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Review Article

Exploring the Concept of Blood Circulation in Unani Medicine: A Critical Review of Classical Sources

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Abstract

The concept of blood circulation, a cornerstone of modern physiology, is often attributed to William Harvey's work in the 17th century. However, the historical origins and philosophical underpinnings of circulatory theory can also be traced to earlier traditions, notably the Unani system of medicine. Unani medicine, which has its roots in Greco-Arabic science, offers a profound comprehension of the human body, with blood (Dam) being one of the four essential humors. Foundational ideas on the heart, vessels, and blood flow were created by notable Unani scholars including *Buqrāt* (Hippocrates), *Jalinūs* (Galen), *Ibn Sīnā* (Avicenna), *Abū Bakr Moḥammad Ibn Zakriyā Al-Rāzī* (Rhazes), and *Ibn Al-Nafīs*. In alignment with the contemporary understanding of pulmonary circulation, Ibn Nafis, who is widely regarded as a prominent and highly influential figure within the traditional Unani medical framework, put forth a significant hypothesis regarding the journey of blood circulation. Specifically, he suggested that blood circulates from the right heart chambers to the left heart chambers through the intermediary of the lungs. This ground-breaking theory, which notably predates the discoveries of William Harvey, stands as a remarkable testament to the expansive breadth and depth of Islamic medical knowledge during that era. Ibn Nafis's pioneering work not only sheds light on the complexities of blood circulation but also serves as a crucial element in acknowledging the valuable intellectual contributions of Unani medicine to the field of anatomical sciences. Furthermore, it is imperative to incorporate his unique and insightful perspectives into the broader narrative of medical history on a global scale, recognizing the lasting impact of such contributions on the evolution of medical understanding and practices across diverse cultures. This research explores the original insights on blood circulation found in classical Unani texts, with a focus on the synthesis of anatomical, physiological, and philosophical knowledge that anticipated several principles of modern circulatory science. With the revival of anatomical dissection in European universities it laid the groundwork for later scientific breakthroughs.

Keywords: Blood Circulation, Unani Medicine, Ibn Nafis, Pulmonary Circulation.

INTRODUCTION

The understanding of blood circulation has long served as a cornerstone in the evolution of medical sciences. While the discovery of systemic circulation is frequently attributed to William Harvey in the 17th century, there exists a less acknowledged yet profound lineage of medical thought in earlier traditions—most notably, the Unani system of medicine. Unani medicine, derived from Greco-Arabic origins, represents an integrative approach to human physiology and pathology based on humoral theory. Classical Unani scholars, especially *Buqrāt* (Hippocrates), *Jalinūs* (Galen), *Ibn Sīnā* (Avicenna), *Abū Bakr Moḥammad Ibn Zakriyā Al-Rāzī* (Rhazes), and *Ibn Al-Nafīs*, developed elaborate models of the cardiovascular system centuries prior to modern discoveries.

In the modern era, the heart is often considered the king of the body, supplying blood to various organs.[1] According to Empedocles of Agrigento (5th century BC), the heart was regarded as the center of pneuma, encompassing both breath and soul.[2] He posited that the life force was linked to the "innate heat" of the body, which the heart distributed. [3] The significance of the heart as the seat of the mind likely

stemmed from the observation that life persists as long as the heart continues to pulse, and death occurs when the heart ceases to beat.[4]According to *Abū Al-Ḥasan Aḥmad Ibn Moḥammad Al-Ṭabarī* in his book "*Firdaus al-Hikmat*," the heart is considered the center of "*Hararat-e-Gariziya*" (vital heat) and life.[5] *Ibn Sīnā* also suggested that the heart is the center of emotional and mental functions, as it controls the distribution of blood or breath throughout the body, including to the brain.[1]

We now recognize that the exploration of the circulation has a history spanning at least five millennia.[6] It was commenced in Egypt around 3500 BC, underwent elaboration by ancient Greeks, found refinement in Alexandria, and, in the Western world, experienced a suspension after the fall of the Roman Empire. The Islamic world and European monasteries retained and improved this knowledge, which subsequently advanced with the resurgence of anatomical dissection in European institutions, finally opening the door for the discoveries.[7]

This paper critically reviews classical Unani sources to explore how the concept of blood circulation was articulated, debated, and refined across different historical periods. Through an in-depth analysis of original texts and scholarly commentaries, the study aims to reposition Unani insights as integral to the global narrative of medical history.

Objectives

The objective of this research paper is to explore the historical evolution of blood circulation theory as presented in classical Unani literature and to contrast the conceptual framework of Unani circulation with contemporary anatomical understanding and scientific discussions, thereby enhancing the comprehension of Unani medicine.

MATERIAL AND METHODS

The study is qualitative in nature and involves a critical textual analysis of primary classical Unani sources, including *Kitāb al-Kulliyāt, Sharh al-Tashrīh al- Qanūn, Kitab al-Tashrīh, Firdos-al-Hikmat, Al-Moālijāt Buqrātia, Kitāb al-Umda- fī al-Jarahat, Al-Qanūn fī al-Tibb, Kitāb al-Hāwi, Kāmil-al-Sanā, and Kitab-al Mukhtarāt fī al-Tibb* etc. Secondary sources in the form of commentaries, historical treatises, and recent academic analyses were also reviewed to contextualize and interpret the primary texts. The research methodology involved comparative historical analysis, translation of key excerpts, and thematic categorization of physiological concepts.

LITERATURE REVIEW

The literature on the history of blood circulation is diverse, yet heavily skewed toward Western medical achievements. Galen of Pergamon (129–216 CE) proposed a model in which blood was generated in the liver and transported through the veins to different parts of the body. He believed that blood passed through tiny invisible pores in the interventricular septum of the heart to mix with pneuma (air) in the left ventricle, creating 'vital spirit'. This view dominated both Greco-Roman and Islamic medical thought for over a millennium [8].

Unani scholars initially built upon Galenic ideas. *Ibn Sīnā*, in his influential Canon of Medicine, offered detailed descriptions of the heart, vessels, and associated functions. He expanded on Galen's physiology by incorporating philosophical perspectives, particularly regarding the role of the heart as the source of innate heat and the seat of the vital spirit [9]. *Al-Rāzī* also contributed significantly by emphasizing empirical observation in clinical practice, though he largely adhered to Galenic anatomical theories.

The turning point came with *Ibn Al-Nafīs* (1210–1288 CE), whose critical analysis of Galen's assertions led to a radically new model. *Ibn Al-Nafīs*, the distinguished physician and scholar, in his detailed commentary on the renowned medical work known as Avicenna's Canon of Medicine, took on a significant challenge by contesting the previously accepted notion of the existence of interventricular pores within the heart. He effectively argued against this traditional view by proposing a revolutionary idea regarding the process of blood circulation. Specifically, *Ibn Al-Nafīs* posited that blood flows from the right ventricle of the heart not through these supposed pores but instead travels to the lungs via the pulmonary artery. The blood undergoes a vital oxygenation process during this activity, enabling it to absorb oxygen. The left ventricle of the heart collects the oxygen-rich blood after this crucial ventilation procedure. His insights contributed to a foundational understanding of the circulatory system, reshaping the way respiratory and cardiovascular physiology was viewed in his time and laying groundwork for future studies in anatomy and medicine. This description aligns closely with the modern understanding of pulmonary circulation [10].

Buqrāt (460-377 B.C.E.)

The earliest suggestion of blood moving in a circular pattern is found in the texts of the Hippocratic Corpus. *Buqrāt* held the belief that the liver and spleen served as central organs where blood was continually produced. According to his view, this blood reached the heart, where it was either heated or cooled by the air entering through the trachea into the lungs and heart [11-13]. According to his conception, the right ventricle was connected to the left ventricle via an opening in the interventricular septum [14].

The heart, a vital organ, sustains itself by drawing upon a purified substance formed during blood separation, unlike the rest of the body which relies on

blood transport [13]. The Hippocratic text, On the Heart, highlights the cardiovascular system's role in respiration, with the right ventricle supplying blood to the lung. A weak pulmonary valve allows air to pass through, demonstrating an early understanding of cardiovascular physiology, a concept that preceded *Jalinūs* conceptions by five centuries [15].

Erasistrātūs (304-250 B.C.E)

Erasistrātūs, hailed as the first experimental physiologist, played a pioneering role in describing the heart as a pump and formulating one of the earliest theories of blood circulation [14]. His approach to the anatomical depiction of blood movement involved considering the heart as the common origin for both arteries and veins [16]. He asserted that the anatomical endpoint of arteries marked the beginning of veins. However, *Erasistrātūs* did not identify the functional continuity between these two components.[14] *Erasistrātūs* proposed that the ventricle, responsible for expulsion of blood and vital spirit during cardiac systole, is responsible for transporting these substances throughout the body.[17]

Erasistrātūs made significant progress in anatomically describing circulation, but his understanding was hindered by the misconception that arteries contained air, or pneuma [18]. *Erasistrātūs* proposed a complex process for nourishment, where digested food reaches the liver via the portal vein, transformed into blood, and distributed to the right ventricle. The pulmonary vein carries air into the lungs, where it is converted into vital spirit in the left ventricle [7,19].

Erasistrātūs's theory of blood flow, based on his understanding of the circulatory system, posits that blood begins in the liver, flows to the heart, and then reaches the lungs, providing a comprehensive explanation of the circulatory system [20,21]. *Erasistrātūs* believed that blood in the left ventricle transforms into animal spirit, essential for motion and sensation. This spirit is conveyed through hollow nerves, solidifying after death. Erasistrātūs saw no need for circulation system explanation [7,19].

Jalinūs (129-200 C.E.)

Jalinūs introduced an early model of the human circulatory system,[12] with an overview of Galen's circulation derived from various translations [17]. *Jalinūs*, in his work "De Usu Partium," distinguishes between spiritual blood and venous blood, stating that both are utilized by peripheral tissues only once.[11,13] *Jalinūs* proposed that the pulmonary vein, a portion of purified blood from the right ventricle, is utilized by the lungs for their nutritional needs due to the spongy nature of the lungs. Though, this supply is inadequate due to the thick wall of the pulmonary artery. To ensure adequate supply, a smaller segment of blood is directed through unseen anastomoses into the pulmonary veins [1, 22].

The majority of the blood that enters the pulmonary artery facilitates its entry into the lungs for the removal of impurities and exhalation [12]. *Jalinūs* believed that even though blood from the pulmonary veins flows to the lungs, but it does not pass through the left ventricle. The lack of a pulmonary circuit is demonstrated by the fact that it instead supplies lung tissue and right atrium gets the blood through the interventricular septum [7,23,24]. According to *Jalinūs*, the majority of the blood entering the left ventricle originates directly from the right ventricle through small "foramina" in the trabeculated interventricular septum that separates the two ventricles [11,25-28]. These foramina, however, close up after death [29]. The connection between the two heart chambers is described by *Jalinūs* as being facilitated by a diaphragm, referred to in contemporary terminology as the interventricular septum [30].

Abū Bakr Moḥammad Ibn Zakriyā Al-Rāzī (850-923 AD)

Razi's *Kitābul Mansoorī* outlines the right ventricle of the heart, which has two orifices: one for the hepatic vein (*warīd kabdi*), and another for the pulmonary artery (*warīd shiryani*). The hepatic vein enters the right ventricle, allowing blood to enter the heart. The left ventricle has two openings: one for the aorta, where all arteries spread, and another for the artery that connects to the lungs, facilitating oxygen from the lungs to enter the heart [31]. He further observed several openings connecting the right and left ventricles [11].

Al-Akhawaynī (?-983 C.E.)

Al-Akhawaynī identifies the lungs as the main pathway for blood flow from the right side to the left, although he also notes openings in the interventricular septum.[32] He acknowledges two apertures in the interventricular septum facilitating communication between both ventricles, but emphasises that the majority of the blood received by the right ventricle is directed to the lungs [7].

He explains that blood enters the heart through the right side, travels to the lungs for aeration, and subsequently returns to the left side of the heart, eventually moving from the heart to the body through the left side [7,12]. He clarifies that arteries originating from the right side of the heart will eventually branch out in the lungs. *Al-Akhawaynī*'s 's *Hidayat al-Mutaallimin Fi al-Tibb* explains that the heart has two openings, one receiving blood from the liver and the other allowing blood to move from the heart to the lung. The cleft between the openings acts unilaterally to prevent blood from exiting the heart and from returning to the heart [12]. Thus, *Al-Akhawaynī Bukhari* described a basic lung circulation, highlighting that the heart's function was to

pump blood, and blood vessels conveyed only blood, not pneuma [7].

'Alī Ibn Al-'Abbās Al-Majūsī (930-994 C.E.)

'Alī Ibn Al-'Abbās Al-Majūsī identified *manfaz* (penetration places) between the two cavities of the heart [33]. According to *Majūsī*'s theory in "*Kamil al-Sanā al-Tibbiya* (Complete Art of Medicine)", the interventricular septum has a foramen that serves as a conduit for blood flow from the right to the left side of the heart. It is worth noting that *Majūsī* proposed that the pulmonary artery, as currently recognized, functions to transport deoxygenated blood from the right ventricle to the lungs, where it contributes to pulmonary nourishment and facilitates gaseous exchange [34]. Regarding the passage from the right to the left cavity, it widens on the right side and gradually narrows as it reaches the left. This narrowing is explained by the blood coming from the liver in the vena cava, which must pass from the right ventricle to the left. The opening is narrower on the left to allow only the most subtle part of the blood to pass into the left cavity [35].

Ibn Sīnā (980-1037 C.E.)

Abū ʾAlī al-Ḥusayn Ibn ʿAbd Allāh Ibn Sīnā (Avicenna) formulated a concept of blood circulation, drawing inspiration from ancient Greek theories. He postulated that the interventricular septum has apertures that facilitate blood flow between the left and right ventricles [12,36,33].

A canal connecting the large lateral ventricles within the middle ventricle is wide open where the heart is broad, while it narrows and collapses where the heart is elongated. This implies that the central ventricle possesses a robust and compact structure, possibly housing a canal inside. In the atrium, where the heart is larger, this canal has a larger width. It then tapers toward the apex, which corresponds to the length of the heart [33].

Ibn Hubal Baghdādī (1122-1213 C.E.)

Kitab-al Mukhtarāt fī al-Tibb, a book by *Ibn Hubal Baghdādī*, explains the heart's circulation. It explains that the right ventricle has two openings, one for the pulmonary vein, which brings blood from the liver into the heart and the other for the pulmonary artery, a large vessel entering the heart. The left ventricle has two openings, one for the aorta, and the second for the pulmonary vein, which opens during blood and carbon dioxide movement from the heart to the lungs [37].

'Alī Ibn Abī Al-Ḥazm Al-Qarashī (Ibn Al-Nafīs) (1207-1288 C.E.)

In 1242, *Ibn al-Nafīs* published a book entitled *"Sharh Tashrīh al- Qanūn*," in which he challenged previous beliefs, including those of Ibn Sīnā and Jalinūs. In this book, he strongly criticized Galen's model of blood circulation and refuted the idea that pores were present in the interventricular septum. The book introduced several novel concepts, with the most significant being the anatomy of coronary, pulmonary, and capillary circulation [12,38].

Ibn al-Nafīs illustrated the interventricular septum, located between the right and left ventricles, as a nonporous wall through which blood could not pass [33]. He considered pulmonary circulation as the sole route through which blood could move from the right ventricle to the left ventricle [12]. As *Jalinūs* believed, blood from the heart's right chambers did not go directly through any pores or routes to reach the left chambers, according to *Ibn al-Nafīs*. Rather, the vena arteriosa, which is now the pulmonary artery, had to carry blood from the right ventricle to the lungs before passing through the lung parenchyma. Blood and air mingle in the lungs before traveling to the left chambers via the arteria venosa, also referred to as the pulmonary vein. From there, via the aorta, it was distributed throughout the body [7]. As a result, he acknowledged that the pulmonary circulation is the sole means of blood circulation between the left and right ventricles of the heart, highlighting the absence of an opening between them [30,35].

Ibn Al-Quff (1232-1286 C.E.)

Ibn al-Quff proposed the idea of blood circulation as a closed system within the human body, emphasizing the crucial connection between arteries and veins. *Ibn al-Quff* seems to have been among the first to propose the existence of capillaries in the circulatory system [39].

According to *Ibn al-Quff al-Masihi* in *Kitāb al-Umda- fī al-Jarahat*, the heart possesses four openings, two of which are located on the right side. Pulmonary circulation is the primary method of blood circulation between the left and right ventricles of the heart, facilitating the flow of blood from the liver to the heart's chambers. This connection to the pulmonary artery facilitates the exchange of unclean and refined air, thereby sustaining pulmonary function and nourishing the lungs [40]. He suggested that numerous small pores exist along the pathway from the right side to the left [3].

DISCUSSION

Early Theories of Blood Circulation:

Buqrāt, the first to suggest blood moves in a circular manner, had the earliest indication found in the Hippocratic Corpus [30]. *Jalinūs* acknowledged that blood passes through the lungs, but believed it was minimal. He proposed that blood ultimately re-enters the right ventricle before entering the left ventricle through pores. *Erasistrātūs* believed nothing is returned to the left ventricle, as pneuma and blood are used for nutrition or eliminated through excretion. However, this perspective is considered incorrect in modern knowledge [7,19]. *Ibn al-Nafīs* considered pulmonary circulation as

the sole pathway through which blood could pass from the right ventricle to the left ventricle, which is a correct understanding [12,30]. *Al-Akhawaynī* emphasized that most blood received by the right ventricle was transported to the lungs, but acknowledged the incorrect concept of two pores in the septum [7]. *Ibn al-Quff* considered blood circulation as a closed system within the human body [39].

Unani Framework of Physiology:

Unani medicine emphasizes the importance of blood, the most vital humour, in maintaining physical and metaphysical well-being. Blood, the source of *'Hararat-e-Ghareezia'* (innate heat), is distributed throughout the body via the heart, highlighting the intricate relationship between blood and health.

This concept positions blood not just as a fluid for nutrient transport, but also as a vehicle for heat, spirit (*Ruh*), and life. Classical texts like Avicenna's Canon describe how digested food is converted into chyle in the liver and then into blood, which nourishes the body. The venous system, originating from the liver, and the arterial system, emanating from the heart, were believed to work in tandem [9].

Anatomical Insights:

Ibn Sīnā was a prominent anatomical scholar who detailed the heart's structure, valves, and rhythmic contractions. However, he did not reject Galen's concept of interventricular pores. *Ibn al-Nafīs*, based on anatomical logic, dismantled this idea, asserting that blood must flow through the pulmonary artery into the lungs, mixed with air, and then carried to the left heart via the pulmonary vein [41].

This represents a methodological shift from speculative philosophy to evidence-based reasoning. Though his conclusions were not based on direct human dissection, they demonstrate an advanced understanding of comparative anatomy and circulation [42].

Bridging Ancient Errors and Insights:

Erasistrātūs accurately identified the heart as a pump, but his understanding of anatomical aspects of circulation was hindered by the erroneous belief that arteries contain air (pneuma). Despite this, Erasistrātūs correctly observed that the heart fills and arteries dilate [12,19].

Jalinūs, in the 2nd century, introduced the theory of circulation by distinguishing between arterial or spiritual blood, which is modern oxygenated, and venous blood, which is modern deoxygenated blood [11,13]. *Ibn Sīnā*, in his 12th century book "Canon of Medicine," made significant contributions to the understanding of the circulatory circuit, particularly the passage of blood from the right to the left ventricle exclusively through the lungs. Galen, despite his significant contributions, did not fully comprehend the complete circulatory circuit [25,38,43].

Relevance to Modern Medicine:

Greek scholars combined philosophical reasoning with observational anatomy, forming early hypotheses that prompted critical inquiry by later scholars. The Unani writings of *Ibn al-Nafīs* offer significant insights into the physiology of blood circulation, highlighting their foundational role in shaping the contemporary understanding of the cardiovascular system.

Comparative Table: Foundations of Modern Blood Circulation

Aspect	Greek Scholar (*Jalinūs*)	Arab Scholar (*Ibn al-Nafīs*)	Modern Understanding
Time Period	2nd Century C.E.	13th Century C.E.	17th Century onward (Harvey & beyond)
Key Contribution	Proposed dual blood system (venous and arterial)	Described pulmonary circulation accurately	Describes both systemic and pulmonary circulation
Blood Origin Theory	Blood produced in liver (venous) and heart (arterial)	Refuted liver-based blood production theory	Blood produced in bone marrow; circulates via heart and vessels
Ventricular Flow	Believed blood passed through invisible pores in septum	Rejected existence of interventricular pores	No pores exist; blood flows through pulmonary and systemic circuits
Lung Function in Circulation	Minimal or misunderstood role	Described lungs as site for blood-air interaction	Lungs perform gas exchange: O_2 in, CO_2 out
Pulmonary Circulation	Not clearly described	Blood travels from right heart to lungs and back to left heart	Confirmed by Harvey and modern anatomy
Methodology	Based on philosophical reasoning and animal dissection	Rational judgement and anatomical explanations	Experimental, evidence-based, with scientific authentication
Influence on Later Scholars	Dominated Western medicine for over a millennium	Influenced both Islamic and later European medicine	Formed basis for modern cardiovascular science

Preservation of Knowledge	Texts later translated into Arabic	Preserved, criticized, and expanded Greek texts	Informed Harvey's work via Latin translations
Legacy	Initial framework of circulation theory	First accurate concept of pulmonary circulation	Comprehensive circulatory system established

CONCLUSION

Ibn al-Nafīs, a prominent figure in the history of Islamic medicine, revolutionized the understanding of blood circulation before the advent of modern physiology. His work on pulmonary circulation, which contrasted with Galenic theories, was a significant departure from established doctrine and aligned with modern scientific findings. *Ibn al-Nafīs* rejected the concept of interventricular pores and gave a detailed explanation about the pulmonary circuit that exemplifies the empirical and innovative spirit of Islamic medicine. Re-integrating Unani perspectives into the history of medicine is not only historical accuracy but also intellectual justice, expanding the framework for understanding scientific development. Unani medicine's conceptual richness, linking the heart, soul, and spirit, offers insights into the human condition that transcend mechanistic models.

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