

ORIGINAL ARTICLE

Haly Abbas' (? 930-994 AD) Pulsology

Abstract

Abū l-Ḥasan Alī ibn al-'Abbās al-Majūsī Ahvazi (? 930-994 AD), best known as *Haly Abbas* in the West, was a 10th century Persian physician whose lifetime coincided with the flourishing of medical science in the Near East, the *Islamic Medicine Golden Age*, an era extending from the 9th to the 12th centuries AD. *Haly Abbas*, in his extant book *Kāmil al-Sinā'ah al-Tibbīyah (The Perfect Book of the Art of Medicine)*, provided a detailed description of the pulse and its features. He practiced the evaluation of the pulse cycles to distinguish between the state of well-being and various diseases. These 10th century views on the pulse are explored in this text through a discussion of *Haly Abbas'* surviving book, the *Kāmil al-Sinā'ah al-Tibbīyah (The Perfect Book of the Art of Medicine)*.

Keywords: *Haly Abbas*; Medieval History; Persia; Pulse; The Royal Book

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Introduction

The study of cardiovascular medicine goes back in history to the ancient civilizations. With the passage of time, cardiovascular science has evolved and undergone a developmental progress.^{1,2} Persian physicians, particularly *Haly Abbas* (? 930-994 AD), were among those who contributed to this knowledge.³⁻⁷

Abū l-Ḥasan Alī ibn al-‘Abbās al-Majūsī Ahvazi, with the Latinized name of *Haly Abbas*, was a 10th century Persian scholar. He was probably born on 930 AD, and was originally from the Old Persian city of Arrajan. *Haly Abbas* made major contributions to the scientific achievements of the *Golden Age of Islamic Medicine* (9th-12th centuries AD).⁸⁻¹³

Haly Abbas was the author of the book *Kāmil al-Sinā‘ah al-Tibbīyah* (The Perfect Book of the Art of Medicine), also commonly known as *Al-Kitāb al-Malikī* (The Royal Book) (Figure 1). Originally written in the Arabic language, it was an encyclopedia on medicine and surgery renowned for its systematic content. The text deals with the various aspects of medicine, in particular the science of cardiology.^{14,15} The objective of this article is to present a new characteristic of *Haly Abbas’* knowledge on cardiovascular medicine, his 10th century views of the pulse. This subject has been a neglected topic until now.

- 1- Gowda et al, 2006: 457-460.
- 2- Yarmohammadi et al, 2013: e165.
- 3- Dalfardi et al, 2014: 36-39.
- 4- Ibid: e145-146.
- 5- Ibid: e147-148.
- 6- Ibid: 491-492.
- 7- Ibid: e143-144.
- 8- Ibid: 36-39.
- 9- Aciduman et al, 2014: e791-796.
- 10- Belen et al, 2006: 381-383.
- 11- Aciduman et al, 2010: 1466-1475.
- 12- Zargaran et al, 2013: 2196-2197.
- 13- Yarmohammadi et al, 2013: 435-440.
- 14- Dalfardi et al, 2014: 36-39.
- 15- Belen et al, 2006: 381-383.



Figure 1. A page from a copy of the *Kāmil al-Sinā‘ah al-Tibbīyah* (The Perfect Book of the Art of Medicine) (belonging to 1726). (Courtesy US National Library of Medicine).

Of note, the ancient science of the pulse (*Ars Sphygmica*) dates back to a time long before the era of Greek physicians like Hippocrates (460-370 BC) and Galen (130-200 AD). It has been suggested that ancient Chinese and Hindu physicians were very skilled in feeling and examining the pulse long centuries before the advent of Hippocratic Medicine. As the other important point, it seems that the oriental knowledge on the pulse and its applications were developed quite independently of Greek influence.¹⁶⁻¹⁸ However, there are missed points in the history of Persian knowledge and findings about this valuable medical tool.

It is hoped that this paper will fill a gap in the history of the pulse, one of the main diagnostic tools of the physicians for many centuries that has developed over time to reach its status in modern medicine.

Haly Abbas' definition of the pulse

Haly Abbas described the pulse as a phenomenon which is responsible for the viability of man, and is produced by the dilation and contraction of the heart and the arteries. He noted the concordant action of these two aforementioned body structures, as follows: "*Heart and the arteries move at the same time and in a unique pattern, and anytime don't have any inconsistency, in such a way that one's movement can be predicted with the movement of another one. Thus, by checking the pulse we can understand the heart movement*". In *Haly Abbas'* opinion, both the dilation and contraction of the heart and the blood vessels were active phenomena.¹⁹ Some centuries later to *Haly Abbas*, *William Harvey* (1578–1657) explained the systole as an active event and the diastole as a passive phenomenon.²⁰

Although *Haly Abbas* was familiar with the arteries located superficially in the ankle, dorsal aspect of the foot, inguinal area and the neck (posterior tibial, dorsalis pedis, femoral, and carotid arteries in current terminology), he introduced the arteries placed in the wrist (radial and ulnar arteries in modern nomenclature) as the best sites for pulse detection. In addition, he recommended using what is in the modern anatomy known as fingers 2 to 5 (not the thumb) to detect the pulse.²¹

Haly Abbas emphasized to his students the importance of working hard to achieve the desired skill of differentiating the various types of pulse, and to gain the ability to realize any minute change in the normal pulse pattern.²²

- 16- Bedford, 1951: 423-437.
- 17- Khodadoust et al, 2013: 289-293.
- 18- Balick et al, 2008: 113-119.
- 19- Ghafari, 2009: 266-335.
- 20- Yarmohammadi et al, 2013: 1819-1821.
- 21- Ghafari, 2009: 266-335.
- 22- Ibid: 266-335.



Haly Abbas' classification of the pulse

Haly Abbas used measurements of the three-dimensional (in modern nomenclature) structure of the heart and the arteries to explain different classifications of the pulse, as will be discussed below.²³

1) Type of pulse according to the amount of arterial dilation: Based on this character, *Haly Abbas* generally categorized the pulse into three classes of large (maximum amount of arterial dilation), Small (minimum of dilation), and intermediate (mean of two previous forms). He specifically introduced some types of the pulse patterns which included a long pulse (maximum dilation in length coordinate to the extent that can be simultaneously palpated with tips of the fingers 2 to 5), the short pulse (minimum dilation in length coordinate), and an intermediate form; wide (maximum dilation in width coordinate to the extent that exceed the edges of the fingertips), narrow (minimum dilation in width coordinate), and intermediate (parallels with the edges of the fingertips); a tall pulse (maximum dilation in height coordinate), the deep pulse (minimum dilation in height coordinate), and an intermediate form; and the sturdy pulse (a type of pulse resulted from more arterial dilation in width and height coordinates in comparison with length coordinate). *Haly Abbas* explained the possibility of the presence of a combined form of the pulse.

2) Type of pulse according to the duration of the pulse: The fast pulse (has short durations between each two pulses), a slow pulse (relatively long duration between each two pulses) and the intermediate form. Fast and slow pulse patterns could be consistent with tachycardia and bradycardia in the current nomenclature, respectively.

3) Type of pulse according to the force: The strong pulse (hits fingertips by force), the weak pulse (hits fingertips weakly) and intermediate.

4) Type of pulse according to the consistency of the palpable artery: The full pulse (the artery seems to be full of the blood), the empty pulse (the artery appears to be full of the air) and intermediate.

5) Type of pulse according to the temperature quality of the artery: The hot pulse (arterial hotness is palpable), the cold pulse (artery seems to be cool) and intermediate.

6) Type of pulse according to the duration of pause in pulse cycle: Continues (with short duration of pause), separated pulse (with long duration of pause) and intermediate. *Haly Abbas*, consistent with *Galen's* (130-200 AD) explanations,



explained that during a pulse cycle two distinct pauses occur; one at the end of dilation when the artery hits the fingertips and another at the end of contraction which is not palpable.

7) Type of pulse according to the duration of each pulse beat with the pulse-to-pulse interval: The harmonious and inharmonious pulse cycles. To define this character, he compared the duration of the arterial dilation phase of the pulse cycle with its contraction phase; or, the duration of the two pauses in the pulse cycle; or, the duration of the arterial dilation phase of the pulse cycle with the duration of pause at the time of arterial contraction in that same cycle. Subsequently, *Haly Abbas* explained that this method could be a practical application in comparing the different people's pulse to each other. For example, he believed that the pulse pattern of a child can be harmonious with another child, but not with that of a young man.

On the basis of *Haly Abbas*' explanations, classifying the pulse pattern using this method proved to be a difficult work that required a long-term experience of trial and error in examining the pulse.

8) Type of pulse according to the amount of arterial dilation in different pulse cycles: Consistent (similar hits to the fingertips in different pulse cycles) and inconsistent (non-similar hits to the fingertips). According to *Haly Abbas*, the inconsistency can occur in any of the above-mentioned features of the pulse.

Haly Abbas explained that inconsistent pulses patterns can have an invariant inconsistency in the different pulse cycles (matching the regularly irregular pulse pattern in modern terminology), or they may show a variant inconsistency in the different pulse cycles (corresponding to the irregularly irregular pulse pattern in current nomenclature).

It is worth mentioning that in *Haly Abbas*' opinion, the most normal type of each of the aforementioned characters, which could be indicative of a healthy man, was its intermediate form.²⁴

***Haly Abbas*' classification of the inconsistent pulses**

In describing the first inconsistent pulse type (regularly irregular group), *Haly Abbas* specifically pointed to a kind of pulse which he named *Zanab-o al-Fa'areh* (Mouse-Tail). According to his descriptions, generally, in this type of pulsation there is a strong pulse followed by a group of pulses, which became weaker and weaker. Afterwards, a strong pulse can be palpated again; and this cycle of strong and weak pulses



repeats continuously.²⁵

Haly Abbas categorized mouse-tail pulses into three following classes: (1) *Zanab-o al-Fa'areh al-Monghazi (Expiring Mouse-Tail)*, in which the force of the pulse rate continuously diminishes to become non-palpable; finally, a strong pulse could be detected; (2) *Zanab-o al-Fa'areh al-Rraje' (Returnable Mouse-Tail)* in which the pulse became gradually weaker; next, they progressively grew stronger to return to its' original strength; and (3) A type of *Zanab-o al-Fa'areh (Mouse-Tail)* in which there is an alternating strong and weak pulse. Although the *Zanab-o al-Fa'areh (Mouse-Tail)* pulse could correspond to the sinus arrhythmia (something like sick sinus syndrome, a term which later coined by Lown in 20th century), *Haly Abbas'* described third class that can be specifically compared to what is presently known as pulsus alternans. According to the modern literature, pulsus alternans was first scientifically described by Traube in 1872.²⁶⁻³¹ In addition to the pulse force, *Haly Abbas* described the pulse duration as a distinct criteria for the mouse-tail pulse. It is interesting to note that the reason for selecting the name *Zanab-o al-Fa'areh (Mouse-Tail)* was that the first part of the tail of the mouse is thicker, then, it gradually becomes thinner and thinner!³²

Haly Abbas explained the other inconsistencies in the pulse patterns. For example, he pointed to the Pulsus Gazellans, as follows: "... it is a kind of pulse in which pulsation begins rapidly; then, it [hits the fingertips one time and then] experiences a pause before hitting the fingertips [for the second time]; afterwards, it continues rapidly". He explained that this pulse pattern is similar to the depiction of the leaping gazelle. The analysis being that when a gazelle jumps, it is momentarily suspended in the air for a minuscule moment, then rapidly lands on the ground to continue his trek. He added: "... the pulse which hits fingertips twice is called 'Zu-al-Ghar'atain' [Pulsus Duplex]...". He also called this kind of pulse as Hammer Pulse (*Metraqi* in Arabic): "... it [pulsus duplex] is like what happened between a stake and hammer. When a hammer hits a stake, due to its [stake's] hardness, the hammer gets far away and then returns again and hits stake for the second time ...". This last aforementioned description is attributable to the pulsus bisferiens in modern medicine.^{33,34}

Curved Pulse is the other described form: "... the curved pulse is when the force is strongly palpable with the two middle fingertips [fingers 3 and 4] and weakly palpable with the

25- Ghafari, 2009: 266-335.

26- Ibid: 266-335.

27- Semelka et al, 2013: 691-696.

28- Weber, 2013: 51-54.

29- Greenwood et al, 1975: 208-213.

30- Schoen et al, 1991: 315-319.

31- Harris et al, 1966: 948-961.

32- Ghafari, 2009: 266-335.

33- Ibid: 266-335.

34- Fleming, 1957: 519-524.



two lateral fingertips [fingers 2 and 5]; or, seems tall in palpation with the two middle fingertips and seems deep in palpation with the two lateral fingertips". He then explained a wavy pulse, as follows: "... this occurs when that part of the blood vessel [artery] which located nearby the small finger [5th finger] becomes elevated [dilated in height coordinate] and its dilation begins very soon; that part located after it [under the 4th finger] becomes dilated slowly and in small amount in comparison to the first part ...; the third part [under the 3rd finger] becomes dilated in a manner that its elevation [dilation in height coordinate] be less than that of the first part, but starts very soon; the forth part [under the 2nd finger] becomes dilated less than that of the second part and more later than it ...".³⁵

The next mentioned form of the pulse is *Pulsus Vermicularis*. Haly Abbas explained that this type of the pulse is very similar to the wavy one in its components. In his view, the differentiating feature of these two aforementioned forms was that the arterial dilation is taller and stronger in wavy pulse than those of the *pulsus vermicularis*; in contrast, *pulsus vermicularis* occurs in a faster way (increased number of the pulse cycles).³⁶

Pulsus Formicans is the other described pulse. According to Haly Abbas, *pulsus formicans* is similar to the *pulsus vermicularis*, but its pulsation occurs smaller, weaker, and faster. In his opinion, presence of this type of the pulse is indicative of significant decrease in body strength. Stable Pulse is fast and tall, but a weak one which indicates the strength of the blood vessels. A *Vibratory Pulse* is a pulse in which pulsations occur in a weak, slow, but continuous pattern.³⁷

Conditions affecting the pulse

According to the Haly Abbas' statements, both the natural (intrinsic) and unnatural factors can affect the pulse status. He identified the factors and characteristics that accounted for these changes: male and female sex, temperament, body figure, age, season, site of residency, air condition, sleep and wakefulness, pregnancy, exercise, bathing, and foods and drinks. Some of the Haly Abbas' descriptions are noteworthy. For example, he noted the higher pulse rate in children (especially at a younger age) than the older age groups, the increased pulse rate during pregnancy (but not so in the early stages of pregnancy), the commonness of the inconsistent pulse patterns in old age group people, the transient increase in the pulse rate after alcohol consumption; and, changes in

35- Ghafari, 2009: 266-335.

36- Ibid: 266-335.

37- Ibid: 266-335.



the pulse patterns during the sleep.³⁸⁻⁴²

In addition to the aforementioned factors, *Haly Abbas* explained the role of the pulse in the different diseases and the pattern changes that occur in the pulse cycle. For instance, he explained a condition in which the heart's strength becomes weak; consequently, the pulse becomes weaker and faster than normal. These descriptions can be attributed to what is known as heart failure in modern medicine and its related pulse pattern.^{43,44}

Psychological factors, such as fear, grief, anger, and happiness, are underlying principles that can influence the changes in pulse pattern. For example anger, he explained that in this state, the pulse becomes strong and fast. These statements could be regarded as an early description of psychosomatic reactions.⁴⁵

Discussion

According to what mentioned in *Kāmil al-Sinā'ah al-Tibbiyah* (The Perfect Book of the Art of Medicine), *Haly Abbas* was familiar with and experienced in examining the pulse and recognizing its significance in clinical practice. He categorized different types of pulse and described properties of each type in detail. In addition, it seems that *Haly Abbas* was familiar with the knowledge on pulse that had remained from the time of his predecessors.⁴⁶

Of note, according to what seen in the writings of Rhazes (854-925 AD) and his successors including *Haly Abbas*, it seems that in the field of pulse, Persian scholars were mainly under the influence of Greek doctrine than the eastern one.^{47,48}

The other considerable issue is that *Haly Abbas*' knowledge of the pulse shows several similarities to that of Akhawayni Bukhari (?-983 AD). The latter named physician was student of student of Rhazes and surely was under the influence of his medical knowledge. Based on these facts, it could be concluded that *Haly Abbas*, parallel to Akhawayni, was also familiar with and under the influence of Rhazes' medicine. This chain of Golden Age physicians, beginning from Rhazes, played a main role in transferring, modifying and improving medical knowledge survived from the time of ancient physicians.^{49,50}

Conclusion

The Persian physician, *Haly Abbas* studied the art of the pulse, to better assess the people's health. His experience-based approach to medicine allowed him to describe the

- 38- Ghafari, 2009: 266-335.
- 39- Pivarnik et al, 2002: 750-755.
- 40- Agarwal, 2005: 57.
- 41- Malhotra et al, 2014: 87.
- 42- Sadock et al, 2007: 749.
- 43- Ghafari, 2009: 266-335.
- 44- McEntegart et al, 2004: 129.
- 45- Ghafari, 2009: 266-335.
46. Ibid: 266-335.
47. Ibid: 266-335.
48. Khodadoust et al, 2013: 289-293.
49. Ibid: 289-293.
50. Yarmohammadi et al, 2013: 435-440.



pulse, categorize it, and explain its value in the differentiating the various diseases, and to introduce those conditions affecting it. A main feature of *Haly Abbass'* approach to his study of the pulse was the detailed and precise classification of his clinical findings.

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