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ORIGINAL ARTICLE

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Ankylosing spondylitis in the pharaohs of ancient Egypt

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Abstract *Background* Among the pharaohs of the 18th and 19th dynasty of Old Egypt, at least three had ankylosing spondylitis: Amenhotep (Amenophis) II, Ramses II (''The Great''), and his son Merenptah. *Objective* An illustrated review is given on the radiological indications for their disease, together with the rough history of these pharaohs, the history of their tombs, of the detection of their mummies in the 19th century and of their paleopathological investigation.

Keywords Ankylosing spondylitis · Paleopathology · Egypt · Pharaohs · Amenhotep II · Ramses II · Merenptah

Historical introduction

Beginning in about 3000 BC ancient Egypt was governed by pharaohs (kings) for about 3000 years (counting the Ptolemaic kings as pharaohs). The first pharaohs unified Upper and Lower Egypt into a single state, introduced with the hieroglyphs a uniform script, and created one of the first advanced civilizations. To today's tourists the pharaohs of the Old Kingdom (2925–2155 BC) are known particularly as the builders of the huge pyramids west of Cairo, while the pharaohs of the New Kingdom (1550–1080 BC) are known mainly for their magnificent tombs in the ''Valley of the Kings'' west of Luxor (Fig. 1) [1, 2].

The first pharaoh of the 18th dynasty (1570–1320 BC) was Amenhotep I (in Greek: Amenophis I). Especially well known is Amenhotep IV (reigning 1365–1348 BC), who changed his name to Echnaton and introduced with his veneration of Aton the first monotheism in the world. His son Tutanchamun (reigning 1332–1323 BC) died at 16 years of age. During his reign the old polytheism with Amun as highest god was reestablished. Since Tutanchamun had no children, his educator and regent Eje was proclaimed pharaoh, and shortly afterwards his general Haremhab, before another officer, Paramessu, later named Ramses I, founded the 19th dynasty.

Ramses II, grandson of Ramses I, ascended the throne at the age of 20 years in 1298 BC. He succeeded in making peace with Hattusil III, king of the Hittites, the other powerful state at that time who had their capital in Anatolia. The peace was sealed in 1280 BC, the text of this international treaty being the earliest to have been handed down to us. Ramses ''the Great,'' as he is known today, lived and ruled until the advanced age of 87 years, after the longest recorded reign ever reached by a ruler in ancient history. His 200 wives bore him 79 sons (according to another source, 96) and 59 (or 60) daughters. He survived many of his children, and it was his 13th son, Merenptah, who succeeded him, as a relatively old man himself.

Ramses II constructed huge buildings throughout the country for his own glorification. These include the ''Ramesseum,'' the walls of which are covered with dramatic reliefs presenting the victories of the ruler, the large columned hall of the temple in Karnak (Fig. 2), the colonnade of Luxor, and the temples of Abu Simbel, in front of which four huge statues of the ruler were carved out of the rock, each 25 m high (Fig. 3). In his new capital, Pi-Ramses in the Nile delta, a team of

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Fig. 1 The "Valley of the Kings," originally hidden and closely guarded funeral site of the pharaohs of the New Kingdom (1550–1080 BC.), then the scene of nocturnal plundering raids, and today a "must" for every tourist to Egypt. In front of many royal tombs entrance halls made of concrete were erected, including the tomb of Ramses the Great (*arrow*). The entrance to the valley is situated in the right-hand side of the background. (Photograph by E.F., reprinted by kind permission of Deutsche Vereinigung Morbus Bechterew, from [10])

Fig. 2 The 134 columns up to 24 m high in the great column hall erected by Ramses II in the imperial temple of Karnak are decorated repeatedly with his name cartouche and descriptions of his heroic feats. (Photograph by E.F., reprinted by kind permission of Deutsche Vereinigung Morbus Bechterew, from [10])

archeologists from Hildesheim recently found a floor lined with gold leaf.

During the reign of Ramses II there occurred the migration of the Israelites through the Sinai Desert, and presumably it was he with whom Moses had to negotiate about the exodus from Egypt. Both ancient Egyptian and Roman chroniclers of the 1st millennium BC, however, report that it was this pharaoh who asked the adherents of the monotheistic Aton cult introduced by Echnaton and banned since Tutanchamun, to leave the country [3, 4]. In some of these reports their leader

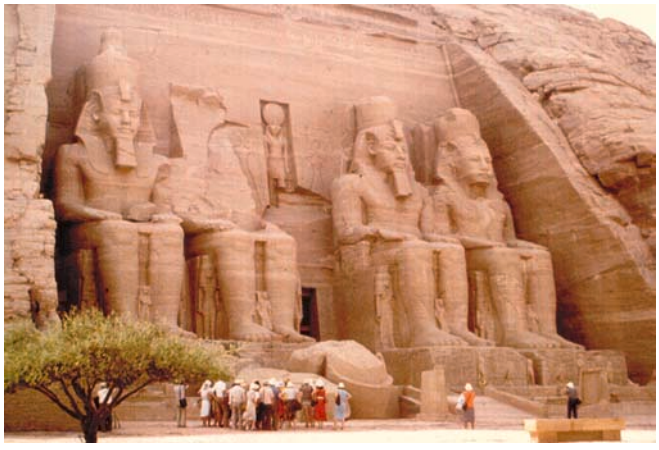

Fig. 3 Four gigantic statues of Ramses the Great, each 25 m high, carved out of the rock in front of the temples of Abu Simbel in the south of Egypt. With the help of UNESCO, the temples were moved to save them from the waters of the Nasser Reservoir. (Photograph by E.F., reprinted by kind permission of Deutsche Vereinigung Morbus Bechterew, from [10])

likewise had the name Moses (a name popular in Egypt at that time) [4]. In other reports, their leader was a prince named Minephta [3] (recall that also in the Biblical version Moses was the adopted child of a princess).

Tombs, priests, and tomb robbers in the Valley of the Kings [2]

To guarantee eternal peace for the mummy huge pyramids were erected over the tombs of pharaohs of the Fourth Dynasty (2680–2563 BC). The architects in the Middle Kingdom (2050–1778 BC) tried to protect the mummies of their kings by constructing elaborate puzzle passages within the pyramids. The pharaohs of the early Eighteenth Dynasty had observed that all these efforts had failed. Tomb robbers succeeded again and again in overcoming the heavy stones blocking the passages and seizing the treasures that were buried with the pharaohs. They therefore chose a remote and relatively inaccessible valley to the west of Thebes to hide their royal tombs. However, even the "Valley of the Kings," as it is called today (Fig. 1), was soon stormed by tomb robbers. Bribery and betrayal were the order of the day, as one can read in the court records written on papyrus during this period. Those convicted were severely punished.

Around 1000 BC whole gangs of robbers attacked the tombs whenever they found them not safely guarded, and they did not hesitate to destroy the mummies to get hold of the treasures. Finally, the situation became so hopeless for the priests guarding the tombs, that they moved the royal mummies from one hiding place to another. Notes found on the hieratic dockets on some coffins or on the bandages of the mummies documented the reburials. Thirteen mummies which were in a bad condition were finally hidden in a chamber of the tomb

of the pharaoh Amenhotep II (also known by his Greek name, Amenophis II), who ruled the kingdom from 1438 to 1412 BC. The other mummies which had been repaired and were in sound coffins were transported to the tomb of Queen Inhapi (early 18th dynasty) near the huge temple of queen Hachepsut. There they were hidden in a shaft difficult to enter but easy to guard. Here they found safety and peace for 3000 years, from 945 BC until 1898 AD. The entrances to these tombs fell into oblivion and soon ceased to be detectable.

Rediscovery and safeguarding

In the nineteenth century AD Luxor became a famous antiquities market, where ancient Egyptian objects were often offered for sale. In 1874 Gaston Maspero, director of the Egyptian Antiquities Service, noticed the appearance on the antiquity market of figures bearing royal names of the 21st dynasty that were doubtlessly genuine. He sent inspectors to Luxor, but without result. In 1881 it was found out that a man named Ahmed Abd el-Rassoul (inhabitant of the village of Qurna located near the royal necropolis) had discovered the hiding place of the royal mummies in a rock wall near the Hachepsut temple. Together with his brother Mohammed, he tried to convert this discovery into money.

In April 1881 the two brothers were arrested and subjected to torture to extract their confessions, but without any result. Shortly afterwards, however, after being promised immunity from punishment, Mohammed agreed to guide the authorities to the entrance of the cache. Behind a small hole in the rock wall he showed them a chamber 3 m wide and 200 m deep, full of coffins, canopic jars, wooden shrines, statuettes, and vessels. Within the coffins the mummies of many of the great pharaohs of ancient Egypt were found. To prevent further theft the transportation of these materials to Cairo was prepared immediately. On 14 July 1881 a government steamboat left Luxor for Cairo; on board were the mummies of 40 pharaohs and queens, including that of Ramses the Great. As the boat progressed along the Nile, hundreds of men and women left their fields and houses and lined the banks to pay tribute to their former kings. Men fired their guns into the air, and women wailed and put dust on their heads as did the original mourners of the pharaohs.

In 1898 the French Egyptologist Victor Loret discovered the tomb of Amenhotep II in the Valley of the Kings. The pharaoh's mummy was found resting in its sarcophagus (Fig. 4), and with it lay the famous bow of which he boasted that no one else of his army nor any of the foreign princes could draw it. In another chamber which had been selected by the priests of the 21st dynasty as a hiding place, Loret found 13 mummies, including 9 pharaohs of the 18th, 19th, and 20th dynasties. Among them was Merenptah, the son and successor of Ramses II.

The identifiable mummies were sent to the Egyptian Museum in Cairo. Amenhotep II was left in the tomb as he was found. He was one of the few pharaohs ever found in the original tomb, but the decision later proved unfortunate. In 1901, 3 years after the discovery, the tomb was attacked by 13 armed thieves, the guards were overpowered, and the mummy was taken out of the sarcophagus and thrown onto the ground. The bandages of the mummy were ripped open. Thereafter this

Fig. 4 The sarcophagus of Amenhotep II (reigned 1438–1412 BC), whose mummy shows clear indications of ankylosing spondylitis, and in whose tomb priests had hidden the mummies of nine other pharaohs. The Ujat eyes may be regarded as a means to ward off evil or a means to look back into the world of the living. The gods Kebech-Senuf, Anubis, and Hapi guaranteed the intactness of the dead. (Photograph by E.F., reprinted by kind permission of Deutsche Vereinigung Morbus Bechterew, from [10])

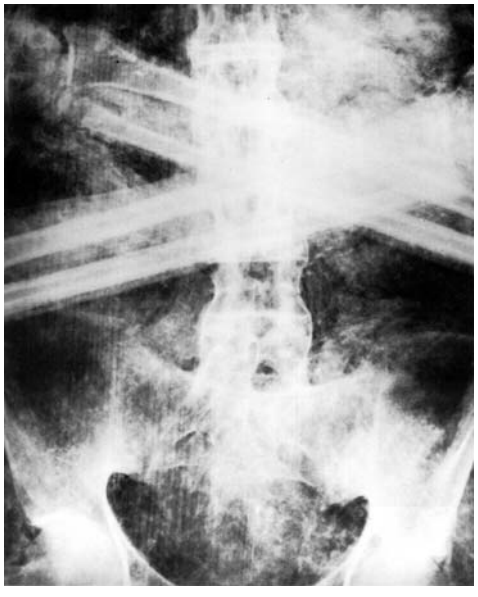

Fig. 5 Frontal view of the lumbar spine and upper pelvis of Amenhotep II. Characteristic changes of ankylosing spondylitis include calcification of the paraspinous ligaments and obliteration of the sacroiliac joints. (Reprinted by kind permission of the University of Chicago Press, from [6])

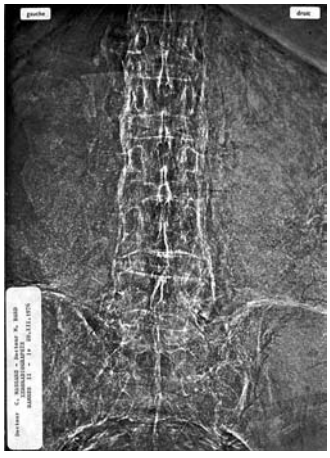

Fig. 6 Xeroradiography (radiograph taken by exposing an electrostatically charged photoconductor plate and transferring the image – in analogy to a laser printer – to paper) of the lumbar spine of Ramses II. (Reprinted by kind permission of Dr. Claude Massare, Cannes, from [8])

mummy was also brought to the museum in Cairo. Investigations and a minute examination of the scene of the crime showed that it was, again, the el-Rassoul family from which the robbers came.

Medical investigations and conservation

After their arrival in the museum in Cairo the mummies were again unwrapped, this time not by robbers but by anatomists and archaeologists. In 1912 the results of their investigation were published in a book entitled *The Royal Mummies* [5].

Systematic radiographs of the royal mummies were taken in 1967 when an American expedition with a transportable equipment on their way to Nubia was invited by the Egyptian Department of Antiquities to investigate the collection of mummies in Cairo. The results were published in 1980 in *X-Ray Atlas of the Royal Mummies* [6] and provided interesting insights into the distribution of diseases and the methods of their treatment in ancient Egypt. Ankylosing spondylitis was discovered in Amenhotep II (Fig. 5).

Fig. 7 Radiograph of the cervical spine of Ramses II, showing a postmortem fracture in C5/C6, vertebral blocks above and below due to ankylosing spondylitis, and vertebral discs of normal height, in contrast to the advanced age of the pharaoh. (Reprinted from [7])

Fig. 8 The mummy of Ramses II in his sarcophagus [7]. Additionally, the head position which would result if his postmortem fracture were rearranged correctly

The mummy of Ramses II was investigated even more thoroughly when it was flown to Paris in 1976 for conservation in connection with a large exhibition, ''Ramsès II'' in the Musée de l'Homme. In addition to radiographs, endoscopic, bacteriological, mycological, and entomological investigations were also carried out to enable preventive measures against further deterioration in the physical condition of the mummy. Pollen and plant remains were also investigated to learn more about the mummification and burial rites at the times. The mummy was then irradiated with intensive gamma radiation to kill any microbes. The results of this extended scientific work were published in a thick volume entitled *La momie de Ramsès II* [7]. Before the publication of this book some radiological findings had been published by one of the investigators [8]. The exceptionally advanced age of Ramses II was confirmed by both the American and the French investigations. Hence there is no doubt concerning the identity of the mummy.

Fig. 9 Radiograph of the lumbar spine and pelvis of Merenptah. (Reprinted by kind permission of the University of Chicago Press, from [6])

The French scientists detected by means of their radiographs that Ramses II almost certainly suffered from ankylosing spondylitis. The ligaments along the spine were ossified (Fig. 6), and the sacroiliac joint was effaced [8]. The intervertebral distances were larger than in those who died aged 35 years, in contrast to the narrower disc spaces to be expected at that age. Massare [8] mentions that all these findings fit well with the opinion of some Egyptologists that Ramses II seems relatively stiff when portrayed in various images. In the cervical spine the researchers found a fracture (Fig. 7) produced intentionally after the death of the pharaoh to straighten the neck before mummification. In Fig. 8 we try virtually to rearrange the fracture ends. The spine and head position thus resulting for Ramses II before his death is well known from elder ankylosing spondylitis patients in present days.

A check through all published radiographs of Egyptian mummies carried out by the late Professor emeritus H. Holzmann (former chairman of the Department of Dermatology, University of Frankfurt/Main, later consultant to the Max Grundig Clinic, Bühlerhöhe, Germany; ''Systemische versteifende Wirbelsäulenerkrankungen bei Pharaonen – eine ätiopathogenetische und radiographische Studie'', 1998, unpublished) and by one of us (A.S.R.) also revealed that Merenptah, son and successor of Ramses II, shows indications of ankylosing spondylitis (Fig. 9). He was diagnosed as having the degenerative disease hypertrophic arthritis [6]. However, as he is the son of a spondylitic, this interpretation of the spinal changes may be in error.

Since the mummy of Merenptah had not yet been treated with intense gamma ray irradiation, it is the only one of the three royal ankylosing spondylitis sufferers for whom a determination of HLA-B27 status is possible using modern molecular biological means.

Since ankylosing spondylitis often clusters in certain families, it is not surprising that both Ramses II and his son Merenptah had the disease. Concerning the question of whether there was also a familial link between Amenhotep II and Ramses II: they belonged to different dynasties, and Ramses I, founder of the 19th dynasty, was married to a Sitre of unknown origin, none of whose titles suggest any link with the preceding dynasty [6]. One of the reasons for Haremhab to select Paramessu (Ramses I) as his successor, was that he originated from Lower Egypt and promised to be an energetic ruler absolutely independent of the family of the previous dynasty [9].

An ankylosed spine is also found in the mummy of Thutmosis I (ca. 1500 BC). In his case, however, the cause was diffuse idiopathic skeleton hyperostosis (H. Holzmann, ''Systemische versteifende Wirbelsäulenerkrankungen bei Pharaonen – eine ätiopathogenetische und radiographische Studie,'' 1998, unpublished). Thus Amenhotep II, Ramses the Great, and Merenptah were not only the earliest ankylosing spondylitis sufferers whose names and personal history we know. They also serve as early examples showing that ankylosing spondylitis sufferers – as other people – are able to live exceptional lives.

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