The ancient Egyptians laid the foundation for the development of the earliest recorded systems of medical treatment. Many specialties such as gynecology, neurosurgery, ophthalmology, and chest disorders were subject to diagnosis, which were followed by an appropriate treatment. Here, we elucidate the remarkable level of their knowledge and understanding of anatomy and physiology in the field of chest medicine. Furthermore, we look at how ancient Egyptian physicians came to a diagnosis and treatment based on the thoracic cases in the Edwin Smith papyrus.

Evidence of Advanced Knowledge

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The autonomy of the ancient Egyptians ensured a freedom from foreign intrusions that favored the development of medical advances. The invention of writing and papyrus paper provided the basis for propagating medical practice. For a culture achieving enormous feats such as the erection of pyramids, together with having a high level of inventive and technical skills that characterized this nation, it is not surprising that this era of old Egyptian culture contributed significantly to the early development of medicine.

The papyri that contain the medical practice and knowledge are comprehensively summarized in the volumes of the Grundriss der Medizin der alten Ägypter.1,2 They belong to a series of important and conclusive reports dealing with different medical specialties such as gynecology (Kahun),3,4 rectal diseases (Chester Beatty),5 ophthalmology (Ramesseum),6 neurology,7 and general medical diseases (Ebers).8 Among these, the Edwin Smith papyrus is considered the most important medical papyrus, pertaining to the medical and surgical aspects of wounds and injuries.9 It provides insights into how doctors recognized symptoms, came to a diagnosis and finally proposed a treatment. It is unique in its approach to disease in that it gives a “hands-on” guide rather than providing a simple description of remedies. The content of this papyrus consists of a precise and thorough delineation of the patient examination, how to make the diagnosis and to provide suggestions for the treatment.

THE UNDERSTANDING OF THE ANATOMY AND PHYSIOLOGY OF THE LUNG

There is ample evidence that parts of the body were anatomically studied in detail.10 In particular, passages from the Edwin Smith papyrus offer remarkable insights into the knowledge of external anatomy. Embalmers were privileged in gaining anatomical structures of internal organs. They developed a great technical expertise from removing those internal organs when mummifying the human body. After preservation, they transferred the internal organs into canopic jars. In contrast to the heart, which was carefully retained in place, the lung was removed and deposited into such a canopic jar under the protection of the God Hapy, one of the sons of Horus.

According to Gardiner’s sign list,11 the lung and trachea together are provided with their own hieroglyph (Figs. 1A–C). This miniature portrait acts as a trilateral (sma), meaning “unite.” When carefully observing the configuration of this hieroglyph, the 2 sides at the lower end of the symbol resemble the right and left sides of the lung whereas the trachea might be represented by the upper part of the sign (Fig. 1A). This theory could be supported by the observation that the hieroglyph symbol of the heart reflects the anatomy of vessels in which the blood flow leaves the organ or drains into it (Fig. 2). Thus, it seems that the understanding of this physiological arrangement was already recognized at that time.

In conjunction with the sign for lung and trachea (sma; Fig. 1D), a piece of flesh was often added which served to differentiate this from homophones with different meanings (Fig. 1C). From the Ebers papyrus we know that the importance of breathing was acknowledged as the breath of life (Figs. 3A–C). The understanding of the cardiorespiratory function was that the air was inspired into the lung, transmitted to the heart, and circulated into the periphery, where it gave rise to the peripheral pulses. There was also evidence that the peripheral pulses arose from the heartbeat. Yet, almost throughout the entire pharaonic period, it was believed that arteries contained air instead of blood. Vivisection could have helped to clarify this error, but sectioning on living subjects was not allowed to be performed under the Egyptian pharaohs. The knowledge about the human body relied exclusively on cadaver dissection. The misconception that arteries contain air arose, because after death pronounced contraction of vessels occurs and scarcely any blood remains post mortem within arteries. When opened, arteries then gave the impression that they contained air. Presumably, palpable pulses were interpreted as the somewhat beneficial effect of the inspired air, transmitted to the periphery by the heart. In case 34 of the Smith Papyrus, it is mentioned that 2 “vessels” (metu) run down on the right and left sides of the throat, leading to the lung.2 It is possible that the dividing trachea into the 2 bronchi was meant but it could also be interpreted that both jugular veins drain the blood into the heart.

FROM THE EDWIN SMITH PAPYRUS

The Edwin Smith surgical papyrus is almost unique in its excellent description of the conditions before proceeding to treatment.9,10 This papyrus is dated from the onset of the New Kingdom, the 18th Dynasty (1550–1295 BC), and is considered the most important medical papyrus. It was offered for sale in 1862 by Mustafa Agha, an Egyptian merchant in Luxor. Edwin Smith, the first American Egyptologist, who resided in Luxor (Thebes) between 1858 and 1876, recognized the significance of the papyrus in terms of its surgical nature. However, the date of this transcript differed significantly from the time the medical knowledge itself was gained because this knowledge dates back to the old kingdom (2650–2150 BC). All cases in the papyrus are individually described in a consistent order matched by a systematic progression focusing on the upper part of the body. They comprise in total 48 cases, starting with...
FIGURE 1. This hieroglyph represents the trachea and most likely the right and left lungs attached at the lower part of the symbol (A). The falcon representing the god Horus was thought to protect the lung within the canopic jars (B), and the symbol of a piece of flesh was often added to distinguish between homophones with different meanings (C). The word sma is presented in (D) and means “to unite.”

FIGURE 2. The hieroglyphic symbol of the heart reveals some impressive similarities to human anatomy. Although the origin of the drainage was not clearly differentiated between esophagus, jugular veins or air (trachea), the upper part is suggestive as being the influx draining part whereas the protrusion at each side could represent the right and the left pulmonary arteries.

FIGURE 3. Different representations of breath and air: pronunciation (A), transliteration (B), and hieroglyph (C).

FIGURE 4. Anatomical location of injuries and diseases that are described in the cases of the Edwin Smith papyrus with the respective numbers, adapted from Nunn. Figure 4 was obtained and adapted from "By Sinuhe20 (Own work) [CC-BY-SA-3.0 (www.creativecommons.org/licenses/by-sa/3.0) or GFDL (www.gnu.org/copyleft/fdl.html)], via Wikimedia Commons".

injuries of the head (cases 1–27), of the neck (cases 28–33), of the collar bone and upper arm (cases 34–38), and of the chest and thorax (cases 39–46), the last of which we are focusing on (Fig. 4), and include 2 additional cases dealing with a disease of the armpit (case 47), and of the back (case 48). Each case is presented in 4 clearly differentiated sections to obtain a reliable diagnosis by thorough investigation, resulting in an appropriate treatment and a statement of the prognosis. These parts essentially resemble the diagnostic and treatment approaches that are currently applied in general medicine. Egyptian doctors mainly came to a diagnosis by observing the patient rather than taking the history from the patient by interviewing him. Even so, the surgical cases recorded suggest that the examiner comes to a reliable diagnosis. All steps toward making the diagnosis are focused on anatomy and physiology using popular, easily understandable terms rather than medical language, largely incomprehensible to ordinary people. It is a remarkable sign of the progress of this period that almost no references to magic elements occur; the recorded findings were highly empiric, resulting from the systematic investigation of a large number of patients. Patients who were cured were obliged to visit the temples to describe the symptoms of their disease and the methods used in their treatment. This unique requirement additionally contributed to the advanced level of rationale medicine.

The cases begin with a concise and informative title such as “information about a wound on his breast.” The examination invariably starts with the phrase “if you examine a man having . . . .” This section sometimes includes and even anticipates parts of the treatment as it is expressed for example by case 40. The diagnosis section, summarizing the findings then starts with the words “you shall then say concerning him . . . .” This phrase is followed by a statement about the treatment and also a comment for the prognosis, as it is mentioned for example in case 42. In contrast, when there is no chance of a cure for the patient, the following formula is chosen (case 44): “A disease that cannot be treated.”

CHEST WOUNDS AND THEIR TREATMENT

Injuries and the resulting possible disorders to the chest were described as essentially caused by violence. The description of case 39 clearly demonstrates that the physician used his hands to carefully investigate the diseased area of the patient. He finds the characteristic signs of inflammation after blunt trauma to the chest: elevation of the body surface, forming of pus, redness, and heat within the damaged area. The word “hervorgebracht” (=originated) that is mentioned in this context suggests that the pus was understood as having resulted from wound inflammation rather than as a direct effect of the injury. As he concluded that the pus was the result of the injury, treatment was performed with a “firedriller” to release and successfully evacuate the pus. In contrast, the necessity to treat inflamed tissue with the opposite, by means of cooling, clearly indicates that the knowledge
about the efficacy of the principle of “antipathy” (cold ↔ warm, white ↔ black) was well known and appreciated. Case 41 describes in greater detail how the heat should be drawn out of the wound by applying cooling. The infection of potentially chronic wounds found on the patient’s breast that do not show the tendency to heal, were recognized as a cause for the development of fever, the generalization of the infectious state. These “wounds” were considered to be anomalies that also meant that the prognosis for complete healing for this anomaly was poor. It might be that it was considered an anomaly in the sense of a malignancy that becomes inflamed and does not easily heal by itself. This hypothesis is supported by a phrase in case 39 where the author states that a wound opens by itself because of the benign character of the lesion. In contrast, malignant lesions or also chronic ulcers tend to become chronic wounds thus making a definitive and spontaneous closure of the wound unlikely.

According to the state of a wound, careful selection of the appropriate therapy was made. Physical treatment often followed a logical concept. Fresh wounds required the application of fresh material directly to the wound. The idea to treat and eventually heal injured tissue by applying fresh meat could be interpreted as a first step toward the concept found in reconstructive surgery whereby muscle flaps are used to replace larger defects at different sites of the body with the intention to treat and heal the wound. Apart from applying agents such as oil and fat, honey was widely used as an effective therapeutic adjunct. Honey was recognized for its anti-inflammatory and anti-infective (bactericide) properties. Even deep wounds that reached to the manubrium sterni perforating the manubrium bone were considered to be treatable with oil, fat, and honey (case 40). The chronically inflamed wound was treated differently, using ochre leaves, powdered malachite to dry the wound, or powdered poppy. It is not known whether the analgesic effect of poppy was recognized at that time.

Case 45 deals with an ulcer that shows a ball-like form. There are no signs of localized nor generalized signs of inflammation such as fever. Presumably, some kind of malignancy is involved in the described disease. Here, the physician is not sure about the definitive treatment nor can he state that he will be able to cure this patient. This is expressed by the phrase “an illness that I will fight with,” meaning that he is willing to try hard to treat it, but cannot make a statement about the definitive prognosis. In contrast, in case 42, it is stated “an illness I will treat” as the physician can almost guarantee that this treatment nor can he state that he will be able to cure this patient. This phenomenon could be what is meant at the end of case 43, though the wound of the ventral neck was recommended to be sutured. This is supported by a phrase in case 39 where the author states that a wound opens by itself because of the benign character of the lesion. In contrast, malignant lesions or also chronic ulcers tend to become chronic wounds thus making a definitive and spontaneous closure of the wound unlikely.

The principle of evacuation of the content of a thoracic wound, even if the wound contains clear fluid such as water, was well recognized as in case 46. This indicated that application of cooling media to the wound was not recommended unless all fluid contents of the wound have been evacuated. This principle is in line with the therapeutic steps that are generally applied today, as wounds with signs of inflammation should be cooled in parallel with evacuation of fluids. Even so, evacuation of the wound on itself should be the prerequisite for a successful therapy.

Case 28 describes a wound on the ventral part of the neck, obviously reaching into the trachea. There was water coming out of the wound after the patient drank some fluid. Although the term “tube of the neck” was well known anatomically to be the trachea, it remains uncertain if the trachea or the esophagus is meant in this context. Egyptian doctors thought that both organs were united not only anatomically but also with regard to their function, leading the content of these structures into the heart to be further processed. The water coming out of the wound could have derived from a defect in the esophagus but also from a defect in the trachea as in both cases the patient would refuse to swallow. The distinction between trachea and esophagus, lung and stomach was often unclear. As mentioned in the Ebers papyrus, no clear differentiation could be made when a patient had suppurations, possibly resulting from bronchiectasis, but this symptom could also be related to vomiting. Remarkably, the wound of the ventral neck was recommended to be sutured. This is surprising as suturing was rarely mentioned as a technique applied in the context of neck and thoracic wounds. Instead, the bandaging of wound “lips” to bring them into contact is mentioned frequently. Direct surgical interventions were considered to be very uncommon as there were almost no scars found on 30,000 ancient Egyptian human bodies examined.13

TRAUMA OF THE CHEST

Egyptian physicians were able to differentiate between a strain, a luxation (dislocation) and a fracturing of ribs. The anatomical compartment of a rib was well recognized (Fig. 5) and in conjunction with the sternum it was called “porcupine,” the sternum being the pig with stings as the radiating ribs. Case 42 describes in detail a patient suffering from a rib strain, eliciting a major pain in the patient after being investigated by the doctor. A contusion, as was likely to be the case here, can be extremely painful, because of a blood collection due to blood collecting within the bone or cartilage, and is often mistaken for a fracture because of the intensity of the pain. As in many other instances, the application of honey also belonged to the mainstay of the treatment of injuries. Just as honey currently belongs to a widely used alternative treatment modality, it was formerly recognized to be anti-inflammatory and a bactericide, but also to display analgesic properties.

The luxation of a rib was palpated as a protrusion underneath the skin when the overlying skin became red as a sign of irritation. From current knowledge it is known that the luxation of costovertebral or costo-sternal articulations—as described in case 43—can cause radiation of pain to different parts of the body such as the loin. This phenomenon could be what is meant at the end of case 43, where the pain is described as radiating to the loin. Finally, case 44 describes a patient with a rib fracture. Rib fractures had an incidence of 4.4%, found in 6000 bodies in burials ranging from 4000 BC to the first century AD.14 In this description, the dislocation of the rib caused a rupture of the overlying skin creating a wound. The ribs here are reported as being shifted, thus assuming that there are fragments dislocated from their original anatomical location. The investigating physician gives the statement about what is presently termed an open fracture by using the phrase “one cannot treat it,” stating that this kind of injury is generally not treatable by the physicians.

CONCLUSIONS

Ancient Egyptian physicians paved the way for modern medical practice by discovering valuable methods for patient examination, diagnosis, and the proposal of appropriate treatment in chest surgery. Intriguingly, medical skills did not rely on hitherto widely used magic elements, but instead, the scientific knowledge emerged from a high level of empiricism. Currently, we treat chest surgical disorders in a routine fashion used for more than 100 years, but we learn that the basis for this medical science actually dates back 4000 years and still remains valid.
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