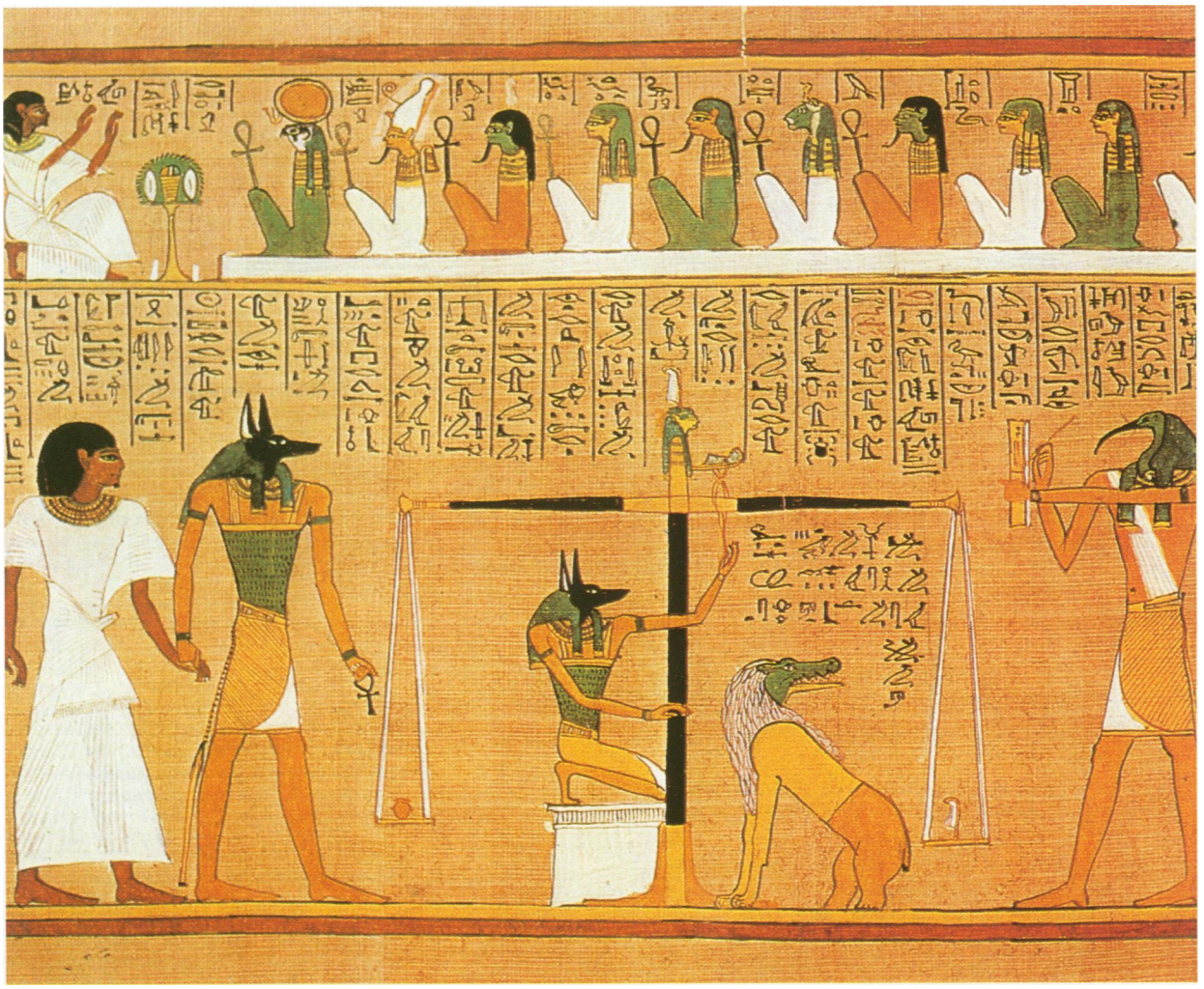

Fig. 1 *Scene from the 19th Dynasty (1307-1196 BC) Book of the Dead papyrus of Hunefer (London, British Museum), showing the deceased led in by Anubis, and his heart weighed against a feather. A second figure of Anubis checks the balance, while the "Eater" stands ready and Thoth records the result. In the small register above, Hunefer (the deceased) adores a group of deities.*

From Baines J, Málek J. Atlas of ancient Egypt. New York: Facts on File, 1982. Used with permission.

Historical Perspectives

Cardiology in Ancient Egypt

Eugene V. Boisaubin, MD

For almost 3,000 years, the dynasties of ancient Egypt wielded power and influence over the Middle East and eastern Mediterranean. Although the earliest roots of Western medicine lie in Mesopotamia, the Egyptians nurtured and enlarged the art of healing with great national fervor and pride. Egyptian physicians were respected and consulted throughout the ancient world. The ancient Greeks, for example, frequently acknowledged their debt to Egypt's physicians: it was said in Greece that to have studied medicine in Egypt was the highest credential a physician could present (Pliny the Elder XXIX, 1).

Even prehistoric man understood that all animal life depended upon a pulsating heart. Perhaps for this reason, there was a tendency to attribute to the heart powers and purposes it did not have. To the ancient Egyptian, the heart was the center of thought, emotion, and all other nervous function—an organ of such importance that it was thought necessary to salvation after death, and was left in the body at the time of mummification to ensure its availability at judgment and during the afterlife.

The heart was thought capable of recording all the good and evil acts performed by a human being during life. At the time of judgment, the heart was weighed on a scale against a feather (Fig. 1). A virtuous heart would prove light, winning its possessor eternal salvation, while a sinful heart would prove heavy and be cast to the crocodiles of the Nile, forever damning its owner.[1]

Recorded Egyptian history begins with the Old Kingdom, around 3000 BC. Unfortunately, the earliest extant major medical papyrus (the Kahun papyrus) dates from approximately 1900 BC. The remaining extant medical papyri, all written over the following 800 years, add up to fewer than 200 pages of text when translated and printed. Their content resembles a catalog more than a traditional book, comprising short paragraphs that describe prescriptions, spells, or diagnoses. The Ebers papyrus,[2] at more than 100 pages the longest intact papyrus, contains the greatest amount of material relating to internal medicine, including a "treatise" on the heart and vessels.

The Practitioners

Since religion, magic, and (to a lesser degree) science, coalesced in the world of ancient medicine, there were both clerical and lay "healers." The priest-physicians, or *wabw* (probably pronounced "waboo"), ranked first in the hierarchy of healers. Often temple-based, these practitioners learned some rational medicine in addition to mysticism, but their education was largely secret, and conveyed orally. Most medical care, in any event, was provided by lay physicians or *swnw* (probably pronounced "soonoo") (Fig. 2). Details of their practice are incomplete, but there is evidence that they were controlled and even salaried by the State. Part of their education was carried out in the "Houses of Life" attached to temples, and most *swnw* became literate enough to master the art of the scribe. Surprisingly, medical specialization was quite elaborate, founded as it was upon distinctions both between body parts and governmental spheres of service: There is evidence, for example, that special physicians served the court and army; and numerous anatomical specialties have been identified, including ones for the eyes, teeth, belly,

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anus, and "inner liquids."[3] Cardiology, however, was not listed as a specialty, and likely was practiced by a variety of healers.

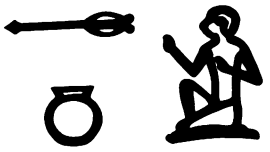

Fig. 2 *These three elements together are the hieroglyphic for* swnw, *or physician.*

From Majno G. The healing hand: man and wound in the ancient world. Cambridge, Mass: Harvard University Press, 1975. Used with permission.

Knowledge of Anatomy and Physiology

The ancient Egyptians' knowledge of correct cardiovascular anatomy and physiology was limited, partly through their failure to perform visceral surgery, autopsy (as we know it today), or anatomical dissection of human beings for exploratory or instructional purposes. Several alternative sources of anatomical knowledge were available, however. Although physicians did not themselves perform embalming, they often were witnesses to the process, and were well aware of the appearance of the organs removed, and of the organs' positions in relationship to one another. Moreover, wounds were examined meticulously, and associated functional impairments were described, as seen in surviving surgical papyri. Finally, because veterinary medicine was practiced widely, the study of animal anatomy was extensive.[4]

Contemporary writings and drawings suggest that ancient Egyptians understood the general relationship of the heart to both the lungs and the abdominal viscera. They also understood the heart to be the center of the vascular system, whereas Hippocrates, a thousand years later, still argued that the veins originated in the liver. The heart was assumed to be connected with many other organs and to receive water and air from vessels through a "receiver" (possibly the aorta). One ancient reference describes the heart as "placed in the blood of the lungs,"[5] which suggests some knowledge of the physiologic relationship between these two key organs. It is uncertain whether the Egyptians believed that the blood was lost in tissues after being pumped by the vessels, a concept that persisted until the time of Harvey.

The vascular system itself was described: "There are vessels [*metu*; probably pronounced "metoo"] going to every limb . . . [those] on which every physician, every priest . . . puts his finger. . . ."[6] But the anatomic and physiologic details of these vessels were misconceived: they were thought capable of carrying air, water, saliva, tears, urine, and fecal material, all of which emptied into the various body organs (Fig. 3). Again through a failure to perform anatomic dissection, ancient man commonly confused arteries not only with veins, but also with major nerves, tendons, and even conduits such as ureters. Flow through these channels was not understood to occur by pulsation; rather, it was believed that substances conveyed by these vessels ebbed and flowed like the Nile that provided life to the land. This analogy was carried still farther: parts of the body could suffer "drought" or "flood," analogous to later concepts of ischemia and plethora. Air entering through the nose was thought to mix with these fluids, a belief that anticipated our concept of oxygenation.

The vessels of the body were also thought to conduct disease, since illness, either physical or mental, was believed to enter through body orifices, and to travel through the *metw* to the affected organ.

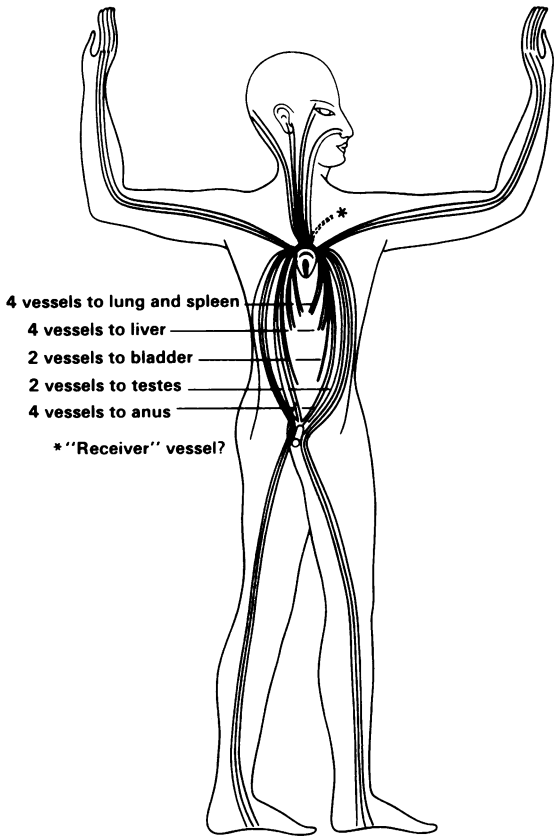

Fig. 3 *A modern-day "informed guess about the vascular system as the Egyptians saw it." The asterisk indicates the "receiver vessel" (possibly the aorta), and each of the lines represents a vessel. All vessels originated in the heart, and had a second assembly center around the anus.*

Adapted from Majno G. The healing hand: man and wound in the ancient world. Cambridge, Mass: Harvard University Press, 1975. Used with permission.

If the disease were to be countered successfully, it would have to be expelled through an orifice as well.[4]

Although the *metw* were believed to be centered around the heart, they were thought to have a second collecting point around the anus. Logic seemed to dictate that feces were the result of organic decay; and because decay was the result of death, one had to avoid decay in the system. Decay could also give rise to *ukhedu* (a serious malady analogous to sepsis), which had its origin in the anus and flowed through the *metw*, spreading systemically in such a manner that it affected even the heart. Keeping the anus clean, through frequent use of purgatives, prevented stasis, decay, and *ukhedu*.[7] Although the ebbing and flowing of fluids through the *metw* would seem to be a harbinger of the important humoral theory of disease, none of the known Egyptian literature comments on the broader implications of the concept.

Assessment and Treatment of Cardiovascular Disease

Taking an accurate history of the patient was an essential component of Egyptian medicine. The physician's lack of anatomic and physiologic sophistication limited the breadth of questioning; but over time, observations that certain events presaged other events gave a reasonable foundation for inquiry. Symptoms such as palpitation, dyspnea, and pain were commonly pursued. Although William Heberden the elder is traditionally given credit for first describing angina pectoris, the Egyptians anticipated him by 4,000 years with a classic and dramatic description of coronary ischemia: "if thou examinest a man for illness in his cardia and he has pains in his arms, and in his breast and in one side of his cardia . . . it is death threatening him."[8] The classic pattern of cardiac pain—radiation to the left arm—was so well known that the ancient Egyptians and Copts even identified the left ring finger as the "heart" finger.

Following completion of the medical history, a fairly rigorous, organized physical examination was performed. The physician focused first upon observation, particularly of the complexion, as well as upon secretions, pigmentation changes, mental alertness, and general nutritional status. For patients with cardiac conditions, palpation and percussion were extremely important. Texts informed the physician of the points at which the pulse could be taken, including the carotids, the occipital, and the peripheral arteries, and the apex of the heart. A treatise on the heart and its "movements" reminds the physician that "there are vessels from it [the heart] to every limb . . . all his limbs possess its vessels, that is, it speaks out of the vessels. . . ."[9] Some Egyptian physicians must have perceived that the pulse originates in the heart, because a description of an arterial aneurysm mentions that stopping blood flow to the aneurysm stops intrinsic pulsation. Accurate timepieces were not available for precise measurement of heart rate, but the physician probably compared the patient's pulse rate to his own, and noted variations. Fluctuations in cardiac rhythm were called "heart dancing," "escape," or "forgetfulness."

Altogether, ancient Egyptians were aware of a variety of abnormal cardiac conditions, particularly of angina pectoris and sudden death, arrhythmia, aneurysm, congestive heart failure, and venous insufficiency. Numerous remedies for afflictions of the heart are found throughout the Ebers papyrus.[2] The simplest consisted of milk, honey, and water. If this failed to produce the desired effect, one proceeded to a stronger mixture of onions, sweet beer, and date meal. For "fever-in-the-heart," the blossoms of a cucumber were used, or the cucumber itself was mashed into a drink with honey, dates, dough, and water. For a particularly refractory case, a remedy to heal the heart "for certain" was given: a mixture consisting of 1/8th part figs, 1/16th part fresh lead-earth, 1/32nd part cake, and 5/6ths part water.[10] Although it is doubtful that these particular concoctions had demonstrable benefit, it is likely that they did no harm. Other prescriptions, however, do seem particularly noxious, and might have caused a patient to consider whether he would prefer chest pain to a combination, for example, of fat flesh, incense, garlic, and writing fluid. Magical spells and incantations were often used in lieu of dietary or medicinal intervention, and physicians were cautioned when not to intervene with other therapy. Aneurysms, for example, were not to be approached surgically, but only through incantation. Specific drugs were used to "speed the flow" of urine, but it is not known if these were prescribed for cardiac or edematous conditions. Since nearly 700 drugs filled the ancient Egyptian pharmacopoeia, some of them must have had specific application to cardiovascular conditions; but treatments remain uncertain. Surprisingly, the concept of flooding, or plethora, did not lead to logical treatment of the condition through bloodletting, which was to become a widespread practice in later millennia.

Although physicians in ancient Egypt faced limited therapeutic options, the papyri suggest they practiced in an extremely caring and supportive fashion. Patients and their disorders were not to be ridiculed, and dying patients were to be treated with great compassion. The ultimate admonition was emphasized through frequent repetition: "Do not abandon him."[11]

Incidence of Cardiovascular Disease

In study of the ancient world, determination of the incidence of a disease in any given population and period is largely speculative. Recorded observations are often inaccurate or fragmentary, and pathologic material is often scarce and damaged by decomposition. However, in the case of ancient Egypt, considerable anatomic material of importance has been preserved as a consequence both of purposeful mummification[12] and, more especially, of a hot, dry climate that often promoted desiccation of soft tissue. Modern histopathology employs sophisticated techniques that make possible the electron-microscopic study of 3,000-year-old material (even red-blood-cell morphology[13]), through gradual rehydration, sectioning, staining, and further preparation.

Extensive histologic analysis of mummies began, however, well before the development of the scanning electron microscope. In 1912, Shattock[14] made sections of the calcified aorta of Pharaoh Merneptah; and the work of Sir Marc Armand Ruffer,[15] published posthumously in 1921, is our most valuable early source of information about vascular disease in ancient Egyptians. Ruffer was able to study a relatively large number of tissue specimens from mummies, mainly from New Kingdom (1600-1100 BC) burials, but covering a wide period of time. In a mummy of the 28th to 30th Dynasty (404-343 BC), he observed atheromas in the common carotids and calcific atheromas in the left subclavian, common iliac, and more peripheral arteries. Ruffer concluded from the state of the costal cartilage that this mummy was not that of an old person. A mummy of a man of the Greek period (ca. 300 to 30 BC), who died at not over 50 years of age, showed atheromas of the aorta and brachial arteries. Since the discoveries of Ruffer, numerous other mummies, whose ages at death ranged from the 4th to the 8th decade, have shown similar vascular changes (Fig. 4).

In 1931, Long[16] described a female mummy of the 21st Dynasty (1070-945 BC), found at Deir-el-Bahari—that of the lady Teye, who died at about 50 years of age. The heart showed calcification of one mitral cusp, and thickening and calcification of the coronary arteries. The myocardium is said to have had patchy fibrosis, and the aorta "nodular arteriosclerosis." The renal capsule was thickened, many of the glomeruli were fibrosed, and the medium-sized renal vessels were sclerotic. The condition appears to be that of hypertensive arteriosclerotic disease associated with atheromatous change. In the 1960s, Sandison[17] examined and photographed mummy arteries using modern histologic methods (Fig. 5). Arteries in the mummy tissues were described as tape-like, but could be dissected easily, whereupon arteriosclerosis, atheroma with lipid depositions, reduplication of the internal elastic lamina, and medial calcification were readily visible under microscopy.

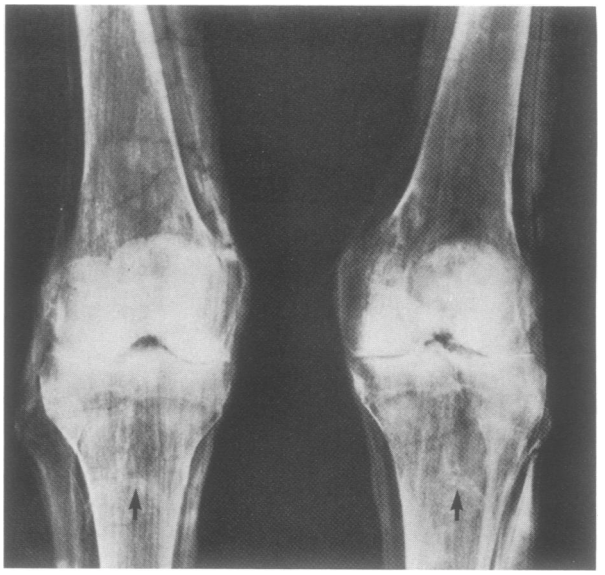

Fig. 4 *Radiograph showing anterior aspect of the knees of Ramesses II. Note calcification of the popliteal arteries at their bifurcation (arrows).*

From Whitehouse WM. Radiologic findings in the royal mummies. In: Harris JE, Wente EF, eds. An x-ray atlas of the royal mummies. Chicago: University of Chicago Press, 1980. Used with permission.

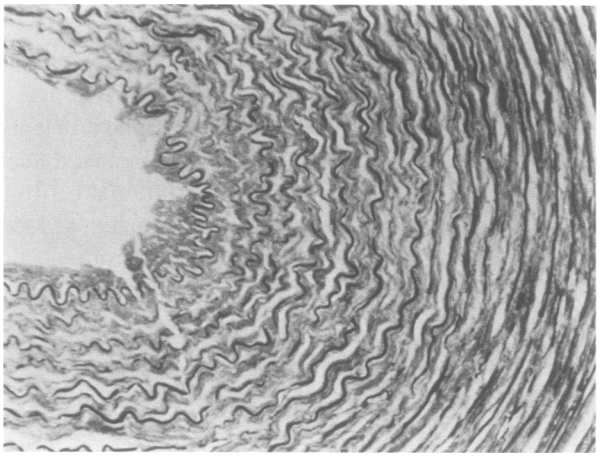

Fig. 5 *Carotid artery of a male mummy showing fibrosis. Verhoeff-van Gieson stain.*

From Sandison AT. Diseases in ancient Egypt. In: Cockburn A, Cockburn E., eds. Mummies, disease, and ancient cultures. Cambridge: Cambridge University Press, 1980. Used with permission.

Still more recently, one of the most extensively studied Egyptian mummies has been PUM II from the Pennsylvania University Museum (hence its initials),

now on loan to the National Museum of Natural History at the Smithsonian. It is believed to be from the later Ptolemaic period, circa 170 BC. The heart and portions of an atherosclerotic aorta were found in the abdominal cavity. Histologically, large and small arterioles and arteries from other organs showed areas of intimal fibrous thickening typical of sclerosis. These findings are particularly striking since the estimated age of PUM II at time of death was between 35 and 40 years.[18]

Conclusions

Evidence suggests that a variety of cardiovascular diseases existed in ancient Egypt, and that many of these were recognized and treated, albeit naively. This finding would seem to call into question the periodic assertions that atheromatous cardiovascular disease is a consequence of "modern" times and lifestyles. If current theories on the genesis of atheromatous disease are valid, a comparison of ancient and modern risk factors is appropriate. Smoking, as we know it, was not practiced by the Egyptians of antiquity; however, ancient lung specimens do show evidence of both silica and carbon deposition, possibly from sand and oil lamps, respectively. Hypertension has not been detected directly, but its presence can be inferred from associated organ damage. Lipid disorders cannot be measured; but premature atheromatous disease and obesity occurred, and cholesterol-rich foods (i.e., beef, pork, and eggs) were plentiful for the upper classes—the group that usually was embalmed. The diet of the lower classes was primarily vegetarian, so theoretically the prevalence of atheromatous disease should have been lower at the bottom of the social and economic scale. Unfortunately, well preserved bodies of poorer Egyptians are too few to permit comparison.

Have the basic causes of cardiovascular disease been the same throughout the last 5,000 years? The study of limited human remains and of the written descriptions outlined here suggests many identical conditions. Unfortunately, the study of ancient medicine is more typified by void than by known truth. Aside from fragmented papyri and a few other commentaries, the record of more than one thousand years of Egyptian medical practice is unavailable for analysis. Part of this void can be explained by the fact that the teaching and practice of medicine in those times was communicated largely through an oral, rather than written, tradition. Although more mummies and archaeologic sites will be studied, it is doubtful that additional major records await discovery.

Despite these large gaps in our knowledge, we can be certain that the ancient Egyptians' contribution to the evolution of Western medicine was substantial. Their skills in history-taking, observation, physical examination, clinical diagnosis, and surgery presaged developments millennia later. And although their young science was often mixed with witchcraft and mythology, it represented a major step from superstition to the scientific foundations of Greek and Roman medicine, and beyond.

It seems fitting to leave the world of the ancient Egyptian with a cardiovascular salutation recited in hailing the dead:[19]

> May his *metw* flourish.
> May his *metw* be sound.
> May his *metw* be excellent.
> May his *metw* be comfortable.

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