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IBN AL-NAFIS AND THE DISCOVERY OF THE PULMONARY CIRCULATION AND CORONARY BLOOD FLOW

Jaffar Shehatha[*] & Abdulsalam Y Taha[@]

*MB ChB, AMC, FICMS, FRCS, FRACS, Consultant Cardiothoracic Surgeon, Head of Cardiac Surgery, Suleimania Center for Heart Diseases. Adjunct Senior lecturer/ University of Western Australia, School of Surgery. [@]MB ChB, FIBMS (CTVS) Professor and Head of Cardio-thoracic and Vascular Surgery Unit, School of Medicine, University of Suleimania, Consultant Thoracic and Vascular Surgeon, Suleimania Teaching Hospital, Suleimania, Iraq

Correspondence to: Mr. Jaffar Shehatha, E-mail: jaffarshehatha@hotmail.com

Abstract

Ibn al-Nafis was a great Arabic scholar and physician of his time. His account of coronary blood flow and pulmonary circulation in 13th century preceded the description by European researchers by almost three decades. At his time anatomical dissections were prohibited by the social and religious Muslim rules. Therefore it is not exactly known how he had reached his conclusions, whether through conjecture, observation on animals like monkeys, or by autopsy studies of humans. Because of the long period between Avicenna (the name used by the west for Ibn-Sina) and the appearance of Ibn-Al-Nafis and because of Ibn-Al-Nafis's remarkable contributions many called him as the (second Avicenna). Ibn-Al-Nafis was a remarkable man and he deserves to be better known.

Introduction

Ibn al-Nafis (1213-1288) was a great Arabic scholar and physician of his time. Ibn-al-Nafis have had contributions to medicine but the one which had a great significance in history was his discovery of the pulmonary circulation, which was re-discovered by other scientists after a lapse of three centuries[1]. In this article we discuss the contributions made by Ibn al-Nafis to the discovery of coronary and pulmonary circulations in human.

Who was Ibn al-Nafis?

His full name is Abu-l-Hasan Ala-ud-Din Ali ibn Abi-l-Hazm, popularly known as Ibn al-Nafis[1-3], who was born in Damascus, Syria in 1213 (fig 1). Ibn al-Nafis attended Bimaristan al-Noori medical college hospital in Damascus. He also learned Arabic literature, jurisprudence, theology and Islamic philosophy. In 1236, he moved to Cairo, Egypt where he began to work at the Al-Nassari Hospital and became the chief physician. At the age of 29 years, Ibn al-Nafis worked at Al-Mansouri Hospital and finished his book "Sharh Tashrih IL Qanun Ibn –Sina" which in English means "Commentary on the Anatomy in the Avicenna's Canon"[1]. Avicenna had some influence on Ibn al-Nafis. This is apparent from the logical way of presentation of Ibn al-Nafis's last book "Kitab ash-Shamil fi't-Tibb" which means "The Comprehensive Book on the Art of Medicine".

Ibn al-Nafis wrote 43 volumes of the comprehensive book of medicine from 1234 to 1240. This book replaced Avicenna book in all the hospitals at that time[1]. Between 1260 and 1277 he became

the personal physician of Sultan Baibars. Ibn al-Nafis died in December 1288. In his last will, Ibn al-Nafis donated his house, library and clinic to Mansuriya Hospital[4]. A copy of his book is located in Prussian State Library in Berlin at medical faculty of Albert-Ludwig's University in Germany[1].

Ibn-Al-Nafis and The duty of the surgeon

Ibn al-Nafis was a great surgeon and physician. He believed that attention should be paid during three stages for the success of any surgical operation. The first stage which was called the 'time of presentation'; the surgeon diagnoses the affected part of the body. This stage was called the 'time of presentation' because the patient submitted his body to the surgeon, to deal with it in the way he sees right. In the second stage which was called the 'time of operative treatment', the surgeon repaired the affected organs. The third stage was called the 'time of preservation', referring to the post-surgical care, a stage during which the patient should take good care of himself. It is also the duty of the nurses and servants to watch over the patient during this period, until the patient recovers[5]. For each of these three stages, Ibn al-Nafis gives a detailed record of the role of the surgeon, the patient, and the nurses. He also gave a detailed description of the surgical instruments and their proper maintenance.

The story of Discovery of Pulmonary Circulation and Coronary Blood Flow

The discovery of the coronary and pulmonary circulation is one of the most fascinating stories in history of medicine. It is generally believed that the pulmonary circulation was described in Europe in 16th century by a cumulative effort of Servetus, Vesalius, Colombo and then by Harvey[1]. However, a review of the Arabic and Islamic literature has showed that Ibn al-Nafis in the 13th century already gave a detailed description of the coronary and pulmonary circulation and the related physiology[1,2,4,6].

Concepts on blood circulation before Ibn al-Nafis

It appears that the theory of circulation was put forth by Galen in the 2nd century who proposed that blood reaching the right side of heart circulated through invisible pores in the interventricular septum to the left side of the heart where it mixes with air to create a spirit and then it distributes to the rest of the body. According to Galen the arterial and venous system are totally separate and come in contact only through the pores located in the interventricular septum[1,5,7]. These views were further advanced in 12th century by Avicenna in his book "Canon al tib", which translated from Arabic means "The Law of Medicine". Avicenna generally agreed with Galen but also believed that the heart has three chambers and that the heart received its nutrition from the right ventricle[2,7]. This book is known today as "Avicenna's canon", which became an encyclopaedia in medicine of those days.

Views of Ibn al-Nafis

In 1242, Ibn al-Nafis published a book (Sharh Tashrih IL Qanun), in which he rebut the previous believe including those of Avicenna's and "Avicenna's canon" and provided his own views on the anatomy and physiology of the vessels of the heart and lungs. The book contained many novel concepts. Most important of these included the anatomy of the coronary, pulmonary and capillary circulation. Ibn al-Nafis stated that blood from the right chambers of the heart reached the left chambers, but there is no direct pathways or pores between those chambers as Galen thought[1]. Instead, blood from the right ventricle must flow through vena arteriosa (known today as pulmonary artery) to the lungs and then further through the lung parenchyma. In the lungs blood mixes with air and then passes through arteria

venosa (known today as pulmonary vein) to reach left chambers[1]. Therefore, Ibn al-Nafis emphasised that the heart had only two ventricles and that there was no direct communication between these two chambers. He also described the anatomy of lungs. He gave a description that the lungs are composed of what are known today as bronchi, the branches of arteria venosa, the branches of vena arteriosa and loose porous flesh[1,2]. Ibn al-Nafis was convinced that the blood in the right ventricle did not nourish the heart. Instead, in his opinion, the heart was nourished by blood that goes through the vessels in the body of the heart. This appears to be the world's first reference to the coronary arteries and coronary circulation[1]. In the words of Ibn al-Nafis, "a thought that the blood on the right side is to nourish the heart is not true at all, for the nourishment to the heart is from the blood that goes through the vessels that permeate the body of heart"[2].

Subsequent views on pulmonary circulation

These observations surfaced in Europe 300 years later when the work of Ibn al-Nafis was translated into Latin by Andrea Alpago of Bellunoin in 1547. Andrea Alpago lived in Syria for 30 years before returning to Italy[8]. In 1553, Michael Servitus described pulmonary circulation in his book "Christianismi restitution". He wrote that air is mixed with blood and that circulated bright blood colour is given by the lungs and not by the heart[1].

In 1543, Adreas Vesalius described his views on the pulmonary circulation in his book "De Fabrica". Vesalius views were strikingly similar to the original description of Ibn al-Nafis. Although Vesalius initially agreed with Galen that blood passed through the interventricular septum, in the second edition of his book published in 1555, Vesalius changed his view on the latter and wrote that he did not believe that even the smallest quantity of blood can be transferred through the septum[1]. With this observation he basically agreed with what Ibn-al-Nafis described before. In 1559, Colombo in his book "De Re Anatomica" confirmed the same anatomy[9]. In 1628, William Harvey wrote in his book "Exercitatio Anatomica de moute cordist sanguinities in animalibus", "I began to think there was a sort of motion in a circle. I found it true that the blood pushed by the beat of the left ventricle gets distributed through the arteries to the whole of the body and back through the veins to the vena cava and then returned to the right ventricle. This is further pumped to the lungs through the pulmonary artery and returned from lungs via the pulmonary veins[9]. These significant remarks were similar to Ibn al-Nafis views described about 300 year prior to Harvey. The physiology of gas exchange in the lungs was not fully understood until discoveries done by Lavoisier in 18th century[1].

In conclusion the main emphasis of Ibn al-Nafis work was on

1. The anatomy of two ventricles.
2. Absence of pores in the interventricular septum.
3. The concept that blood flows from the right ventricle to the lungs to mix with air.
4. The presence of a porous system of blood vessels that form a capillary network to make the passage of air into pulmonary circulation at a time when no microscopes were available. He called this system the Nafisian system[10].
5. In the lungs blood mixes with air and then passes to left heart chambers.
6. The ventricles take their nourishment from the blood flowing in the vessels in its substance, in other words, from the coronary arteries.

Figure 1: Ibn al-Nafis performing an autopsy. Drawing by Mr. Waheed Magharbah, Aleppo, Syria. Courtesy of Dr. Abdul Nassar Kaadan, President, the International Society for the History of Islamic Medicine.

Figure 2: Ibn-AlNafis Pulmonary Circulation. Source: http://www.islamicmedicine.org http://www.islamonline.net by Dr. Sharif Kaf Alghazal

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