Four Landmarks of Egyptian Cardiology

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When Egyptian architects and sculptors were erecting the Great Pyramid and hewing the Sphinx, an unknown physician was recording his observations on a papyrus scroll of which long excerpts were reproduced in several papyri. He called his work ‘Beginning of the physician’s secret... To measure the heart in order to recognise its indications’[1].

The expression ‘to measure the heart’ has prompted many discussions but most Egyptologists agree that it means ‘counting the pulse’, although they do not agree on the way used to count it. The difficulty is that the earliest known Egyptian time-measuring instruments are the water-clocks of Tuthmose and Merneptah who reigned long after the papyri were written, and a water-clock is just too cumbersome and inaccurate to help count the pulse. An alternative suggestion was that the physician measured the pulse against his own. Whatever the means they used, the Egyptians were thus ahead of the Greeks who, 2,000 years later, never mentioned the pulse rate and, considering the title ‘The physician’s secret’, one cannot help thinking that this was one of the secrets that the Egyptians withheld from the Greek scholars who, according to the classics, frequented their schools.

The papyri tell us a lot more. They teach that the heart is located on the left side, from which it is displaced only by disease. It pours into a receptacle (the aorta) from which vessels branch to all the organs.

The pulse was carefully studied. Its relation to the heart was realised: ‘That on which every physician lays his hand’, say the papyri, ‘he feels something of the heart, for its vessels speak in every one of the limbs’. Unlike the Greeks, the Egyptians did not conceive of the pulse as a local phenomenon, but they looked at it as an intermittent rush of whatever the vessels contained for, by a confusion between them and other hollow ducts, the vessels were thought to convey the various fluids of the body (sperm, blood, tears and air) without distinction.

Especially interesting is prescription 855e of the Ebers papyrus that explains weakness of the heart; ‘... this means that the vessels of the heart speak no longer. Its information that normally appears under your hand because of the air with which the vessels are filled, is missing’. Grapow, who was responsible for this translation, commented that air was, therefore, thought to be the cause of the pulse that was called forth by its movement, a concept similar to the Greek ‘pneuma’ and the origin of the word ‘artery’, derived from the Greek ‘area’, air.

The flow of blood being appreciated, what was its fate? Was it consumed by the tissues like the Greek pneumonia or was its return realised? We do not know for certain, but a description (Ebers 855k) of ‘the heart placed in the blood of the lungs’ suggests that the relation between these two organs was understood.

It has already been said that the physicians confused the vessels with other ducts. They called them by the same name (mit). This was natural since the physicians probably learned anatomy from sacrificial animals or from the cadavers they embalmed. Thus, if the liver was said to possess four vessels containing bile and blood, these were obviously the portal vein, the common bile duct, the hepatic artery, and the inferior vena cava.

The paradox is that this error led them to the interesting notion of peccant humours that pre-figured the humoral theory. Living in a land that depends on irrigating canals for its very life, and where drought or flooding could be equally disastrous, they could not but imagine the body permeated by a network of similar ducts conveying nutrients or morbid material, the first essential to health, the second conducive to disease. This was the basis of their physiopathology[2].

Clinically, several cases of circulatory symptoms were recognised:

(a) Signs directly referable to the heart; displacement, rotation, pricks, escape, etc.
(b) Peripheral circulatory insufficiency expressed by such expressions as ‘the heart is dumb in the limbs’.
(c) Conditions due to morbid matter in the circulation.
(d) Referred cardiac pain, for example in this remarkable description of cardiac ischaemia: ‘If you examine a man for illness in his cardia, and if he suffers from pain in his arms, in his breast, and in one side of his cardia, it is death threatening him’ (Ebers 191).

Such an observation of cardiac disease causing referred pain in the arm may be at the origin of the belief in a nervous connection between the heart and the ring finger.

In the second century, Aulus Gelle wrote: ‘When one opens the human body as the Egyptians do, one finds a very thin nerve starting from the ring finger that courses to the heart where it ends’. Again, Macrobus (Saturnalia, 13, 7-10), in the fifth century AD, asserted that, because of this nerve, the Egyptian priests smear their ring finger with scented oil to anoint the god.

Some confusion must have arisen in the minds of the Greek authors because on temple walls it is the small finger of the right hand that carries the scent (Fig. 1). Its meaning is clear, however, for above this finger one often finds an ‘eye of Horus’, the symbol of every healing and beneficial thing.
The very special relationship of the ring finger to the heart as the seat of emotions is further stressed by a magical recipe of the Leyden papyrus that uses blood drawn from the left ring finger to prepare a love philter. The relationship was so familiar that in Coptic, which is the late form of the Egyptian language, the word 'heart' ended by designating this finger.

By coincidence or transmission, Chinese acupuncturists describe a cardiac point situated at the side of the tip of the ring finger.

To come back to the heart, the hieroglyph that designated it was at first drawn with vessels attached to it (Fig. 2) but, after the Third Dynasty, this sign was considerably modified and acquired the traditional shape of a heart-shaped jar. Regarded as the organic motor of the body, and the seat of intelligence, emotions and desire, theologians explained creation as being the making of the heart that conceives and of the tongue that commands.

The heart came thus to be held responsible for man’s actions. In scenes of the final judgment in the Book of the Dead[4], it was weighed against the feather of truth. The result was recorded by Thot, the scribe of the gods, standing behind the jackal-headed god of the dead, Anubis, who tested the tongue on the scales, in front of the monster Amam who stood ready to devour the damned.

Again, being the chief motor of the body, it had to be kept intact in the mummy to ensure its eternal life. If it was removed by accident, it was replaced by a stone scarab, symbolising rebirth. For added security Queen Nedjemut (Fig. 3) had one placed beside her heart although it was still in her chest, and rich people enclosed gem scarabs, set in gold, in the mummy’s wrappings over the heart.

The horrible human sacrifices and heart-snatching of the pre-Columbians were unknown in Egypt, but in some scenes of the ‘Book of Caverns’ that illustrates an important stage of Egyptian religious thinking, rows of captives...
are shown— their arms tied behind their backs, blood spurting out of their chests towards their hearts which are thrown down in front of them (Fig. 4) — and abused in these terms: ‘You, the overthrown, the bloody, whose hearts are snatched out. You, the enemies of Osiris, I deliver you to nothingness’. This may also be the theme of some proto-historic tablets that show captives extending their necks backwards and offering their chests to the sacrificer.

There was another reason for keeping the heart since, if liberated, it could turn and testify against its owner. This is why the deceased addressed the following words to the Gods in front of his pedestalled heart (Fig. 5): ‘Hail, ye who carry away hearts . . . take this heart into your grasp . . . and do not let words of evil spring up against me’. Such spells were inscribed on scarabs and hearts of stone placed over the heart.

**The Second Flowering**

After the golden age of the papyri, nothing happened for over a thousand years. But though at such distances history appears as short blossomings separated by long sterile periods, flowers cannot bloom again if the seeds of past springs are not carefully nursed during the long dry spells.

The main cause of these dark periods was the repeated havoc of wars and invasions. One of the worst destructions was ordered by the mad Cambyses who sacked Egypt and destroyed its temples in the sixth century BC.

His successor Darius was wiser and took several measures to regain the Egyptians' goodwill, one of which was the delegation of his Egyptian physician Udjahorres-
tradition and made of their city an international emporium of trade and ideas that attracted the finest scholars of the known world. Two of these shone with exceptional brilliance. These were Herophilus and Erasistratos who separated arteries from veins, differentiated arterial from venous blood, and nearly discovered the circulation.

Erasistratos was essentially a physiologist. He described the course of the blood from the liver to the vena cava and heart, reaching the lungs via the pulmonary artery, which he called the artery that resembles veins. He considered the air passages, the pulmonary vessels and the arteries as one single system carrying to the tissues air and ‘pneuma’, providing the energy necessary to life, and he imagined communicating channels bridging arteries and veins, the synanastomoses that foreshadowed our capillaries.

On the other hand, Herophilus was an anatomist of distinction who, centuries later, was judged by Fallopius in these terms: ‘Quando Galenum refutat Herophilitin censo tspum refutare Evangelim’. (When Galen refutes Herophilus I feel that he refutes the Gospel itself.)

Herophilus was the first to name what we call the pulmonary artery the ‘arterial vein’, because it carried venous blood but had the thickness of arteries. He questioned the hepatic origin of veins. He showed that the auricles were part of the heart, not of the vein. He was the first to describe the chyliferous vessels, stating that, unlike the mesenteric veins, they did not end in the liver. In particular, he recognised the motor role of the heart in the causation of the pulse, of which he studied the rate and rhythm in his lost ‘Manual of the Pulse’.

It is difficult to tell how deeply these two scientists might have been inspired by stray copies of the Pharaonic ‘Beginning of the Physician’s Secret’ or of other papyri kept in the libraries of Alexandria and Memphis for, according to Galen, Greek physicians still studied there in the second century AD. But some notions seem curiously common to the Alexandrian and Pharaonic physicians: the relationship of the heart to the pulse, the notion of pulse rate and its importance in diagnosis, and the concept of healthy and morbid circulating matter of different kinds.

There is no doubt, however, that this remarkable renaissance of the Greek miracle in Alexandria was ignited by the impact of Greek logic on the mixture of mysticism and empiricism that characterised Egyptian thought, and was kindled by the free intellectual atmosphere reigning in Alexandria, where scientists found enlightened rulers, a library of over 700,000 volumes, flourishing schools in nearby Memphis and Sais, and a public opinion that accepted human dissections and, some even say, vivisections.

The syncretism went deep and far. In distant Nubia, a church built in an old temple beautifully illustrates it. Pharaoh is seen on its walls worshipping, not the old gods, but St Peter re-painted over the old image.

Nearly 13 centuries passed, dominated by the oppressive figure of Galen. Then in thirteenth-century Cairo, Ibn al-Nafis wrote a Commentary on the Anatomy of Avicenna (Fig. 6) in which he flatly refuted Galen and Avicenna on several points. The riddle of Ibn al-Nafis is whether he performed any dissections. Otherwise, in spite of his denials, how could he assert that the blood runs from the right to the left ventricle through the lungs and not through the septal pores that Galen imagined and that Leonardo da Vinci, four centuries later, faithfully drew and described in the reversed hand-writing that remained enigmatic for centuries.

How could he deny the existence of three ventricles asserted by Aristotle and Avicenna? How could he oppose the view that the heart is nourished by a sediment left by the blood in the right ventricle, and declare that the heart obtains its nourishment from the blood that runs in its substance? As far as I know, this was the first description of the coronary circulation, and it was written long before Harvey, who is commonly thought to be the author of this discovery.

Finally, his statement that the walls of the pulmonary veins are thin to facilitate the reception of what comes out of the pulmonary artery through perceptible pores between the two, was the nearest he could get to the capillary circulation before the discovery of the microscope and the description of the capillary circulation by Malpighi. It completed his theory of the lesser circulation.

Fig. 6. Manuscript of Ibn al-Nafis describing the lesser circulation, in Bibliotheque Nationale, Paris, Fonds arabe. No. 2939. f. 95r. (Courtesy of Dr Shehade.)
Any connection between Ibn al-Nafis and Harvey’s *De motu cordis* is usually denied. That this may not be entirely true is suggested by the following considerations (Table 1).

Table 1. Possible connection between Ibn al-Nafis and Harvey.

| Year   | Event                                                                 |
|--------|----------------------------------------------------------------------|
| 1288   | Death of Ibn al-Nafis                                                 |
| Until  | Arab commentaries on Ibn al-Nafis                                     |
| 1547   | Andrea Alpago translates part of Ibn al-Nafis’s ‘Commentary’          |
| 1553   | Miguel Servetus *Christianismi Restitutio*                            |
| 1559   | Andrea Cesalpino *Questionum peripateticarum*                        |
| 1597-1602 | William Harvey in Padua, where his teacher Fabrizio (1537-1619) defined the role of the venous valves in *De venarum ostiolis* |
| 1616   | Harvey lectures on the circulation of *De motu cordis*                |
| 1628   |                                                                      |

Proof has recently been adduced by Iskandar[5] that, from the death of Ibn al-Nafis in 1288, right to the seventeenth century, around the date of the publication of *De motu cordis* the views of Ibn al-Nafis were widely publicised, almost word for word, in several well-known Arabic treatises at least one of which is in the Paris Bibliothèque Nationale (Fig. 6).

Then, in the first half of the sixteenth century, the Italian physician Andrea Alpago, who had spent several years in the Arab world to study the Arabic language and Arabian medicine, translated into Latin the Commentary on the Canon of Ibn al-Nafis. In fact, Arabic seems to have been more widely known than is usually thought, since Jalili[6] reports that Vesalius translated Rhazes from Arabic.

The known translation, which appeared in Venice in 1547, does not contain the fragments concerned with the circulation, but it is reasonable to presume that Alpago was aware of the rest of the work and of the numerous commentaries that had been devoted to it.

Only six years after Alpago’s translation, on 29th September 1553, Miguel Servetus, in contrast to the fate of Ibn al-Nafis, who was highly praised for his science, was burnt at the stake by Calvin for asserting in his *Christianismi Restitutio* the same facts that Ibn al-Nafis had established.

In 1559, six years after the tragedy of Servetus, Realdo of Padua restated the same facts in *De re anatomic*, at the same time clearly describing the function of the cardiac and aortic valves.

Some twelve years later his pupil Andrea Cesalpino repeated the same assertions in his *Quaestionum peripateticarum* and used for the first time the term circulation, i.e. circular motion, in connection with the movement of the blood, describing experiments with vein ligatures similar to those which his pupil Harvey carried out later.

From 1597 to 1602, Harvey studied in Padua, where all this movement was going on and where his teacher Fabrizio (1537-1619) was defining the role of the venous valves, which he made known in *De venarum ostiolis*.

A few years after his return to England, Harvey was appointed Lumleian Lecturer. Having repeated the Paduans’ experiments and added a few of his own, he brilliantly expounded in 1616 the theory of the general circulation, of which he gave a full account in 1628 in *De motu cordis*.

It is not belittling Harvey’s monumental contribution to knowledge to point out his predecessors. The glory of uniting into one majestic stream all the rivulets that the Egyptians, Alexandrians, Arabs, and Italians had opened, and of giving a complete description of the systemic as well as the pulmonary circulation in an integrated whole undoubtedly fell to Harvey. It does not in the least diminish his merit to recognize what he could have owed his teachers and precursors, among whom one should probably place the forgotten Ibn al-Nafis, the two Alexandrians, and the unknown writer of the ‘Beginning of the Physician’s Secret’.

Three centuries of darkness then cast their shadow on Egyptian medicine until, in the 1930s, Azmy Pasha and Sayed Elfat described the dilatation of the pulmonary artery caused by bilharziasis of the lung. This discovery had been foreshadowed by a forgotten observation of Dr Abbate Pasha who, in 1883, described what he called ‘asymmetry of the heart’ in Egyptian peasants[7], though he did not realise its significance. The rest is recent history. It led to the brilliant researches of the Cairo and Alexandria schools on the mechanics of this serious disease.

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