Case report: paleopathology

The mummy of the Lebanese national hero, Youssef Bey Karam (1823-1889): an emblematic paleopathological case.

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Abstract. Youssef Bey Karam was a Lebanese nationalist leader, of a Maronite Christian family, who led the national resistance against the occupation of the Ottoman Empire. He died in exile in Italy in 1889 and his naturally mummified body returned to Lebanon the following year. Here we show the results of the anthropological and paleopathological analyses performed on the mummy during its restoration and preservation. The biological profile that emerged from anthropological investigations corresponds to the Karam's biographical data. The tomographic analyses, in addition to detecting the persistence of the internal organs, highlighted some pathological conditions: multiple healed fractures, osteoarthritis of the lumbar vertebral column, and dental caries with periodontal disease. In particular, the computed tomography showed the thickening of the bronchial tree, and opacity of the pulmonary parenchyma at the level of the hilum of the right lung. These conditions are consistent with a diagnosis of bronchopneumonia, that is the same diagnosis, that was proposed by the pathologist on his death certificate, on 7 April, 1889.

Key words: anthropology, paleopathology, bronchopneumonia, pandemic

Introduction

Prince Youssef Bey Karam was the first theoretician of the Lebanese Nation, as he called their cultural identity. He used his Christian-Maronite faith as the point of mediation between the different local cultures and populations within his Nation. Furthermore, he even traced their geographic extent, and predicted the strategic situation of the promotion of the new Lebanese Nation, in terms of the stabilisation of the whole of the Middle East. For these reasons, the Syrian authorities exiled Karam to Italy, where he died as a political prisoner, at Resina (today called Herculaneum, near Naples) in the night between 6 and 7 April, 1889. For these same reasons, he was proclaimed a Lebanese hero when this Nation was finally established in 1920.

Recently the Maronite authorities requested that our team provide anthropological documentation on the natural mummy of Karam, which had been kept in the Cathedral of Saint Peter in Edhen, Zgharta District, North Lebanon (Fig. 1). As a consequence, we carried out a complete scientific study, which included microbiological, anthropological and computed tomography (CT) imaging analyses of the mummified body. The discovery of arachnids, insects and microbiological contaminants (algae, fungi and bacteria) highlighted the need to carry out disinfection and disinfestation of the mummy; consequently, the restoration work was carried out and the mummy is currently kept in an airproof polycarbonate glass case, following the procedures indicated in the European Patent EP11156807.7 (1).

The biological profile and health status, which emerges from the anthropological and paleopathological investigations carried out on the mummy, coincides with the biographical data of Karam and, in particular,

Figure 1. The mummy of the Lebanese hero Youssef Bey Karam inside the restored niche in the Cathedral of St. Georges in Ehden (Zgharta, North Lebanon)

with the diagnosis of the cause of death reported by the pathologist in 1889. We believe that the case is emblematic, as there is a correspondence between two diagnoses made over a century later.

Materials and methods

The Relic of Youssef Bey Karam consists of a complete natural mummy (Fig. 1).

The corpse inspection and the anthropometric analyses were carried out at the Lady of Zgharta Hospital morgue. For X-ray analysis, a mobile digital radiographic system (X-ray tube, 12.5 KW generator and X-ray tube with adequate powers) was brought into the room. The CT scans of the mummy was performed at the Radiology Department of the Hospital with a tomograph not of the latest generation (thickness: 10 mm; 120 Kv; 80 mA).

The microscopic and microanalytical analyses were performed at the Microscopy Center of the University of L'Aquila (Italy) with a scanning electron microscope (SEM) Philips XL30 CP equipped with microanalysis EDS OXFORD Aztec INCA X-ACT (accelerating voltage: 20kV; detector BSE). In order to evaluate the state of conservation of mummified tissues and identify the nature of biological and chemical-physical contaminants, no. 6 samples were collected from various regions of the mummy: s1- insect exoskeleton; s2 - white patina on the skull; s3- fragment of skin and muscle fibers from the left zygomatic bone; s4 - amorphous material between second and third fingers of the left hand; s5 - patina on the right sock; s6 - dermis of the plantar region of the right foot.

Although there were no doubts about the identity of the mummy, anthropological analysis were carried out in order to reconstruct its anthropological profile. Whenever possible, anthropometric measurements were performed on the mummy (2). The sex and age at death estimates were carried out by analyzing the secondary sexual features of the skull and pelvis and the age-related skeletal changes observed from the x-rays (2-5). The stature estimation was carried out both by anatomical (6) and mathematical methods (7). Regarding to the first method, considering the reduced thickness of the mummified tissues, the skeletal height was approximated to the length of the mummy (from vertex to the calcaneus). In the same way, the approximate maximum length of the tibia was estimated directly on the mummy.

Results and discussion

Conservation status of the mummy

The analysis of the samples taken during the mummy's inspection clarified the state of conservation of the mummified tissues and provided the information necessary for its restoration and long-term conservation.

The exoskeleton (s1) belongs to the beetle *Anthrenus museorus* MEGNIN, an insect of the so-called "VII squad", that is, that group of insects that come into play in the decomposition of the corpse in a very late phase (8).

The microscopic aspect and the microanalysis of the sample 2 are compatible with lead carbonate, also known as white lead. Human hair is intimately entangled in the material.

The stereomicroscopic aspect of sample 5 is that of a dry acrylic paint intimately adhering to the texture of the sock fabric. The microanalysis of this material revealed the presence of Calcium, Potassium, Aluminum and Silicon, with slightly lower peaks of Sodium, Chlorine, Iron, Phosphorus and Lead.

Morphological and microelementary analyses of sample 6 show, also in this case, that the skin of the foot is covered with a thin acrylic patina.

Beyond the lead salts present on the skull and the film of acrylic paint on the skin surface of the feet, no traces of other substances commonly used in the past for the mummification of corpses (e.g. resins, balms, mineral salts) were detected. Based on the information provided by samples 1, 2, 5 and 6 it is likely that Youseff Bey Karam's body underwent a natural mummification process. On the other hand, the historical documents do not refer to conservative interventions aimed at preserving the corpse (while providing other details on the death of the Lebanese hero), and show that the body was immediately buried, only to appear mummified at the time of its transfer from Italy to Lebanon, that took place one year after his death. However, the mummy certainly underwent two manipulations: the first testified by the additions made with white lead, the second by the film with acrylic component applied in more recent times.

The sample 3 consists of skin and muscle tissue which, in general, appear in a good state of preservation: microscopic analyses highlighted the presence of red blood cells between the muscle fibers (Fig. 2a) and polymorphic cell masses that could be white blood cells. In some areas, however, the mummified tissues are altered by the activity of insects and arachnids. Exoskeletons belonging to the *Coepophagus echinopus* (MEGNIN) species are present among the muscle fibers (Fig. 2b); it is a mite of the VI squad, which acts late in the decomposition process of the cadaver (8). SEM observation of this sample also demonstrated the presence of leaks, bacteria and spores, that are typical of mummies that remain for long periods in high humidity environments (9).

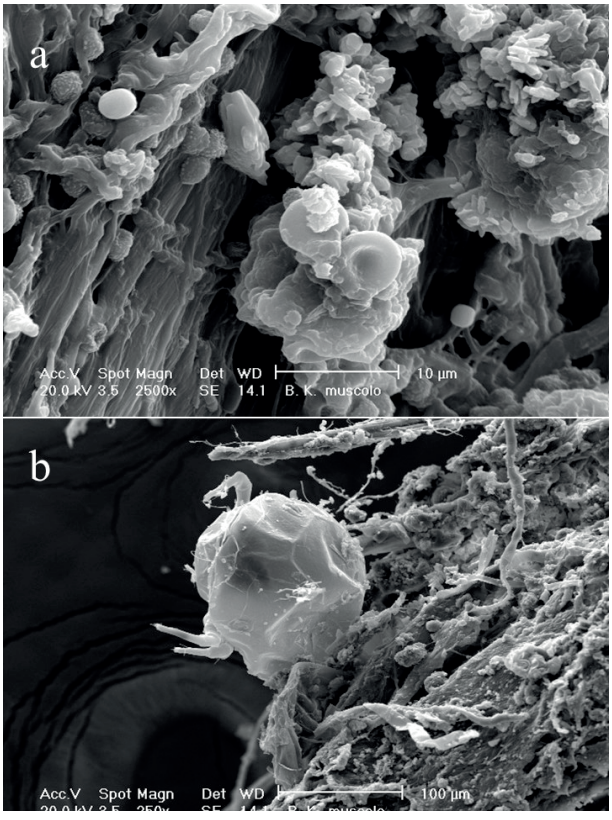


Figure 2. Perfectly preserved red blood cell in the context of Joseph Karam's left temporal muscle, observed with the SEM at high magnification (2500x) (a). Mite of the species *Coepophagus echinopus* (MENGNIN) (component of the so called VI squad of the death) in Karam's left temporal muscle (SEM, 250x) (b)

Sample 4, finally, is an accumulation of materials (exoskeletons, fungal hyphae, bacteria) deriving from the biological degradation of the mummy itself.

The results of the microscopic and microanalytical analyses demonstrate unequivocally that, at the time of the first recognition of the body, the conservation of the soft tissues of the Karam mummy was excellent, so much so as to be able to observe the structure of the muscle fibers, the red blood cells, probably of blood cells whites. At the same time, the mummified tissues were heavily contaminated by bacteria, microscopic fungi, yeasts (in activity), plant spores of various species and, finally, by insects and arachnids. For these reasons the mummy was treated with the appropriate toxic gases and, after disinfestation and restoration, it was sealed in a glass urn, which was then filled with dehydrated nitrogen, according to the procedure described in the European Patent EP11156807.7 (1).

Anthropology

The maximum length of the mummy is 157 cm; considering this measurement similar to the skeletal height, stature during life was about 168 cm" (6). The maximum length of the tibia is approximately 35 cm, that corresponds to a stature of about 165 cm (7). The stature during life, therefore, was about 165-168 cm. Moreover, it was possible to detect the following anthropometric measurements of the head (2): maximum head length: 17.1 cm; maximum cranial breadth: 15 cm; minimum frontal breadth: 9.3 cm; upper facial height: 6.7 cm; nasal height: 4.6 cm; nasal breadth: 3 cm; bigonial breadth: 13.8 cm.

The identity of the mummy was certified by historical documentation and was further authenticated by the anthropometric profile: the cranial and nasal morphology and the stature are consistent with those inferred from historical and iconographic sources.

The radiographs demonstrate the perfect state of preservation of the skeleton and do not detect taphonomic alterations in the anatomical districts analysed. The X-ray of the head show residues of organic substance (probably dehydrated remains of the meninges and brain) adhering to the internal cranial table.

The radiographic examination of the chest highlights the good preservation of the rib cage. The heads of the humeri show a loss of the spongy bone and a reduction in the thickness of the cortical bone, that are characteristics generally found in adult individuals and completely in accordance with the age of Youssef Bey Karam.

The general morphology of the pelvis is that typical of an adult male individual. Radiographic examinations of the lower limbs demonstrate the excellent state of preservation of the bones and their completeness. We note the persistence of the ancient metaphyseal line in the distal region of both tibias.

CT images integrated the results of classical radiology exams, adding further information.

In the cranial cavity, in the occipital region, the dehydrated organic remains of the endocranial tissues are now clearly visible.

Contrary to classical radiographs, the CT scan showed the presence of radiopaque masses in the thoracic region, close to the posterior wall, attributable to internal organs, in particular collapsed remains of the lungs and pleura. In addition, a denser patch of radiopaque tissue, clearly visible especially at the level of the medium-high sections of the left hemithorax, could represent the dehydrated remains of the heart muscle and pericardium.

Finally, there is the preservation of the genitalia, which rarely remain in mummified human remains.

Paleopathology

Paleopathological analyses revealed the presence of pathological alterations that made it possible to reconstruct the health status of the Lebanese hero; in particular, CT images showed the presence of lung lesions compatible with bronchopneumonia and related to his death.

The X-ray demonstrated multiple healed fractures, osteoarthritis of the lumbar vertebral column, and dental caries with periodontal disease (Fig. 3). In addition, the CT images demonstrated thickening of the bronchial tree, and opacity of the pulmonary parenchyma at the level of the hilum of the right lung (Fig. 4). This last is consistent with bronchopneumonia (10), which may well have been related to the cause of his death. However, a biopsy for possible diagnostic confirmation was not permitted.

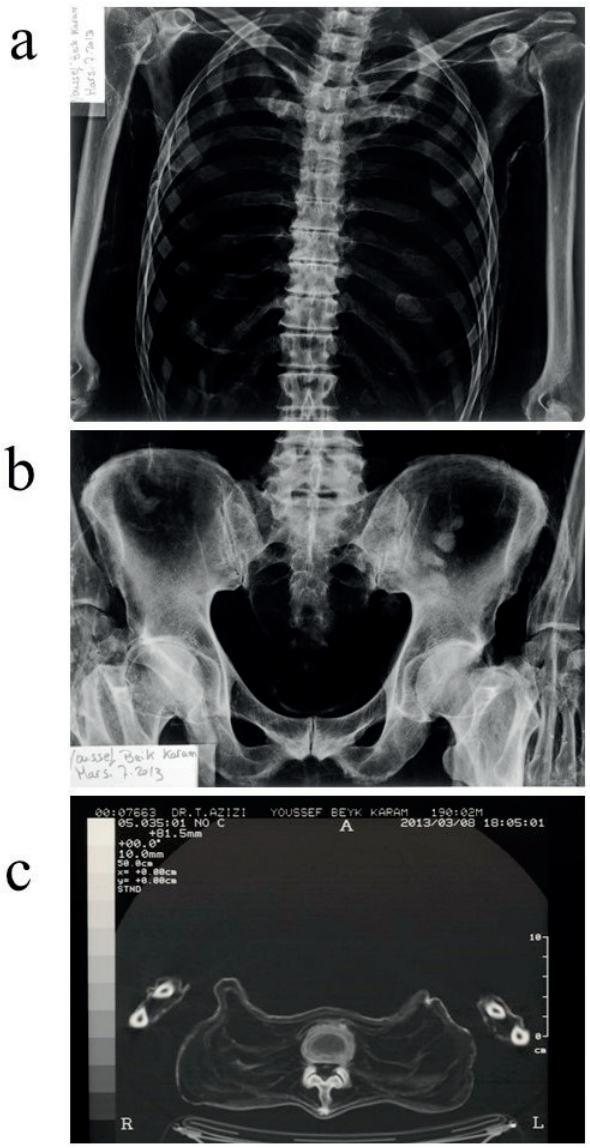


Figure 3. Skeletal pathologies of Prince Youssef Bey Karam. Healed fracture of the IV and V left ribs (a); initial bilateral hip arthrosis (b); somatic osteophytes suggesting spondyloarthrosis (c)

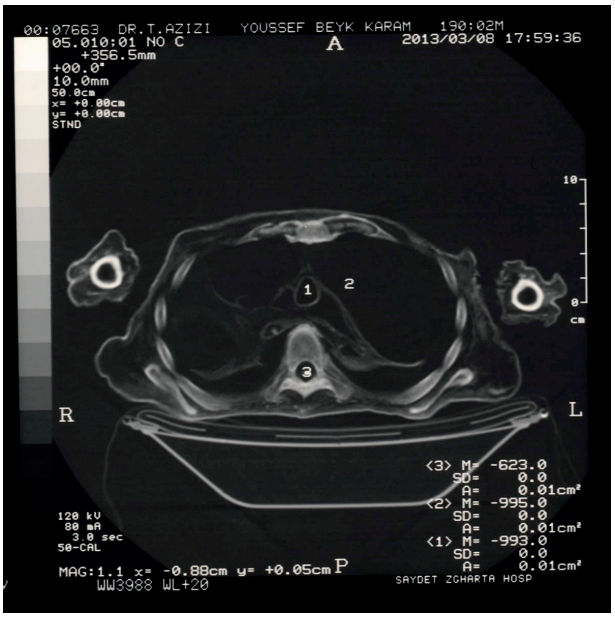
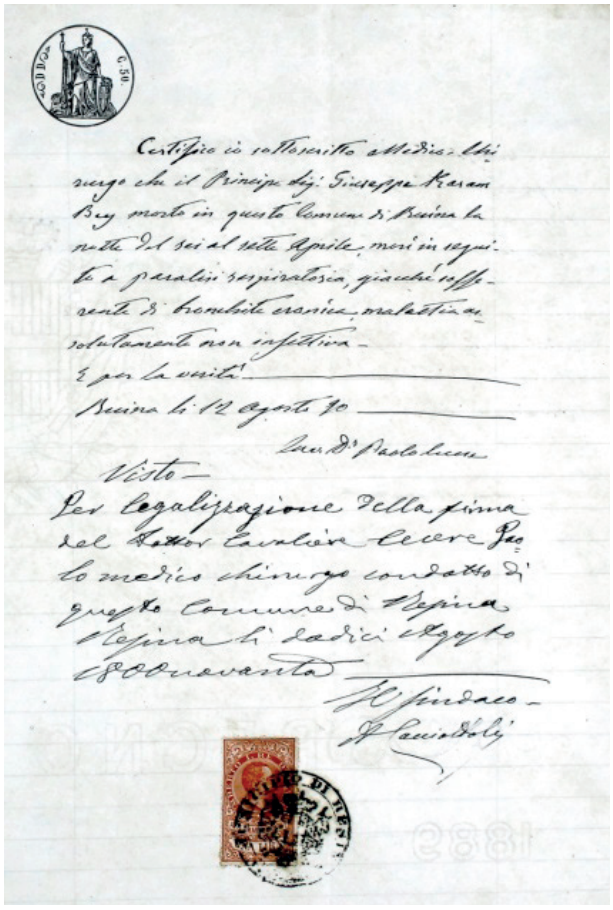


Figure 4. Computed tomography of the mummy of Prince Youssef Bey Karam, at the level of the 8th thoracic vertebra. Opacity of the right lung can be seen, consistent with a diagnosis of bronchopneumonia

This paleopathological diagnosis remained hypothetical, although in this case, we had the possibility to access historical medical documentation. This was possible because some months after his death, Karam's body was requested by his family, and was thus returned from Italy to Syria. For this reason, we searched the State Archives of Naples, and in this way, we also read his death certificate, in which the pathologist, Dr. Paolo Cerere, indicated the cause of death as bronchitis (Fig. 5).

It is likely to assume that Youssef Bey Karam was a victim of the great flu pandemic of 1889-1901, which probably originated between Asia and Russia; the disease spread to the Caucasus, to then involve all of Europe, arriving in America in December and in Australia in January 1890, thus affecting the whole globe (11, 12). According to Patterson (13), the first presence in Italy probably took place in mid-December 1889 in Rome, and then extended to southern Italy at the end of the same month. In Naples, in particular, the first documented cases are dated between 21 and 31 December 1889. Karam's death occurred in the spring of 1889, therefore it would seem excluded among the victims of the 1889-1901 pandemic; however, the possibility remains that his bronchopneumonia may be related to the same pathogenic strain, also considering his numerous travels and contacts (unfortunately not precisely documented) before his arrival in Italy, in search of economic and political aid for Lebanon (14).



Certifico io sottoscritto Medico Chirurgo che il Principe Sig.r Giuseppe Karam Bey morto in questo Comune di Resina la notte del sei al sette Aprile, morì in seguito a paralisi respiratoria, giacché sofferente di bronchite cronica, malattia assolutamente non infettiva -
E per la verità
Resina li 12 agosto 90
Dott.r Paolo Cerere
Visto -
Per legalizzazione della firma del Dottor Cavaliere Cerere Paolo medico chirurgo condotto di questo Comune di Resina
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Figure 5. The diagnosis of bronchitis on Youssef Bey Karam's death certificate. The literal translation in English of the original text in Italian: "I, the undersigned surgeon, certify that Prince Youseff bay Karam died in this Municipality of Resina on the night of April 6th and 7th following respiratory paralysis, since he suffers from chronic bronchitis, an absolutely non-infectious disease.
And for the visit _____Resina 12 August [18]90_____Doctor Paolo Cerere
Validation ___To legalize the signature of Doctor Cavaliere Paolo Cerere, surgeon of this Municipality of Resina. Resina twelve August 1800ninety_____Mayor"

Conclusion

The relic of Youssef Bey Karam, Lebanon's national hero, consists of his naturally mummified body. The disinfection intervention eliminated the fungi and other microorganisms, which had colonized the superficial mummified tissues, without involving the deeper organic components. The mummy is currently preserved inside a polycarbonate glass case, with a controlled atmosphere, at the Cathedral of Saint Peter in Edhen (North Lebanon).

The results of the anthropological investigations confirmed the information on the biological profile of the Lebanese national hero inferred from historical sources. The anthropological characters are those typical of an adult male individual about 165-168 cm tall and with anthropometric values which are fully in the ranges of variability observed in the populations of the Middle East.

The paleopathological analyses revealed the tomographic signs of bronchopneumonia, which most likely caused Karam's death. On the other hand, the doctor who wrote the death certificate indicated the bronchitis as the cause of death. Thus, we can say that at least once, two doctors have agreed on exactly the same interpretation of a clinical case, notwithstanding the passing of more than a century between these two diagnoses.

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