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Paleoradiological Survey Through Virtopsy of the Natural Mummies from the Church of Sant'Anna in Modica, South-Eastern Sicily

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ABSTRACT

Two natural well-preserved mummies were found in the Church of Sant'Anna in Modica, south-eastern Sicily. The bodies, dating back to 19th and 18th century, underwent external examination, digital radiology, and computed tomography scanning. The conservative survey to these mummies allowed to date them back, understanding the preservation mechanism and detecting significant diseases. Paleoradiological investigation allowed us to detect pulmonary tuberculosis in both individuals, complicated by phthisis in one of them. Obesity, degenerative joint disease, gallstones, and phleboliths were also found in the other subject, along with possible traditional remedies to pain relief, and a iatrogenic pneumothorax. Further investigations are planned in order to better evaluate each single disease and related findings.

Key words: *paleoradiology, forensic clinical anatomy, paleopathology, mummies, Sicily, physical anthropology*

Introduction

Sicily is the Italian region hosting the largest number of mummies collections. Beside the well-known series in Palermo, Savoca, and Comiso, additional examples were described throughout the island in the last decades[1,2]. Recently, we had the opportunity to document new examples of mummified bodies in the city of Scicli, Ragusa province, located in the south-eastern area of the island[3]. Unfortunately, most of the mummies recovered in Scicli were reburied prior to be submitted to any scientific investigation, and only a single one underwent thorough paleoradiological and paleopathological examination[4].

The church of Sant'Anna in the city of Modica (Ragusa province, south-eastern Sicily) was built at the end of 17th century, possibly in 1686, on the pre-existing chapel of Saint Calogero, attached to a Franciscan Convent[5,6]. No significant structural damage was suffered by the church during the major earthquake occurred on January 11th 1693, that partially destroyed the friary[6]. Since the end of the 19th century, the lack of planned maintenance resulted in a progressive decay of the building and in recent times the ceiling collapsed on the floor in the central part of the church[6]. During the restoration works, many tombs and crypts were unveiled. In the crypt beneath the Crucifix altar, two mummified human bodies were found and subsequently recovered. In the year 2000 they were provisionally stored in a wooden case near the main altar, to be occasionally showed to visitors (Figure 1).

A preliminary survey carried out by our group in 2010 allowed to recognize the poor conditions of the bodies, prompting us to advice an intervention. Subsequently, we were entrusted by the Ente Morale Autonomo "Liceo Convitto" in Modica to perform a paleopathologic investigation of the mummies, started in June 2016. Here we present the results of the paleoradiologic survey of both bodies.

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Fig. 1. The mummies inside the wooden case.

Material and Methods

The study was carried out by a conservative approach, based on visual inspection, digital radiology, and computed tomography (CT).

Both mummies were recovered from the wooden case in which they were placed since the first recover, and identified as MSA1 and MSA2. A superficial cleaning allowed to remove the dust and to sample insects from the clothes. Sampling for laboratory investigations was limited to the external surface of the clothes and the exposed body regions, due to conservative reasons. Visual inspection of the clothes and the exposed parts of the bodies was performed. Vestimentary analysis according to historical costume essays was performed as an absolute dating method[7-9].

The bodies were then fixed to a wood sheet by partially wrapping them in clear plastic film, in order to avoid shocks during transportation and at the same time to ensure adequate ventilation for mummified tissues preventing increases in humidity. The mummies were then submitted to the paleoradiological study. Direct radiograms in different projections were obtained with the digital radiology system Philips OmniDiagnost. Plain films of the skull, chest, upper and lower limbs, spine and pelvis were acquired. Subsequently, they underwent computed tomography (CT) scanning using a General Electric LightSpeed Pro 32 scanner with 0.625 mm thick sections, obtained with a 1:1 pitch at 50 mA and 120 kV, with maximum field of view (FOV) 47.1 x 47.1. Preliminary anteroposterior and laterolateral scout images were obtained to include the whole body and optimize the FOV. A total of 2819 scans was generated for MSA1, and 2761 scans were generated for MSA2. Tomodensitometric evaluations were made according to the Hounsfield scale (HU: Hounsfield unit), whereas volumetric 3D rendering was carried out to obtain reconstructions of external and internal aspects of the mummies.

Sex estimation of the subjects was evaluated by inspection of the external features and by radiological features of hip-bone and skull sexual characters[10-11]. The skull was additionally used to assess sex using standard anthropological methods[12]. Due to the partial state of mummification of MSA1 and MSA2, it was not possible to apply multiple methods to determine the individual's age at death. Primary centers of ossification were predominantly used. In cases where the centres were already fused, the degree of closure of the cranial sutures and dental wear patterns were used as a means of verification[13,14].

Anthropometric analysis was carried out using the digital image data and by calculating the pilastric index (related to the degree of development of the linea aspera), platymeric index (related to the degree of flatness in the upper portion of the femoral diaphysis) and the humeral robusticity index, to quantify diaphyseal shape and robusticity[12], and to assess the degree of muscle engagement and possible asymmetry in the long bones.

Results

Both mummies were clothed in their original garments and the assessment of their historical clothing clearly showed that they belonged to male individuals. As the mummies underwent radiology and CT scanning without removing their clothes, superimposition of metallic artefacts (buttons, pins, and buckles) and plaster fragments made paleoradiological evaluation challenging.

The body named MSA1 was complete and in an excellent state of preservation, as showed by visual inspection and CT scanning. It belonged to a long-bearded man, dressed in clothes dating back to the first half of 19th century (timespan: 1830-1840) (Figure 2). The age at death, according to radiologic evaluation of cranial sutures closure and dental wear patterns, was 35-40 years. The mummy measured 170 cm in length, with a calculated stature of 177 cm based on the measurements of the femur and tibia, and belonged to a skinny subject with a weak pilastric index, eurimeric femur, humeral robustness indices tending to frail, with fully euribrachic diaphyseal index.

The presence of internal organs and the absence of filling materials or skin cuts allowed us to define a natural mummification process obtained by a rapid dehydration

Fig. 2. The body of MSA1 after superficial cleaning and its preliminary antero-posterior CT scout image.

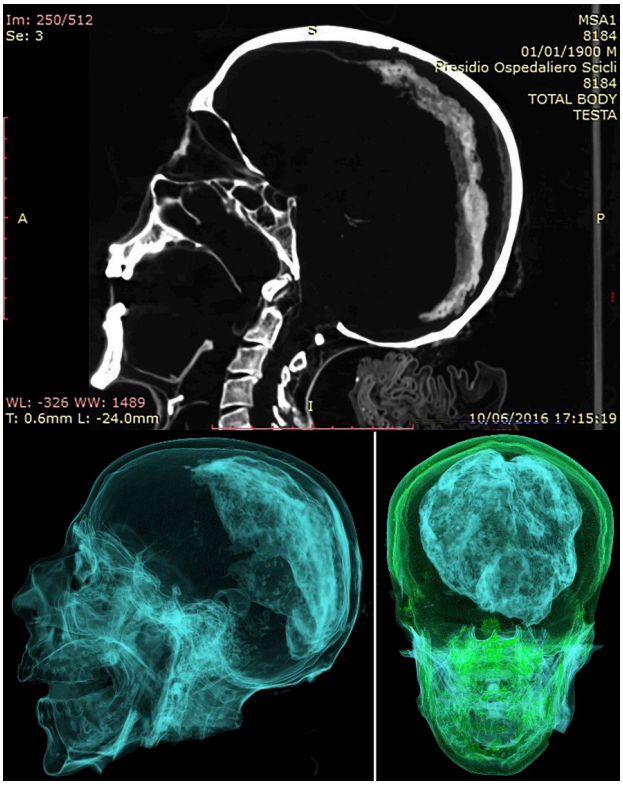

Fig. 3. CT imaging of the head in sagittal (above) and 3D reconstructions (below). Encephalic remnants in the superior posterior cranial vault. Exploration of the head after virtual removing of the frontal skull shows a clearcut distinction between brain and cerebellum (right bottom image).

mechanism in dry environment, possibly related to a chamber burial in hot climate.

Abundant material corresponding to encephalic remnants, measuring 13.4 x 10.5 x 6.5 cm, was highlighted in the upper posterior cranial vault (Figure 3), along with fibrous portions of the meningeal wrappings, also visible along the entire vertebral column. Tissue remnants were also observed within both orbits. All dental elements were present, but two molars: the left lower first and right upper third were lost ante mortem. Neither significant deposits of tartar nor dental wear were observed.

Thoracic and abdominopelvic organs were extremely well-preserved and readily recognizable.

Diffuse left pleural adhesions were observed along with multiple calcifications of the lung. A peribronchial calcified nodule measuring 17.9 mm in largest diameter (maximum density 940 HU) and a subpleural one measuring 6.5 mm (maximum density 515 HU) were noted (Figure 4). Such findings were consistent with post-primary (secondary) pulmonary tuberculosis and recurrent pleuritis. The right lung appeared normally collapsed.

Neither growth arrest (Harris) lines, nor bone fractures could be noted in the standard radiograms of the long bones. Abdomino-pelvic viscera also appeared well-preserved. The rectosigmoid tract was easily recognized, and appeared distended by endoluminal fecal material.

The mummy named MSA2 was complete and in a very good state of preservation. It belonged to an old man, with extensive remnants of clothes. Vestimentary analysis allow to date it back to the end of 18th century (timespan: 1785-1795) (Figure 5). The age at death, according to radiologic evaluation of cranial sutures closure and dental wear patterns, was over 60 years and probably the subject was even older. The mummy measured 166 cm in length, with a calculated stature of 169 cm calculated based on the measurements of the femur and tibia, and belonged to a plump subject as displayed by the abundant cutaneous folds with a null pilastric index, stenomeric femur, high

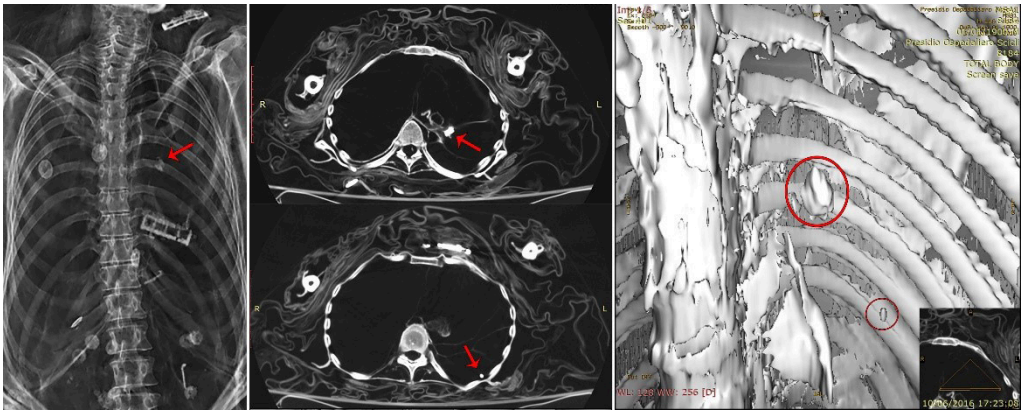

Fig. 4. On the left, direct radiogram showing superimposed artifacts and a lung calcified nodule (arrow). In the middle, CT scans showing left pleural adhesions and calcified pulmonary nodules (arrows). On the right, virtual endoscopy of the left hemithorax with both nodules.

Fig. 5. The body of MSA2 after superficial cleaning and its preliminary antero-posterior CT scout image.

humeral robustness indices, with fully euribrachic diaphyseal index. No signs that could be ascribed to anthropogenic preservation were noted. Poor dental status was observed. All upper molars, as well as the left lower first and right lower second were lost ante mortem. High degrees of dental wear and periodontal disease were also noticed. Amorphous material was observed in the posterior cranial vault and fossa with a clearcut distinction of the cerebellum and both hemispheres, and clear evidence of the falx and the tentorium (Figure 6). Thoracic and abdominopelvic organs appeared extremely well-preserved and readily recognizable. These findings confirmed the occurrence of natural mummification due to rapid dehydration and possibly related to the hot dry climate.

A 36 x 15 mm incision with smooth borders was observed in the fourth intercostal space of the anterior hemithorax. A left fibrothorax with multiple subpleural calcified nodules measuring from 7.0 to 3.6 mm in largest diameter, with maximum density values between 1115 HU and 365 HU of the lung and a single right costal adhesion with partial lung retraction were observed with two subpleural nodules ranging from 4.5 mm to 2.5 mm, with maximum densities between 483 HU and 334 HU (Figure 7). Such findings were consistent with post-primary (secondary) pulmonary tuberculosis and bilateral pleuritis' outcomes, and suggested the possibility of a traumatic or iatrogenic pneumothorax.

Additional radiologic findings included gallbladder stones, pelvic phleboliths, and severe degenerative joint disease of the spine and the right hip (Figure 8). The total number of gallstones was 7, measuring 1.3 cm to 2.0 cm in largest diameter. They had ellipsoid shape and inhomogeneous morphologic pattern with central hypodense cores and CT density values ranging from 70 to -289 HU (average density: -40 HU). These features suggested combined cholesterol gallstones. The small round phleboliths within the pelvis measured 2 to 3 mm in largest diameter with an average density of 1667 HU. Their location was close to the bladder lateral walls and the prostatic region.

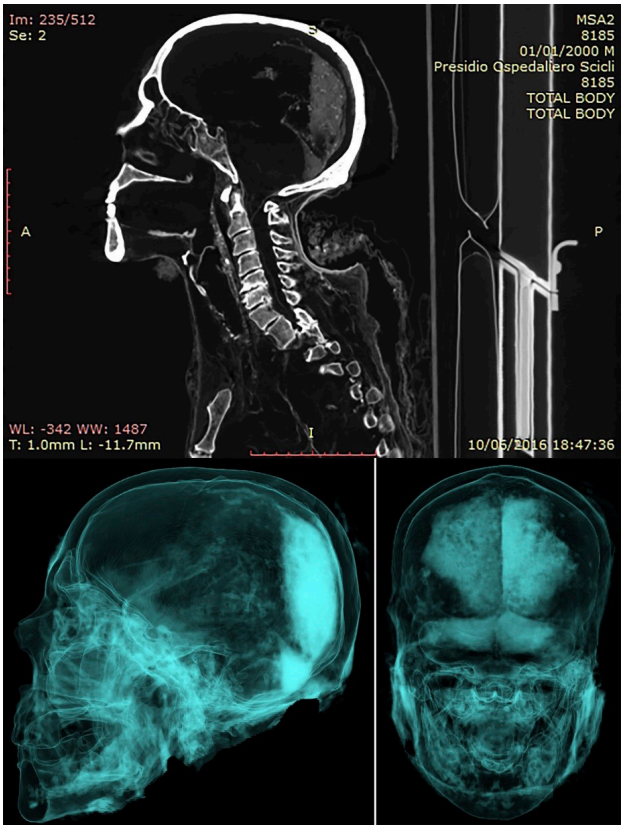

Fig. 6. CT imaging of the head in sagittal (above) and 3D reconstructions (below). Encephalic remnants in the posterior cranial vault, with clearcut distinctions of hemispheres and cerebellum.

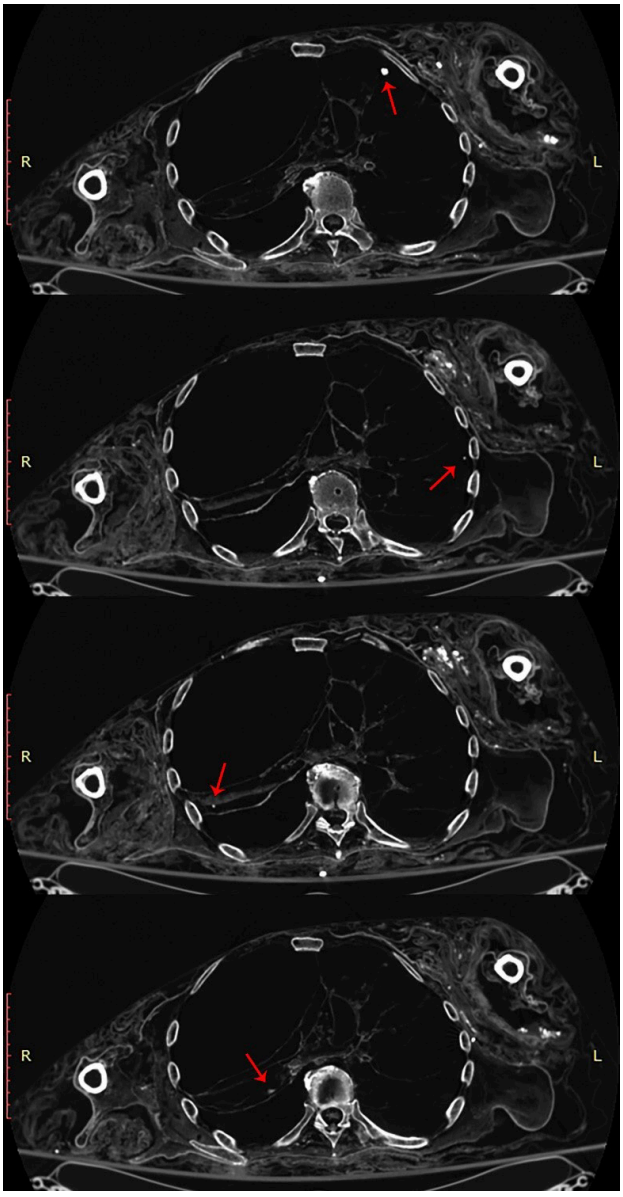

Fig. 7. CT scans of the thorax showing pleural adhesions and lung nodules (arrows).

Careful visual examination of the legs revealed the remnants of a fabric compress containing three well-preserved leaves on the right shin, a chalky device on the dorsal aspect of the homolateral foot (Figure 9), and the presence of a fabric bandage around the left knee, probably representing analgesic devices or medications. CT density values of the foot device ranged between -30 HU and -592 HU with an average value of -147 HU. Calcifications were also noted in the wall of the abdominal aorta and both iliac arteries, as a possible sign of atherosclerosis. Abdominal-pelvic organs appeared well-preserved. The rectosigmoid tract was easily recognized and distended by endoluminal fecal material.

Discussion

The living conditions of people in past centuries represent an extremely interesting issue for scientific investigation. Human mummified bodies as a direct source of study offers exceptional opportunities for bioanthropological research. Spontaneous mummification of the bodies gives a further element of exceptionality, granting extraordinary possibilities of biocultural knowledge and providing invaluable information about diseases in past times. As a historical and biological heritage, mummies should be properly surveyed and protected, but also adequately studied through non-invasive or minimally invasive analyses by multidisciplinary teams of experts. The presence of skilled radiologists and pathologists, well trained in the study of ancient human remains, in such teams represents an undeniable condition.

Over the past decade, there has been a constant increase in paleoradiology studies of human remains. Beside plain radiology, CT scanning represents an extremely valuable non-invasive method to examine mummies. CT examination allows to visualize the normal anatomy, pathological findings, degenerative alterations, and for-

Fig. 8. Direct radiogram and coronal CT reconstruction showing gallbladder stones, pelvic phleboliths, and severe osteophytosis of the toraco-lumbar spine and the right hip. Pathologic findings can be much more easily recognized in CT scan, whereas clothes' buttons are evident in plain film.

Fig. 9. The right foot with the posterior part of the shoe. 3D reconstructions of CT scanning highlight a chalky device on foot's dorsal aspect.

eign objects, also enabling virtual documentation of the mummy. As one of the main goals of bioanthropological and paleopathologic research is to investigate an object without destroying it, the virtual autopsy (virtopsy) approach represents an ideal technique for non-invasive investigation of mummified bodies[15]. Virtopsy also allows virtual osteological analyses aimed at sex and age at death estimation, as well as different anthropometric and ergonomic evaluations[16]. Investigations are repeatable and digital data can be easily shared with other experts in order to verify, discuss and reassess the findings avoiding additional manipulation of the bodies[16,17]. The detection of degenerative changes and pathological findings may provide valuable information on mummies also in case of sub-optimal preservation[18].

As stated by various studies, the use of fine resolution radiologic devices is to be preferred to portable machines and is fundamental in obtaining virtual reconstructions of the bodies[18-22]. Despite its easy availability, relative cheapness, and high spatial resolution, conventional radiography alone rarely gives sufficient results[23-27]. Moreover, tomodensitometric measurements represent an additional advantage of CT and a rather neglected issue in paleoradiology, as they were primarily addressed to normal organs preservation and body treatments identification[28,29]. Actually, they may be of great help also as a powerful diagnostic tool for the investigation of internal organs disease. Although density values need to be calibrated depending on tissue dehydration and other environmental or anthropogenic effects, HU ranges are highly specific for pathologic findings, and especially for soft tissue calcifications[29-32]. This approach enabled us to recognize and accurately diagnose bone and extra-skeletal diseases without significant damage to the bodies[33-38].

By all odds, Sicily represents the Italian region with the largest number of mummified bodies. The intentional mummification of corpses became a diffuse practice in the island since 17th Century, especially among priests and laymen. Most Sicilian mummies are the result of peculiar treatments, such as drying the body in favourable microclimatic conditions, without evisceration. This allowed to achieve a state of preservation almost equal to eviscerated, embalmed mummies[2,39]. According to Aufderheide, the mummification process may be classified into anthropogenic (artificial), spontaneous (natural), spontaneous-enhanced, and indeterminate forms[40]. The methods employed in the mummies from the well-known Capuchin Catacombs of Palermo and Savoca vary from spontaneous-enhanced to anthropogenic, whereas in the series from Comiso the bodies may be considered spontaneous-enhanced as no trace of artificial mummification was described.

In the Sicilian scenario, hosting a large number of bodies obtained by artificial or spontaneous-enhanced mummification, the mummies in the church of Sant'Anna, Modica represent a good example of natural mummification, quite similar to those described throughout the Italian peninsula[18,41,42]. It is worth noting that a similar preservation mechanism was also observed in the so-called "Queen of the Moors" and in the mummies from the church of Santa Maria della Consolazione in the nearby town of Scicli[3,4]. These uneviscerated mummified bodies allowed to identify different pathologic conditions and to understand health conditions of these subjects as well as their social status.

A point of great interest is that both subjects from Modica were affected by pulmonary tuberculosis. This finding improves our current knowledge about the impact of the disease on the island population in past centuries. A definite diagnosis of pulmonary tuberculosis depends on the demonstration of typical lung lesions with histologic or molecular detection of Mycobacterium tuberculosis. In the present cases, the radiologic and CT scan evidence of multiple pulmonary/mediastinal calcifications along with pleural adhesions provided a convincing demonstration of secondary tuberculosis. Even though tissue sampling was not authorized, none of the conditions considered in differential diagnosis (chronic hemorrhage, histoplasmosis, coccidiomycosis, pneumoconiosis, sarcoidosis, amyloidosis, hemosiderosis, primary or metastatic cancer, hamartoma, hypercalcemia, mitral stenosis, and alveolar microlithiasis) seemed relevant to our cases. Moreover, the anthropometric measurements and the scarcity of muscle and fat body mass in the subject MSA1 may represent the result of the weight loss commonly associated with end-stage disease, historically referred to as consumption (phthisis).

Additional examples of pulmonary tuberculosis in Sicily during past times were detected in natural mummies from the same geographical area, namely in Scicli and Comiso. The already mentioned "Queen of Moors" in the nearby Scicli, belonging to a 45-55 years old female and dating back to 20th century, showed multiple tiny calcifications of the lung and a paratracheal calcified nodule measuring 21x16x12 mm[4]. Also, a 30-35 years old male mummy dating back to 19th century in the church of Santa Maria delle Grazie in Comiso showed post-primary pulmonary tuberculosis. Histological examination showed pulmonary fibrosis with multiple calcified nodules in the left lung, each measuring 2 to 5 mm in largest diameter[43]. These findings highlight the great impact of this disease on the island population during the last centuries allowing to infer that tuberculosis was a common disease in SE Sicily and allegedly in the whole island. Urbanization, population growth, and the huge trade improvement registered after the major earthquake in 1693 might have fostered the spread of the infection. This is not surprising as in the pre-antibiotic era tuberculosis was an extremely diffuse disease. According to the Italian Pathology Textbook edited in 1921 by Professor Pio Foà, any manifestation of the disease could be observed in 60% of all necropsies and tuberculin skin tests gave positive results in nearly 100% of adults living in large cities or densely populated regions[44]. Further research is needed in order to confirm the presence of ancient microbial DNA and investigate molecular features of the mycobacteria in this peculiar area.

Moreover, the possibility of an iatrogenic pneumothorax recorded in MSA2 subject, if confirmed, would corroborate the diagnosis of tuberculosis, backdating the introduction of this procedure in medical practice of at least one century. This is not surprising, as in 1696 the Italian physician Giorgio Baglivi (1668-1707) described a general improvement in tuberculosis patients who suffered penetrating sword wounds to the chest. This represents the very first description of the pneumothorax effects on lung tuberculosis, almost 200 years before Carlo Forlanini (1847-1918) introduced his artificial pneumothorax treatment[45-46].

Additional pathological findings detected in MSA2, such as cutaneous folds, poor dental status, atherosclerosis, pelvic phleboliths, and gallstones yield valuable information about his social status and nutrition. Abdominal and thigh skin folds *per se* lay for an overweight subject, as confirmed by the osteophytic bridges throughout the lower thoracic and lumbar vertebrae. Aortic and iliac atherosclerosis along with phleboliths corroborate the hypothesis that this subject belonged to high-social class with high fat and sugar intake.

With regard to the gallstones, we know that they only represent a theoretical finding in skeletal remains, but they may be extremely well preserved in natural mummies. On the basis of their gross aspect, gallstones can be usually subclassified as pure cholesterol, mixed cholesterol (multiple), combination or composite, and pigmented stones[47,48]. To the best of our knowledge, about twenty paleopathological cases of biliary stones were reported in literature, only two ancient gallstones underwent complete CT study, and a single case was described in Italy, namely in 16th century Naples[49,50]. Unfortunately, due to conservative reasons, endoscopical sampling of the stones could not be performed, preventing us from performing further investigations. Modern advanced morphological and analytic investigations of at least one of the stones would have add important additional data about their precise structure and detailed chemical composition[51]. In any way, the low values obtained at CT densitometric measurements allowed to exclude pigment stones, whereas size and morphology and classify them as mixed cholesterol gallstones[30,48,52].

Paleoradiological diagnosis of pelvic calcifications can be an even more challenging task. Phleboliths are venous calcifications representing the end product of thrombosis. In modern patients they are frequently observed within the pelvis, in the veins outside the posterolateral regions of urinary bladder, prostate, uterus and rectum. Also, they are generally considered of no clinical significance, and for this reason they are actually neglected in modern radiology and histopathology reporting[53,54]. Pelvic phleboliths are common in people from economically developed countries, and may be considered a marker of western pattern of diseases[53]. They represent an under-recognised condition in paleopathological literature as their presence has been only incidentally reported in mummies, often misinterpreted as inflamed lymph nodes, and barely cited in differential diagnosis[55-57]. They share pathogenesis and location with their modern counterparts, and can be easily distinguished from ureteral calculi or calcified lymph nodes by the classic concentric calcification pattern seen in radiology, high CT densitometric values, and histology[58-60]. When found in ancient remains, they represent a useful marker of age at death, social class, and nutritional status, and a clue to related diseases.

Finally, MSA2 showed showing evident signs of severe spinal and lower limbs degenerative joint disease, along with possible traditional remedies applied for the disease. The presence of natural remedies in an ancient body is a point of great interest. The use of such devices in past times is well described in historical sources, but they are not frequently recognized in mummies[61]. Their application may have been necessary in a subject needing joint pain relief. We do not know the reason why these remedies were left beneath the clothes after death, but the presence of such devices, along with undeniable signs of OA, strongly suggest anti-inflammatory or analgesic medications in an old individual. In particular, the use of a clay pack as a natural remedy in folk medicine dates back to prehistoric times, and a hot clay cataplasm (poultice) can soothe aching joints and relieve swelling and inflammation[62].

In conclusion, the conservative survey to these mummies through external examination, digital radiology, and computed tomography scanning allowed us to date them back, understanding their preservation mechanism and detecting significant diseases. Actual signs of pulmonary tuberculosis complicated by phthisis and possibly undergone iatrogenic pneumothorax, obesity, gallstones, phleboliths and degenerative joint disease along with traditional remedies to pain relief could be reliably recognized. Further investigations are planned in order to better evaluate each single disease and findings related to therapeutic interventions.

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REFERENCES

1. ASCENZI A, BIANCO P, FORNACIARI G, RODRÌGUEZ-MARTÌN C. Mummies from Italy, North Africa, and Canary Islands. In: COCKBURN A, COCKBURN E, REYMAN TA (eds) Mummies, Disease & Ancient Cultures (Cambridge, University Press, 1998). — 2. FORNACIARI A, GIUFFRA V, Med Secoli, 18 (2006) 925. — 3. VENTURA L, PENSIERO V, CARUSO C, VOI G, FORNACIARI G. The natural mummies from the church of Santa Maria della Consolazione in Scicli (south-eastern Sicily) In: Book of abstracts of the 19th European Meeting of the Paleopathology Association (Lille, 2012). — 4. VENTURA L, ROMEO G, GRIMALDI B, CAUSARANO A, CARUSO C, VOI G, PENSIERO V, Pathologica, 114 (2022) 152. doi: 10.32074/1591-951X-256. — 5. AMMATUNA L, Archivum Historicum Mothycense, 5 (1999) 19. — 6. POIDOMANI G, Archivum Historicum Mothycense, 5 (1999) 7. — 7. SICHEL M, History of men's costume (Batsford, London, 1984). — 8. HENNESSY K et al. (Eds) Fashion. The definitive history of costume and style (Dorling Kindersley Ltd, London, 2012). — 9. TORTORA PG, MARCKETTI SB, Survey of historic costume (Bloomsbury, New York-London, 2015). — 10. FEREMBACH D, SCHWIDETZKY J, STLOUKAL M, J Hum Evol, 9 (1980) 517. — 11. MURAIL P, BRUZEK J, HOUËT F, CUNHA E, Bull Mem Soc Anthropol Paris, 17 (2005) 167. doi: 10.4000/bmsap.1157. — 12. BUIKSTRA JE, UBELAKER DH, Arkansas Archaeol Surv Res Ser, 1994. doi: 10.1002/ajhb.1310070519. — 13. LOVEJOY CO, Am J Phys Anthropol, 68 (1985) 47. — 14. MEINDL RS, LOVEJOY CO, Am J Phys Anthropol, 68 (1985) 57. doi:10.1002/ajpa.1330680106. — 15. JACKOWSKI C, BOLLIGER S, THALI MJ, Paleoradiology. In: THALI MJ, DIRNHOFER R, VOCK P (Eds) The virtopsy approach. 3D optical and radiological scanning and reconstruction in forensic medicine (CRC Press, Boca Raton, 2009). — 16. EJLSKOV PEDERSEN CC, VILLA C, ASINGH P, THALI MJ, GASCHO D, Forensic Imaging, 25 (2021) 200455. doi: 10.1016/j.fri.2021.200455. — 17. ULDIN T, Forensic Sci Res 2, (2017) 165. doi: 10.1080/20961790.2017.1369621. — 18. PETRELLA E, PICIUCCHI S, FELETTI F, BARONE D, PIRACCINI A, MINGHETTI C, GRUPPIONI G, POLETTI V, BERTOCCO M, TRAVERSARI M, PLoS ONE, 11 (2016) e0154349. doi: 10.1371/journal.pone.0154349. — 19. VENTURA L, FORNACIARI G, CALABRESE A, ARRIZZA L, FORNACIARI A, Med Historica, 4 (2020) 29. — 20. MACCHI V, PICARDI EEE, PORZIONATO A, MORRA A, TABARIN L, GUSELLA F, GRIGNON B, DE CARO R, Surg Radiol Anat, 40 (2018) 967. doi: 10.1007/s00276-018-2050-0. — 21. PROFICO A, TAFURI MA, DI VINCENZO F, RICCI F, OTTINI L, VENTURA L, FORNACIARI G, DI LERNIA S, MANZI G, J Cult Heritage Manag Sustain Dev, 2 (2020) 144. doi: 10.1108/JCHMSD-06-2019-0066. — 22. VENTURA L, MERCURIO C, FORNACIARI G, Virchows Arch, 475 Suppl 1 (2019) S35. — 23. VENTURA L, IOANNUCCI M, TUDICO G, RAFFAELE A, MASCIOCCHI C, Virchows Arch, 475 Suppl 1 (2019) S34. — 24. VENTURA L, GAETA R, ZAMPA V, ARINGHIERI G, FORNACIARI G, DI LERNIA S, TAFURI MA, MANZI G, FRANCHI A, Eur J Radiol, 130 (2020) 109183. doi: 10.1016/j.ejrad.2020.109183. — 25. LYNNERUP N, RÜHLI F, Anat Rec, 298 (2015) 1085. doi: 10.1002/ar.23147. — 26. GAETA R, VENTURA L, FORNACIARI G, Pathologica, 107 (2015): 214-215. — 27. GAETA R, VENTURA L, FORNACIARI G, JAMA Dermatol, 153 (2017) 643. doi: 10.1001/jamadermatol.2017.1847. — 28. PANZER S, AUGAT P, ZINK AR, PIOMBINO-MASCALI D, Int J Paleopathol, 20 (2018) 50. doi: 10.1016/j.ijpp.2018.01.003. — 29. VILLA C, LYNNERUP N, Anthrop Anz, 69 (2012) 127. doi: 10.1127/0003-5548/2012/0139. — 30. POLVEROSI R, SBEGHEN R, ZAMBELLI C, CARACCIOLO F, SPIGARIOL F, CAROLI A, Radiol Med, 84 (1992) 387. — 31. GUPTA NP, ANSARI MS, KESARVANI P, KAPOOR A, MUKHOPADHYAY S, BJU Int, 95 (2005) 1285. doi: 10.1111/j.1464-410X.2005.05520.x. — 32. ZERHOUNI EA, STITIK FP, SIEGELMAN SS, NAIDICH DP, SAGEL SS, PROTO AV, MUHM JR, WALSH JW, MARTINEZ CR, HEELAN RT, BRANTLY P, BOZEMAN RE, DISANTIS DJ, ETTENGER N, McCAULEY D, AUGHENBAUGH GL, BROWN LR, MILLER WE, LITT AW, LEO FP, FISHMAN EK, KHOURI NF, Radiology, 160 (1986) 319. — 33. VENTURA L, BRUNO F, BARILE A, MASCIOCCHI C, Int J Osteoarchaeol, 31 (2021) 1276. doi: 10.1002/OA.3019. — 34. VENTURA L, PETRELLA E, PICIUCCHI S, CILLI E, LUISELLI D, FEENEY RNM, TRAVERSARI M, Virchows Archiv, 479 (2021) 1255. doi: 10.1007/s00428-021-03192-5. — 35. TRAVERSARI M, FIGUS C, PETRELLA E, PICIUCCHI S, VAZZANA A, CILLI E, SARAGONI L, BENAZZI S, Med Histor, 1 (2019) 39. — 36. TRAVERSARI M, FELETTI F, VAZZANA A, GRUPPIONI G, FRELAT MA. Bull Mem Soc Anthropol Paris, 28 (2016) 202. doi: 10.1007/s13219-015-0140-7. — 37. TRAVERSARI M, DA VIA S, PETRELLA E, FEENEY RNM, BENAZZI S, Int J Paleopathol, 30 (2020) 110. doi: 10.1016/j.ijpp.2020.03.003. — 38. TRAVERSARI M, SERRANGELI MC, CATALANO G, PETRELLA E, PICIUCCHI S, FELETTI F, OXILIA G, CRISTIANI E, VAZZANA A, SORRENTINO R, DE FANTI S, LUISELLI D, CALCAGNILE L, SARAGONI L, FEENEY RNM, GRUPPIONI G, CILLI E, BENAZZI S, Int J Paleopathol, 25 (2019) 1. doi: 10.1016/j.ijpp.2019.03.003. — 39. FORNACIARI A, Med Secoli, 25 (2013) 205. — 40. AUFDERHEIDE AC, Mechanisms of mummification. In: AUFDERHEIDE AC (Ed) The scientific study of mummies (University Press, Cambridge, 2003). — 41. VENTURA L, VACCARELLI I, IANNELLA M, CASTELLANI L, D'ALTRI G, TRAVERSARI M, Coll Antropol, 46 (2022) 295. doi: 10.5671/ca.46.4.5. — 42. VENTURA L, BRUNO F, AVITABILE A, RISDONNA A, VENTURA A, PETRELLA E, BISELLI A, CILLI E, TRAVERSARI M, Virchows Archiv, 483 Suppl 1 (2023) S97. — 43. GAETA R, GIUFFRA V, FORNACIARI A, Abstract Book of the 10th World Congress on Mummy Studies, Bolzano (2022) 140. — 44. FOÀ P, Trattato di Anatomia Patologica per medici e studenti (UTET, Torino, 1921) 7: 185. — 45. MARTINI M, BESOZZI G, BARBERIS I, J Prev Med Hyg, 59 (2018) E241. — 46. MAZZARELLO P, Appl Sci, 10 (2020) 3138. doi: 10.3390/app10093138. — 47. CARIATI A, J Surg, 77 Suppl 2 (2015) 376. doi: 10.1007/s12262-013-0847-y. — 48. STEINBOCK RT, J Paleopathol, 3 (1990) 95. — 49. CÁRDENAS-ARROYO F, MARTINA MC, Int J Paleopathol, 24 (2019) 53. doi: 10.1016/j.ijpp.2018.09.003. — 50. FORNACIARI G, POLLINA L, TORNABONI D, TOGNETTI A, Pulmonary and hepatic pathologies in the series of mummies of S. Domenico Maggiore at Naples. In: CAPASSO L (Ed) Advances in Paleopathology, Proceedings of the VII European Meeting of the Paleopathology Association, Lyon, 1988 (M. Solfanelli, Chieti, 1989). — 51. VENTURA L, Med Secoli, 33 (2021) 417. — 52. WEE S, LEE YH, KIM YR, YOON KH, PARK D-E, Korean J Abdom Radiol, 5 (2021) 42. doi: 10.52668/kjar.2021.00080. — 53. KLOPPERS PJ, FEHRSEN GS, S Afr Med J, 51 (1977) 745. — 54. VENTURA L, GRAVINA GL, FESTUCCIA C, MENICHINI M, MERCURIO C, Anticancer Res, 35 (2015) 3724. — 55. VENTURA L, Virchows Archiv 473 Suppl1 (2018) S178. — 56. ARMENTANO N, SUBIRANA M, ISIDRO A, ESCALA O, MALGOSA A, Int J Paleopathol, 2 (2012) 236. doi: 10.1016/j.ijpp.2012.11.003. — 57. GONZÁLEZ-REIMERS E, GONZÁLEZ-ARNAY E, CASTAÑEYRA-RUIZ M, ARNAY-DE-LA-ROSA M, Int J Paleopathol, 22 (2018) 92. doi: 10.1016/j.ijpp.2018.06.003. — 58. GIUFFRA V, VENTURA L, MINOZZI S, LUNARDINI A, QUARESIMA R, ARRIZZA L, FORNACIARI G, Am J Med, 124 (2011) 1186. doi: 10.1016/j.amjmed.2011.04.036. — 59. VENTURA L, FORNACIARI A, CALABRESE A, ARRIZZA L, FORNACIARI G, Virchows Archiv, 475 Suppl1 (2019) S230. — 60. VENTURA L, ARRIZZA L, QUARESIMA R, CAPULLI M, Pathologica, 114 (2022) 339. doi: 10.32074/1591-951X-260. — 61. PITRÈ G, Medicina popolare siciliana. (Clausen, Torino-Palermo, 1896). — 62. CARRETERO MI, Appl Clay Sci 21 (2002) 155.

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PALEORADIOLOŠKO ISTRAŽIVANJE PUTEM VIRTOPSIJE MUMIJA IZ CRKVE SANT'ANNA, MODICA, JUGOISTOČNA SICILIJA

S A Ž E T A K

Dvije dobro očuvane mumije pronađene su u crkvi Sant'Anna u mjestu Modica, na jugoistoku Sicilije. Tijela koja datiraju iz 19. i 18. stoljeća podvrgnuta su vanjskom pregledu, digitalnoj radiologiji i kompjuteriziranoj tomografiji. Konzervativno istraživanje ovih mumija omogućilo je njihovo datiranje, razumijevanje mehanizma očuvanja i otkrivanje značajnih bolesti. Paleoradiološka istraživanja omogućila su nam da otkrijemo plućnu tuberkulozu u oba pojedinca, kompliciranu ftizom kod jednog od njih. Pretilost, degenerativna bolest zglobova, žučni kamenci i fleboliti također su pronađeni kod drugog subjekta, zajedno s mogućim tradicionalnim lijekovima za ublažavanje boli, kao i jatrogeni pneumotoraks. Planiraju se daljnja istraživanja kako bi se bolje procijenila svaka pojedinačna bolest i povezani nalazi.