From the medical press

The pulse in antiquity

Rachel Hajar MD, FACC, Director, Non-Invasive Cardiology, Department of Cardiology and Cardiovascular Surgery, Hamad Medical Corporation, PO Box 3050, Doha, Qatar.

I touch his heart, but it does not beat at all. (1) Gilgamesh, c. 2600 BC

Gilgamesh, the hero-king in the Mesopotamian Epic of Gilgamesh, uttered the above lament in 2600 BC at the death of his best friend, Enkidu. The passage is the earliest reference indicating that as early as 2600 years BC, man understood that the heart is the life sustaining organ of the body, and that its motion can be palpatated. The text does not tell us whether Gilgamesh placed his hand on the chest, on the head, or on the extremities.

A remarkable drawing in a prehistoric cave dating as early as 15,000 years ago depicts a mammoth with a leaf-shaped dark area where the heart should be. If it were truly the drawing of a heart, it would be the first anatomical illustration (2). Prehistoric societies were primarily hunting societies. The heart must have been the organ that attracted the attention of man from the earliest times because he found it beating as long as there was life and he soon must have discovered that the best way to kill an animal was to hit it through the head. Perhaps also, he felt his own heart hammering in his breast when fear seized him. It should not be surprising then, that by 5000 years ago, when man settled into city-states, he already realized that the heart is an organ vital to life.

Palpation of the pulse was the sole “window” into the heart for thousand of years until the mid-twentieth century. Throughout the history of medicine, the pulse was an important parameter in assessing cardiac dysfunction, and the tactile examination of the pulse was referred to as “the messenger that never fails” (3).

The evolution of pulse taking, from skillful bedside diagnostic technique to highly sophisticated digital beat-to-beat display with blood oxygen monitoring, is fascinating. We can not have a proper understanding and appreciation of the present unless we know something of the past. A quick historical overview of pulse theories may make us appreciate better the current level of knowledge in the field of cardiac arrhythmias. The desire to understand the physiology of the pulse led to the momentous discovery of the circulatory system, as well as the numerous landmark cardiovascular discoveries of the past fifty years.

The roots

The practice of medicine was inseparable from religion and magic in primitive cultures. At the core of ministering to the sick was a central figure – the healer – known as medicine man, or shaman, or witch doctor. After taking a “history”, the primitive healer consulted the gods, demons or spirits of the supernatural world to determine the nature of the problem before deciding on a course of action. Physical examination was non-existent. He found plants and mineral substances with properties to alleviate specific complaints through trial and error. Many of the
primitive healer's techniques had no rational or pharmacological basis. We do not know in what remote period primitive man first decided to invest the healing arts entirely in a specialist, but by the time mankind had reached the stage of "civilization" the doctor was already in practice.

The oldest civilization flourished in the "land between the two rivers" or Mesopotamia, present day Iraq, where writing was invented. The oldest medical text extant anywhere is a cuneiform tablet from Mesopotamia, c. 2200 BC. The reputation of Mesopotamian medicine has, perhaps, suffered unfairly, owing to Herodotus' ill informed, but often-quoted remark, that physicians were quite unknown in Mesopotamia. It is known that there were two kinds of medical practitioners in Mesopotamia: the ashipu, the expert in spirits and magic, who played the role of "psychiatrist", and the asu, the physician. The ashipu and asu were not competitors; the asu may refer patients to the ashipu and vice versa. The prevailing belief that illness was a punishment from the gods perhaps allowed the ashipu to supersede the asu in later periods.

The ashipu tablets deal with omens and activities relating to the ashipu. The asu texts on the other hand, mention disease conditions and specific symptoms with detailed instructions regarding the appropriate medication. Clinical examination is also mentioned: the temperature of the sick man was noted and rhythm of the pulse was apparently recognized (4). Although Babylonian practitioners referred to arterial blood as "blood of the day" and venous blood as "blood of the night, there is no indication in the surviving texts that they distinguished between arteries and veins (3). Surviving Babylonian medical writings are scanty and ill understood. Babylonian medical writings are silent on the topic of cardiovascular anatomy and physiology.

Legacy of ancient Egypt

To know the movements of the heart and to know the heart . . . From the heart arise the vessels which go to the whole body . . . if the physician lay the hands or his fingers to the head, to the back of the head, to the hands, to the place of the stomach, to the arms or to the feet, then he examines the heart, because all his limbs possess its vessels, that is: the heart speaks out of the vessels of every limb . . . If the heart trembles, has little power and sinks, the disease is advancing. (5)

The Papyrus Ebers, c. 1534 BC

The above texts establish beyond doubt that the ancient Egyptians believed that the heart gives rise to vessels that lead to different parts of the body, and that its motion can be felt at different peripheral sites. They recognized that the pulse is an important diagnostic sign, linked to cardiac activity. In addition, they seemed to have used the pulse to prognosticate the course of illness. The ancient Egyptians left abundant artifacts, but their hieroglyphic writing was virtually indecipherable until the Rosetta Stone was discovered in 1799 during Napoleon's conquest of Egypt. This basalt stela provided Jean-Francois Champollion with the necessary keys to decipher the language and open doors to a wider understanding of ancient Egypt.

That the ancient Egyptians were the first to describe the relationship between heartbeat and peripheral pulse is undisputed. The body of knowledge in cardiovascular anatomy and physiology of the ancient Egyptians is contained in three medical papyri: the Edwin Smith papyrus (c. 1550 BC); the Ebers papyrus (c. 1534 BC); and the Brugsch papyrus (1300 BC). They are the most ancient Egyptian medical writings, but they are dated from a later period than the Mesopotamian medical tablet. However, the Egyptian papyri are believed to be copies of a much older and lost literature, the sacred Hermetic books of the god Thoth, from a period well over 3000 BC (2)
Examining is like one counting a certain quantity with a bushel, or counting something with the fingers...like measuring the ailment of a man in order to know the action of the heart. There are canals in it [the heart] to every member: If the priests of Sekhmet or any physician put his hands or his fingers upon the head, upon the two hands, ... upon the two feet, he is measuring the heart. (5)

The Edwin Smith Papyrus, c. 1550 BC

According to Breasted, who translated the Smith papyrus, the reference to “counting with the fingers” and “measuring the heart” means counting the pulse (6). Thus, the ancient Egyptians also counted the pulse during palpation. Indeed, the Smith papyrus contains an illustration of hieroglyphic characters depicting counting of the pulse (3). In actual practice, the pulse was counted with the aid of an earthenware vessel that acted as a clock. This vessel had a tiny hole in the bottom, which allowed water to drip, drop by drop. The pulse rate was determined by correlating it with the drops of water escaping from the vessel. The markings on the side of the bowl divide the day into 24 increments, each increment representing an hour (3).

The ancient Egyptians observed and recorded important cardiovascular phenomena, for which they had no explanation. For example: they noted that when the patient fainted, the pulse could be expected to disappear; they also described the weak thready pulse, which was later associated with heart failure; and the displacement of the heart impulse on the left side of its usual position, now recognizable in retrospect as left ventricular enlargement (7). Ancient physicians also seem to have been able to detect abnormalities of the heartbeat—extrasystoles were called “forgotten beats”. “Flooding of the heart”, which the ancients attributed to excessive salivation (7), might have represented some cardiac disease that today would be interpreted as heart failure.

The medical hypothesis of ancient Egypt is extremely interesting and is contained in the Smith papyrus, in a section called The physician’s secret: knowledge of the heart’s movement and knowledge of the heart. Considering that Egyptian medicine was colored with magic and religion, the theories, though highly inaccurate, are surprisingly sophisticated for its time. They represent man’s first rational attempt to explain why illness occurs.

They regarded air as vital to life. It entered the body through the nose and traveled through the trachea directly into the heart. Air, blood, and water left the heart and traveled via a series of afferent ducts called metu to each of the body’s organs. The organs in turn contained a second set of efferent metu, which carried the organs’ respective products or increments to the surface. Thus, the Egyptians considered the metu to be indispensable to normal body function since they were the principal means for transporting blood, air, and water to nourish the various organs. Imbalances of air, blood, and water in the metu were believed to cause illness. However, they did not differentiate arteries, veins, nerves, and tendons; they were all lumped together as metu (7).

Although the disease hypotheses and empirical observations of the ancient Egyptians were unproven by experimentation, their efforts to correlate the action of food, air, and blood to explain disease have been viewed as the beginning of physiology (8).

There is substantial evidence that the ancient Egyptians appreciated that the peripheral pulses reflected the beating heart. They could palpate the pulse at several sites, but they could not know that the blood circulates, nor could they differentiate blood vessels from nerves and tendons. To the ancient Egyptians, the word “heart” was synonymous to “mind”, a peculiarity in thinking shared by other old cultures and religions such as Hebrew. They reasoned that all the senses report directly to the heart. Therefore, the heart was the seat of life and conscience, as well as of both good and evil thought.
Magic and religion permeated medical practice in ancient Egypt, nevertheless, there is ample evidence that the ancient Egyptians developed and described skills of inspection, examination, and primitive surgery, and laid the foundations for a rational approach to the practice of medicine.

**Chinese pulse lore**

*The pulse is the storehouse of the blood. When the pulse beats are long and the strokes are markedly prolonged, the constitution of the pulse is well regulated; when the pulse beats are short and without volume, the constitution of the pulse is out of order. When the pulse is quick, and contains six beats to one cycle of respiration, it indicates heart trouble; when the pulse is large, the disease becomes grave.*

Nei Ching, c. 479 – 300 BC

Western knowledge about early Chinese medicine is derived from the *Nei ching* (9), or The Yellow Emperor’s Classic of Internal Medicine, compiled between 479 and 300 BC. It takes the form of a conversation between the “golden emperor” Huang Ti, who is supposed to have lived between 2629 and 2598 BC, and his physician, Ch’i Pai. The work is considered important because it develops in a lucid and attractive way a theory of man in health and disease and a theory of medicine (10).

The study of the pulse was very important in Chinese medicine — it was the chief means of diagnosis and prognosis. “Those who wish to know the inner body feel the pulse . . . “ (9). The human body was compared to a stringed instrument, with the various pulses corresponding to the strings and tones; a skilled observer could detect harmony and dissonance.

*One should feel whether the pulse is in motion or whether it is still and one should observe attentively and with skill. One should examine the five colors and five viscera. . . One should investigate the appearance of the body whether it is flourishing or deteriorating. One should use all these five examinations and combine their results, and then one will be able to decide upon the share of life and death.*

The *Nei ching* distinguishes six different pulses in the wrist; each pulse corresponded to a specific organ, which reflected the health of that particular organ. The process of taking the pulse is complicated and the whole procedure could take many hours. The physician is advised to time the pulse with his own breathing and to note the volume, strength, weakness, regularity or interruptions of the pulse beat. A pulse could be superficial, deep, slow, and rapid. A superficial pulse is a “floating pulse” or pulses visible to the eye, whereas deep pulse feels “like a small stone at the bottom of a shallow river”.

Since pulse was made to correspond to the age, sex, and constitution of the patient, and season of the year, the physician had to keep in mind 200 pulse variations, on whose individual meanings his diagnosis, recommended course of therapy, and prognosis depended.

The *Nei ching* noted that “excess of salty flavor hardens the pulse” and may be the earliest recognition of changes in blood pressure reflected by the intensity of the pulse; it also may be the earliest reference associating salt intake with hypertension (10).

Chinese medical theory was strongly philosophical in character. Early Chinese medical philosophy was based on Tao principles, which expounded the theory that for good health two opposing, yet complementary forces, *Yin* and *Yang*, must be in harmony. *Yin* is the element of darkness or the female principle, while *Yang* is the element of light or the male principle (11).

The best time of the day for taking the pulse was considered to be the very early morning, when the physician himself was still cool and collected, and “when the breath of *Yin* has not yet
begun to stir and when the breath of Yang has not yet begun to diffuse...when vigor and energy are not yet exerted.” (9)

The Yin and Yang theory explains many idiosyncrasies of Chinese pulse-taking techniques: For a woman, her right pulses had to be taken first; for a man, his left pulses had to be examined first. The left pulses indicated diseases of men (Yang) and the right pulses indicated diseases of women (Yin). However, examination of both pulses was necessary since both Yang and Yin are represented in both sexes (9).

The multitude of qualities that each pulse could have is poetically described: smooth as a flowing stream...dead as a rock...like water dripping through the roof...like the notes of a string instrument...like wood floating on water...like fish gliding through waves (9).

The characteristics of the pulse were described by comparing them with familiar sounds and actions: “The pulse of a healthy heart should feel like continuous hammer blows.” At another place in the text it is noted: “When the pulse is small and fine, slow and short, it indicates that heart is irritable and painful...the pulse of a very sick man rushes and pants” (9).

The Chinese wrote numerous books on the technique of pulse taking and its interpretation. The Maijing or The Pulse Classic, a massive ten-volume treatise, was a compilation of all of the knowledge on the pulse since the Yellow Emperor's Classic, and describes in detail the correct method for the examination of the pulse. This treatise on the pulse has remained a key reference work throughout the centuries and is still followed in traditional Chinese medicine.

There are passages in the Nei ching concerning the movement of the blood: “All the blood is under the control of the heart” and “The blood current flows continuously in a circle and never stops.” These have been thought to indicate that the Chinese had an understanding of its circulation (2) thousands of years before the time of Ibn-Al Nafis in the Arab world or Harvey in the West. However, there is little evidence that Chinese physicians perceived the blood as a contained system.

Chinese physicians clearly appreciated the significance of the pulse and the association of changes in the pulse with disease, but they did not progress beyond manual palpation (10). Nevertheless, Chinese culture spread to its neighbors and to the west since the dawn of history. Through the Silk Route, the Chinese exported not only silk, but also theories of medicine to the Arab world and Europe.

References


---

**Collaboration with medical journals**

*The medical journal of the Islamic Republic of Iran,* National Centre for Scientific Research, Teheran, Islamic Republic of Iran, has agreed to join the mutual collaboration scheme with the EMHJ. Each party is now authorized to reproduce selected articles already published in the other journal, as deemed useful to its audience. In such cases, acknowledgement of the authors and source journal will be cited. The EMHJ welcomes this collaboration.