

REVIEW

THE ARABO-ISLAMIC CONTRIBUTION TO THE EVOLUTION OF CARDIOLOGY

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ABSTRACT

In the 8th century AD, when the West sank into the darkness of the Middle Ages, the bloom of the sciences came from the Arabs. The work of the most famous Arabo-Islamic physicians reflects their knowledge of heart function and heart disease. Rhazes (864-925), claims that heart has two ventricles while Hally Abbas (930-994), was one of the first to deny the existence of communication between the right and the left cavities. Avicenna (980-1037) observed that there are three valves in the aorta's outflow, which open when the volume of blood is ejected from the heart during contraction and close during the expansion of the heart. He was also a pioneer in examining and studying pulse and its wave. Finally, Ibn Al-Nafis (1213-1288) was the first to describe pulmonary circulation and for this reason, he is considered as a true precursor of cardiology.

Keywords: history of cardiology, Arabo-Islamic medicine, Rhazes, Avicenna, Ibn Al-Nafis.

RÉSUMÉ

La contribution arabo-islamique à l'évolution de la cardiologie

Le 8e siècle après JC, lorsque l'Occident s'est enfoncé dans les ténèbres du Moyen Age, l'épanouissement des sciences est du aux Arabes. Le travail des plus célèbres médecins arabo-islamiques reflète leur connaissance sur la fonction et les maladies cardiovasculaires. Rhazès (864-925), affirme que le cœur a deux ventricules alors que Hally Abbas (930-994), fut l'un des premiers à nier l'existence de la communication entre les cavités droite et gauche. Avicenne (980-1037) a observé qu'il y a trois valves à la sortie de l'aorte, qui s'ouvrent lorsque le volume de sang est éjecté du cœur pendant la contraction et se ferment pendant l'expansion du cœur. Il était aussi un pionnier dans l'examen et l'étude du pouls et son onde. Enfin, Ibn Al-Nafis (1213-1288) fut le premier à décrire la circulation pulmonaire et pour cette raison, il est considéré comme un véritable précurseur de la cardiologie.

Mots-clés: histoire de la cardiologie, médecine arabo-islamique, Rhazès, Avicenne, Ibn Al-Nafis.

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In the 8th century AD, when the West sank into the darkness of the Middle Ages, the bloom of sciences came from the Arabs. In Persia, the Arab conquerors came in contact with the Nestorians, who exiled from Byzantium, founded the famous school of Gondishapur, the cradle of Arabic medicine. By comprehending the knowledge of the time, Arabs gave a new breath to medicine. The work of the most famous Arabo-Islamic physicians includes their knowledge of heart function and heart disease and their contribution to the evolution of medicine and cardiology, in particular, has been enormous¹.

Abu Bakr Mohammad Ibn Zakariya al-Razi, also known by his Latin name Rhazes, (864-925), is considered one of the greatest scholars of Arabo-Islamic medicine and middle ages, and even perhaps the greatest clinical practitioner of all time, with many „firsts“ in medical research and clinical practice. In cardiology, he claimed that „heart has two ventricles, one to the left and one to the right ... while there are passages from one to the other ...“² (Figure 1)

Ali Ibn Abbas al-Majusi, known as Hally Abbas (930-994) is regarded to be the greatest physicians of the eastern caliphate. He was one of the first to deny the existence of communication between the right and left cavities of the heart, as

Galen (130-201) had erroneously wrote. This idea and knowledge facilitated the description of small or pulmonary circulation, later in the 13th century AD. Hally Abbas also wrote that pulmonary arteries consist of two layers, an internal oblique fiber and an outer elongated fiber, which allow their relaxation (dilation) and shrinkage (contraction)³.

Ibn Sina or Avicenna (980-1037) was a leading figure of Arabo-Islamic medicine; physician, philosopher, politician, encyclopaedist, astronomer and mathematician wrote numerous works among which the celebrated „Canon of Medicine“, a reference point for many generations. (Figure 2) Among others, he observed that there are three valves in the aorta's outflow, which open when the volume of blood is ejected from the heart during contraction and close during the expansion of the heart, thus not allowing blood regurgitation. Furthermore, he referred to arrhythmia, tried to explain the cause of thrombosis, and sustained that heart is the organ that gives life to man^{4,5}. Avicenna has been a pioneer in examining and studying pulse and its wave. According to him, each pulse beat consists of two movements and two pauses. So the normal pulse wave is: dilation, pause, constriction, pause. Thus, he rejected the ideas of Galen about a particular kind of pulse for each organ separately and

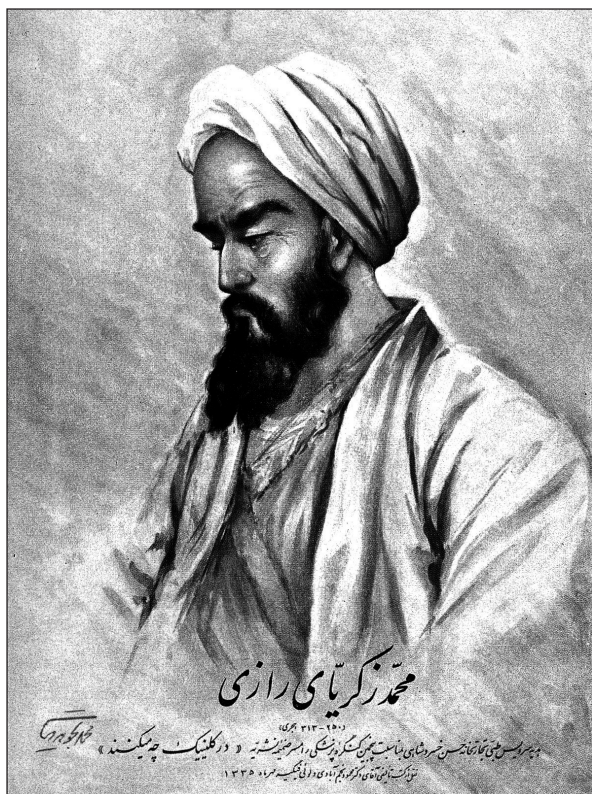


Figure 1. The distinguished Arabo-Islamic physician Rhazes

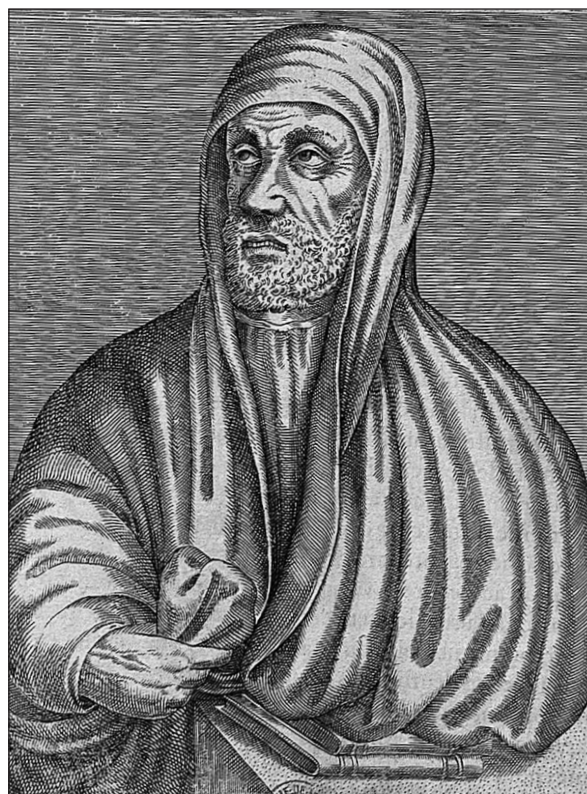


Figure 2. Avicenna, a leading figure of Arabo-Islamic medicine, known as „the prince of physicians“.

for each disease. The symptoms, effects and treatment of cardiac flutter are also explained in detail in his work. As he mentions, flutter is caused by heart trauma, pericardial or neighboring organ injury. All kinds of heart failure lead to flutter due to its inconsistent operation. Avicenna supported the view that acute flutter leads to loss of sensation, while acute and prolonged flutter leads to death. He described the faint pressures following carotid stress and provided the first description of carotid body hypersensitivity and syncope. In an attempt to describe vascular stenosis, he mentioned that it was provoked by the local concentration of „abnormal juices“ in vessels which eventually lead to obstruction^{6,7}.

As far as cardiological drugs are concerned, Avicenna devoted a special treatise called *Kitabal Adviyt al Qalbiye (Book of Medicines of Heart Disease)*. This treatise has a physiological-philosophical character and was first translated into Latin at the beginning of the 14th century by Arnaud de Villeneuve (1238–1314) titled *De Medicines Cordialibus*. The book describes simple and complex cardiological drugs divided into stimulants, diuretics and inhibitors. Altogether, 83 simple and 17 complex drugs are mentioned in the form of elixirs, mortars, pills and syrups derived from plants, animals and minerals, and their mode of action in the heart is extensively explained. In addition, the strength and dosage of each drug is described. One of the drugs mentioned in the book is the „zarnab“ (*Taxusbaccata* L.) which provided „relaxation of the heart“. Currently we know that *Taxus baccata*, also known as common yew, contains poisonous toxins alkaloids and it has been shown to have calcium channel blocker activity. It can be said that Avicenna used such a type of medicine long before the use of synthetic drugs, although it remains unclear in which cases he prescribed this drug⁸.

It seems that blood circulation preoccupied Arabo-Islamic physicians. Avicenna and the 10th-century Arabo-Islamic doctors claimed that blood circulation is made in two directions: firstly, much of the blood in the heart is transported to the lungs for „purification“. Secondly, the pure blood is mixed with the inhaled air and returns with breathing to the left ventricle of the heart. They were convinced that two vessels were leaving the left heart, a vessel called the venous artery and carrying blood to the lungs and a second largest artery known as aorta. Aorta was divided into two arteries: one to the head and the cervix, and the other to the other organs, transferring them to the „vital spirit“ and natural heat. Finally, the vein over the liver transported the blood from

the viscera and by ejecting into the lower cavity it reached the right heart cavity.^{9,10}

However, Ibn Al-Nafis (1213-1288) was the first to describe pulmonary circulation, or the pulmonary passage of blood, thus defying Galen's theory of pulmonary circulation. In his work, he mentioned: „heart has only two ventricles ... and between them there is absolutely no opening, because diaphragm is too thick. The advantage of this blood of the right cavities is that it mixes with air in the lungs and then goes to the left cavity, from the two that has the heart ...“. But also in the pulse issue he had his own view: „pulse is the result of both physical and forced movements of the arteries ... the forced movement must be the contraction of the arteries and it comes from the heart, while the physical movement that characterizes them must be their dilation... The heart and arteries do not contract and expel simultaneously. Rather, the opposite happens when one organ contracts the other expands and vice versa“. Ibn-an-Nafis, studied in Damascus and practiced medicine at Al Mansouri Hospital in Cairo. Admirer of Hippocrates and Avicenna, he was particularly interested in commenting on their works and he did not hesitate to break completely with the erroneous ideas of the earlier medical scholars¹¹. Ibn Al-Nafis's fundamental changes to the misconceptions of Galen and Avicenna were as follows: 1) He rejected the existence of pores in the interventricular diaphragm of the heart. 2) Blood from the right ventricle goes to the lungs where part of it is filtered into the pulmonary vein with air 3) The idea that the blood or the spirit from the mixture of blood and air passes from the lung to the left ventricle, and not in the opposite direction. 4) The claim that there are only two ventricles, not three as claimed by Avicenna. 5) The statement that the ventricle takes its nourishment from the blood flow to her wall (the coronary arteries) and not as Avicenna says of the right ventricle blood. 6) A premonition of capillary circulation, with the claim that the pulmonary vein receives the blood coming out of the pulmonary artery, means there are some passages between the two. Ibn al-Nafis in his *Commentary on Anatomy of Avicenna's Canon* makes the first description of pulmonary circulation. Initially, he says that the blood after being cleansed in the right ventricle must then be channeled somehow into the left cavities where the vital spirits are created.^{12,13} In contrast to Galen and Avicenna, who supported the existence of communication between right and left ventricles, Ibn-an-Nafis makes clear that there is no interventricular communication. In particular, he emphasizes that at this level the essence of the heart is very compact and there is no diode, visible or invisible¹⁴. He then clarifies that blood from the right ventricle is

pumped to the lungs to mix with the air and then return to the left cavities. He also analyzes the composition of the vessel walls (arteries and veins) and observes the difference of the pulmonary arteries and veins from the opposite vessels of the rest of the body, while the anatomy of the lungs is also concerned¹⁵.

In a dark period for Europe, Arabo-Islamic medicine flourished and contributed to the evolution of concepts in cardiovascular system. One of its greatest achievements still remains the comprehensive and detailed description of pulmonary circulation, centuries before Michael Servetus (1511-1553), Realdo Colombo (1516-1559) and William Harvey's (1578-1657) leading contribution^{16,17,18}.

Compliance with Ethics Requirements:

„The authors declare no conflict of interest regarding this article“

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