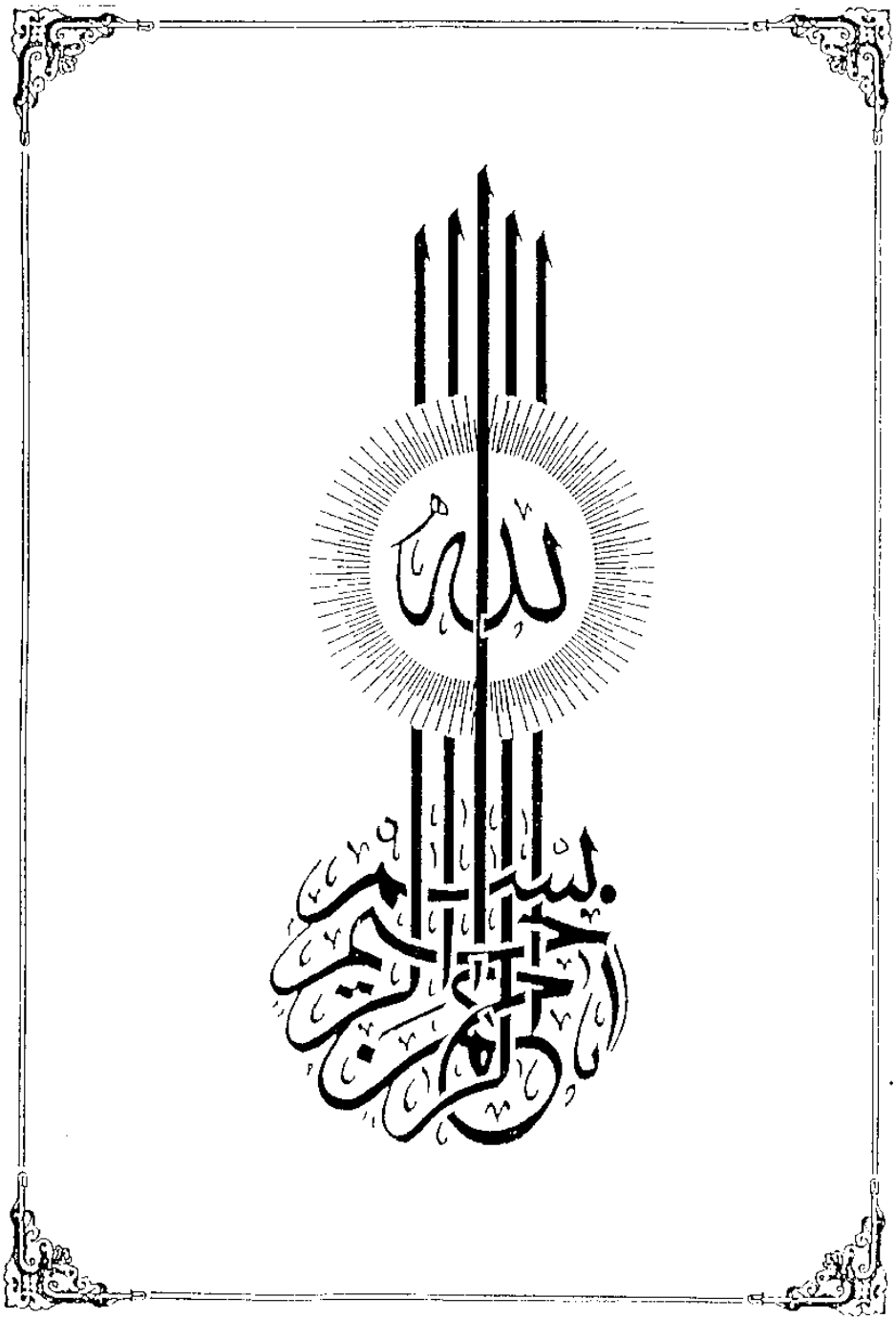

CONTENTS

INTRODUCTION

INTRODUCTION AND AIM OF WORK

Although the anatomy of the coronary arteries was a subject of interest since the times of Vieussens, (1706), yet it assumed more importance as a subject of research work only after the establishment of the relation between the coronary artery disease and chest pain. The advances in coronary surgery over the last three decades stimulated much interest in these vessels. However, on the basis of the blood supply, the Kidney (Graves, 1954) the liver, (Hjortsjo, 1951, Healey and Schroy, 1953 and Gupta et al 1977), the spleen (Gupta et al 1976 and Mikhail et al 1979) and the lung (Warwick and Williams, 1973) were divided into sigments. Therefore it became the aim of the present work to study the anatomy and distribution of the human coronary arteries and clarify the possible segmentation in their domain of distribution.

The superficial and deep cardiac plexuses were formed by the cardiac branches of both vagi and sympathetic trunks. These were interconnected and sent secondary branches to supply the right and left coronary arteries (Warwick and Williams 1973). Kuntz (1947), mentioned that large fibres of vagal origin terminated in the adventitia of the coronary arteries, apparently without penetrating the media. Recently, some studies delt with the intrinsic innervation of the coronary arteries in cats and dogs (Dahlström et al 1965, Schenk and El-Badawi, 1968, Krokhina 1973 and Doležel et al 1978). Moreover, numerous ganglia were described on the posterior surface of both atria and at the roots

of great vessels (Perman, 1924). In the literatures, histological studies concerned with the innervation of the coronary arteries in man were meagre. Accordingly,it became the second aim of the present work to investigate the pattern of intrinsic innervation of the human coronary arteries. Moreover, an attempt was made to study the existence of ganglia in relation to them.

REVIEW OF LITERATURE

ANATOMY AND DISTRIBUTION OF THE CORONARY ARTERIES

Distribution of the Coronary arteries:

Vieussens (1706), was the first to be interested in the anatomy of the coronary arteries. He described an arterial anastomotic ring (Vieussens ring) made up of a branch of the anterior descending coronary artery, with a branch of the right coronary artery. Both were directed towards the pulmonary conus. The point of their union was taken as an important anatomical landmark for the pulmonary valve.

Schlesinger (1940), observed that the pattern of distribution of the coronary arteries was not the same, in all its details in any two human hearts. But after examining 225 human hearts, he could classify the variations of distribution into three different groups according to the distribution of the major coronary trunks: namely, the right, left anterior descending and the circumflex coronary arteries. He determined the arterial predominance by the size and origin of the vessel that crossed the posterior crux (the region of meeting of the four cardiac chambers and both cardiac septa on the posterior surface of the heart). Group I comprised 48% of the material examined, the right coronary artery predominated in the blood supply of the heart, i.e., supplied the whole right ventricle, posterior half of the intraventricular septum and a variable portion of the posterior aspect of the left ventricle. This group was intermediate to the other two groups in their reaction to the effects of coronary atherosclerosis. Group II comprised 34% of human hearts, the coronary arterial supply was balanced between the right and left coronary arteries, i.e. each ventricle was supplied from the correspondingly named artery, while the anterior half of the interventricular septum was supplied from the

left coronary and its posterior half from the right coronary. These hearts suffered the least effects of coronary atherosclerosis. He also observed that this balanced pattern of coronary circulation was commener in females than in males. Group III comprised 18% of human hearts, the left coronary predominated in the supply of the heart. In these cases the left ventricle and more than one half of the interventricular septum were supplied by the left coronary artery. These hearts suffered the most, from the effects of atherosclerosis.

Schlesinger, Zoll and Wessler (1949), noticed that the area of the right ventricle in the human heart known as the area of the conus arteriosus often had a unique arterial blood supply through a vessel accessory to the two main coronary arteries. That supplimentary vessel was called by the authors the conus artery and was noticed to arise by a separate ostium behind the right aortic valve cusp, then passed over the antero-superior surface of the right ventricle and terminated in the anterior interventricular groove. After studying 651 hearts, the investigators found single or multiple conus arteries in half of the hearts examined. The occurence of the conus arteries was unrelated to age and sex. The artery served as a source of anastomotic blood supply directly from the aorta to the other vessels of the heart when these were narrowed or occluded.

James, and Burch (1958) studied the atrial coronary arteries in 43 fresh human hearts. They observed that the largest atrial artery was that supplying the sinoatrial node. That was noticed to arise from the left coronary artery in 39% and from the right coronary artery in 61% of cases. In either cases it was directed towards the anterior inter-atrial septum, then terminated at the base of the superior vena

cava. They also observed a specific artery that supplied the region of the atrioventricular node. That was noticed to arise from the right coronary artery at the posterior junction of the interatrial and interventricular septa in 83% of cases. At that location the right coronary showed a peculiar U- shaped turn. Many other small and variable atrial arteries were noticed. They postulated that these atrial arteries may act as a potential source of collateral circulation.

James and Burch (1958),studied the blood supply of the interventricular septum. They prepared 43 coronary vinylite casts of normal human hearts. They noticed that the blood supply of the interventricular septum was derived mainly from a number of diagonally penetrating branches, that arised from the left anterior descending coronary artery. The posterior descending coronary artery supplied only a small strip of the interventricular septum near the posterior interventricular sulcus. Moreover,they noticed that the interventricular septum was an important site of coronary collateral channels in normal hearts.

James (1961),considered the anterior interventricular artery as the direct continuation of the left main coronary artery. Both together constituted a reverse of S curve. The initial turn of the"S" was around the base of the pulmonary artery into the anterior interventricular sulcus. The second turn was around the cardiac apex. He also observed that the sinus nodal artery arised from the left circuflex coronary artery in 45% of cases.

Pitt, Zoll, Blumgart and Freiman (1963),utilized the injection plus dissection technique in 1576 human hearts. They observed that

the incidence of coronary artery occlusion and the severity of coronary atherosclerosis were not correlated with the coronary arterial pattern.

Paulsen, Venter and Hagerup (1975),determined the length of the left main coronary artery in the postmortem, non-fixed hearts of normal weight (group I) and hypertrophied hearts (group II). Group I was 76 men and 88 women hearts. Group II was 136 men and 61 women hearts. The mean length of the left main coronary artery in group I was 9.1 mm. in men and 8.4 mm. in women. Corresponding values in group II were 10.3 mm. and 8.8 mm. They found no significant sex difference in the length of the left main coronary artery in group I, but the sex difference in group II was significant. The difference in length between group I and II was significant in men but insignificant in womens' hearts. In both sexes no significant correlation between the heart weight and length of the left main coronary artery in both groups. There was significant correlation between the area of the ostium of the left main coronary artery and its length in men but not in womens' hearts of group I. Corresponding comparison of both sexes in group II was statistically insignificant.

CORONARY COLLATERAL CIRCULATION

Schlesinger (1938), observed that the coronary arteries in normal human hearts and even in senile hearts, were trully cohnheim end arteries, without anastomotic connections. Anastomosis developed readily whenever or wherever arteriosclerotic narrowing or occlusion occured. These anastomosis were localized to the region where they were needed.

Schlesinger and Zoll (1941), studied the incidence and localization of the coronary artery occlusions. They noticed that, most zones of occlusions of the coronary arteries were less than 5 mm in length, so they were easily overlooked by ordinary dissection. Occlusions were as numerous in the right coronary artery as in the anterior interventricular coronary artery. There was no relation between the manner of branching of the coronary arteries and localization of the occlusions therein. The majority of coronary artery occlusions were found within 3 cm of the mouth of these vessels.

Prinzmetal, Simkin, Bergman, and Kruger (1947), studied the intercoronary anastomosis using labelled erythrocytes and glass spheres of known caliber. These were ingected into one of the coronary arteries. They observed the existence of spheres with diameters of 70 and 180 um, in the other artery. They came to the conclusion that intercoronary anastomosis of caliber oscillating between these values do existed.

Zoll, Wessler, Monroe and Schlesinger (1951),studied the

interarterial coronary anastomosis in an autopsy series of 1271 unselected human hearts by a uniform injection plus dissection techniques. They observed in a series of 1050 human hearts an increased interarterial anastomosis in cases of coronary heart diseases, cor-pulmonale, antemortem anaemia, cardiac hypertrophy and valvular diseases. In 101 grossly normal hearts from non anaemic patients, the incidence of interarterial coronary anastomosis was 9%. In 89 grossly normal hearts from anaemic patients the incidence of interarterial coronary anastomosis was 39%. In the remaining abnormal hearts, the incidence of interarterial anastomosis was 89 - 100% with coronary artery occlusion, 11 - 63% with coronary artery narrowing, 73% with cor-pulmonale, 26% with cardiac hypertrophy and 28% with valvular diseases.

Zoll and Norman (1952), studied the effect of certain agents upon the development of the intercoronary collaterals in 349 young domestic pigs, by ingecting the coronary arteries with lead-egar mass. Functionally significant anastomosis appeared two days after coronary narrowing and became abundant by the seventh day. Sodium nitrate showed a stimulating effect on the development of the interarterial coronary collaterals, when given prophylactically in normal pigs and when given theraputically after coronary narrowing. Anaemia also stimulated significantly the development of the intercoronary anastomosis in normal pigs.

Paul, Norman, Zoll and Blumgart (1957), studied the effect of acute coronary narrowing on the production of large intercoronary collateral channels. In a control series of 161 normal pigs, they observed only three hearts which showed intercoronary anastomotic