

A Unique Case of Stroke and Upper Limb Paralysis in a Mid-18th Century Natural Mummy

Francesco M. Galassi, Michael E. Habicht, Frank J. Rühli, Stefano De Carolis

Despite its globally acknowledged importance in the clinical setting, the history of stroke has to date only been reconstructed through historical descriptions, whereas no clear palaeopathological evidence has ever been adduced. Here, a unique case of a naturally mummified body from the mid-18th century is shown to have a high degree of contracture of the upper left hand, whereas coeval documentary sources clearly indicate that the patient experienced a stroke in the last phase of his life that left him disabled. This example highlights how a combination of historical research and traditional palaeopathology can help in the reassessment of the presence of cerebrovascular diseases in the past.

Stroke represents the second leading cause of death above age 60 globally and a leading cause of disability.¹ By understanding its history and evolution, future preventive and therapeutic strategies may be improved. Cardiovascular diseases are complex entities caused by the interplay between genetics and environmental modulation, greatly increased in prevalence and incidence in Western societies on account of the drop in infectious disease-related mortality, longer life spans, and hypercaloric lifestyles.² Historically, stroke was first described by Hippocrates (460–370 BC) who coined the term apoplexy and related an ischemic insult to a paralytic outcome, but a clear physiopathological understanding had to wait until the 17th-century discoveries of Johann Jacob Webpfer (1620–1695). In particular, the Swiss physician described the origins and terminations of the carotid and vertebral arteries at the arterial circle at the brain base. He also documented their occlusion and calcification and the fact that stroke could be provoked by a hemorrhage within the brain. This latter discovery proved to be a physiopathological turning point.^{3,4} Later in that century, the 1664 masterpiece *Cerebri Anatome* of Thomas Willis (1621–1675) further clarified cerebral vascular irroration, but it would be another 200 years before Rudolph Virchow (1821–1902) showed the significant role in the development of stroke that carotid thrombosis could play.⁴

Furthermore, palaeopathology has demonstrated the presence of cardiovascular diseases in antiquity, with the first observation of calcific aortic atherosclerosis reported in an ancient Egyptian mummy of an elderly woman,⁵ whereas Sir Marc Armand Ruffer (1859–1917) provided additional related evidence in many other Egyptian mummies.⁶ The incontrovertible nature of these findings was assured through histology, whereas more recent studies have produced comparable results through computed tomographic scan analysis,⁷ a technique, however, that some authors think may lead to the misinterpretation of postmortem calcifications as truly intravital lesions.^{8,9} For its part, palaeomolecular analysis of ancient populations has yielded genotypic information demonstrating the antiquity of a predisposition in the Egyptian upper classes to the development of cardiovascular diseases.¹⁰ Nonetheless, to this date, with the sole exception of the suggestion of a stroke in the case of Francesco I de' Medici (1541–1587) on the basis of a 19th century watercolor representation of his then still mummified body—a hypothesis no longer verifiable, the soft tissues having been lost¹¹—research has failed to provide a compelling multidisciplinary retrospective diagnosis of a historic case of stroke. This article aims to describe the first such case.

Methods

A visual morphological inspection was made of a naturally mummified body that was found in the church of San Lorenzo a Monte (Rimini, Northern Italy) during restoration works in 2005. The evidence was complemented by the reassessment of the corresponding diocesan archival record (Card. G. Garampi Historical Diocesan Archive, Rimini) in its original Latin [c. 6r; 20 settembre 1749 and c. 2r; 25 settembre 1749]. The combination of palaeopathological evidence and documental sources used in this study reflects the standards adopted in the context of retrospective diagnoses in multidisciplinary palaeopathology.^{12,13}

Results

Taphonomical and Palaeopathological Sources

The body of a mummified individual (apart from its fully skeletonized cranium) was found within a wooden coffin and severely dismembered (Figure [A]). It was identified as that of don Giovanni Arcangeli (1677/78–1751), the ancient parson, through a grave marker on the perimeter wall of the church specifying that he perished at the age of 73 in 1751: « D.O.M./IOANNI ARCHANGELO/HVIVS/ECCLESIE PAR/OCHO QVI VIXIT/ANNOS LXXIII OBIJT/VII KAL. IANNVARIAS/BLASIVS ANTONIVS/NEPOS ET SVCESSOR/M.P. A.D. MDCCLI » [translation: « To God, most good, most great. In honor of Giovanni Arcangeli, parson of this church, who lived 73 years and died on the 7th of January, his nephew and successor Biagio Antonio (ie, established this memorial) by his own hand in the year of Our Lord 1751 »].

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Figure. **A**, The fragmented mummy of don Giovanni Arcangeli laid out on a table after the discovery. It is evident how the contralateral hand is not affected by the same pathological contraction as the left one. **B**, The mummy's left upper limb. **C**, Detail of the gryposis of the left hand. **D**, Document attesting the nature of don Giovanni Arcangeli's disease from the Rimini Diocesan Archive (with permission). **E**, Detail of the words « ob morbum apoplepticum » (« because of an apopleptic attack »), also indicated by the white arrow in **D**.

Reassembled for an initial morphological inspection in a satisfactorily accurate, supine anatomic position, the mummy manifested an eye-catching unilateral gryposis of the left hand, absent in the contralateral limb (Figure [B] and [C]). Additionally, the left hand seems to show a rather striking degree of contracture of the tendons of the dorsum of the hand.

Archival Sources

[entry: c. 6r; 20 settembre 1749; Figure [D, E]]: «[...] *Eccl. ia Paro.lis S. Laurentii in Monte* [...] vacaverit, et vacat ad praesens p.r dimissionem, seu renunciationem **causa adversae valetudinis** R.di D. Io: Archangeli ultimi illius Curati **ob morbum apoplepticum** [...]»[translation: «[...] The Parish of San Lorenzo in Monte [...] has been vacant and is vacant at present because of the resignation, or renunciation, of the last curate, the Reverend don Giovanni Arcangeli, **as a result of his poor health caused by an apopleptic illness** [...]»].¹⁴

[entry: c. 2r; 25 settembre 1749]: «[...] *R.D. Blasius Arcangeli Presbiter. Ariminen. Diocesis* [...] per Curam Animarum Ecclesiae S. Laurentij in M.te ob dimissione facta a R.D. Ioanne Archangeli **causa suae indispositionis, et malae valetudinis** [...]»[translation: «[...] The Reverend Biagio Arcangeli, presbyter of the Diocese of Rimini [...] for the care of the souls of the Church of San Lorenzo in Monte because of the resignation of the Reverend Giovanni Arcangeli **on account of his infirmity and poor health** [...]»].¹⁴

Discussion and Conclusion

The documentary evidence clearly indicates that don Giovanni Arcangeli experienced a stroke (apopleptic illness) some time before the writing of the diocesan notes of September 1749, leaving no doubt on its interpretation because that medical condition had already been thoroughly understood and described by then. Moreover, the priest having died at 73, an occurrence of stroke in a patient approaching—or already in—his 7th decade of his life would not have been unlikely in the 18th century.¹

The documents themselves establish a causal link between this stroke and a worsening of the parson's health. The severity of his problems may be reasonably interpreted as a major disability because he was unable to persevere in his position in the church, which subsequently fell to his nephew Biagio Arcangeli (who commissioned of the epitaph mentioned above). Poststroke disability may include a series of medical complications such as pneumonia, thromboembolism, depression, cardiac and musculoskeletal problems, and so on.¹⁵ Any one of these conditions may well have caused his decline and contributed ultimately to his death. Notably, one of the incapacitating outcomes of stroke is upper limb paralysis.¹⁶

The striking degree of monolateral gryposis of the mummy's left hand seems to be higher than that of the typical rigor mortis seen in cadavers and ancient mummified bodies; importantly, the contralateral hand lacks any such alteration. Thus, it is sensible to hypothesize that this modification

occurred intravital, rather than postmortem. Although it may be too much of an interpretative leap to speak confidently of monoplegia because the desiccation of the muscular substance in the upper and lower limb complicates the certain exclusion of hemiplegia, the patent contracture of the hand, substantiated by the documented evidence of stroke in this patient, and the absence of any mention of pre-existing deformities reasonably lead to the proposal of this case as the oldest multidisciplinary demonstrated palaeopathological example of stroke.

Planned future radiological, histological, and genetic analyses on don Giovanni Arcangeli's mummified remains may further corroborate this diagnosis. Even at this early stage, however, this unique case clearly shows that an intelligent blending of hard biological evidence and historical documentation can significantly improve retrospective diagnostics, thus elucidating the history of diseases.

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None.

References

1. Feigin VL, Norrving B, Mensah GA. Global burden of stroke. *Circ Res*. 2017;120:439–448. doi: 10.1161/CIRCRESAHA.116.308413.

2. Rühli F, van Schaik K, Henneberg M. Evolutionary medicine: the ongoing evolution of human physiology and metabolism. *Physiology (Bethesda)*. 2016;31:392–397. doi: 10.1152/physiol.00013.2016.
3. Nilsen ML. A historical account of stroke and the evolution of nursing care for stroke patients. *J Neurosci Nurs*. 2010;42:19–27.
4. Thompson EJ. The evolution of surgery for the treatment and prevention of stroke. The Willis Lecture. *Stroke*. 1996;27:1427–1434.
5. Czermack J. Beschreibung und mikroskopische Untersuchung Zweier Ägyptischer Mumien, S.B. *Akad Wiss Wien*. 1852;9:27.
6. Ruffer MA. On arterial lesions found in Egyptian Mummies (1580 BC–535 AD). *J Pathol Bacteriol*. 1911;16:453–462.
7. Allam AH, Thompson RC, Wann LS, Miyamoto MI, Nur El-Din Ael-H, El-Maksoud GA, Al-Tohamy Soliman M, Badr I, El-Rahman Amer HA, Sutherland ML, Sutherland JD, Thomas GS. Atherosclerosis in ancient Egyptian mummies: the Horus study. *JACC Cardiovasc Imaging*. 2011;4:315–327. doi: 10.1016/j.jcmg.2011.02.002.
8. Charlier P, Wils P, Froment A, Huynh-Charlier I. Arterial calcifications from mummified materials: use of micro-CT-scan for histological differential diagnosis. *Forensic Sci Med Pathol*. 2014;10:461–465. doi: 10.1007/s12024-014-9544-9.
9. Fornaciari G, Gaeta R. Atherosclerosis in ancient populations. *Lancet*. 2013;382:123. doi: 10.1016/S0140-6736(13)61554-8.
10. Zink A, Wann LS, Thompson RC, et al. Genomic correlates of atherosclerosis in ancient humans. *Glob Heart*. 2014;9:203–209. doi: 10.1016/j.gheart.2014.03.2453.
11. Arba F, Inzitari D, Barnett HJ, Lippi D. Stroke in Renaissance time: the case of Francesco I de' Medici. *Cerebrovasc Dis*. 2012;33:589–593. doi: 10.1159/000338667.
12. Mitchell PD. Improving the use of historical written sources in paleopathology [published online ahead of print March 7, 2016]. *Int J Paleopathol*. <https://doi.org/10.1016/j.ijpp.2016.02.005>.
13. Rühli FJ, Galassi FM, Haeusler M. Palaeopathology: current challenges and medical impact. *Clin Anat*. 2016;29:816–822. doi: 10.1002/ca.22709.
14. Archivio Storico Diocesano di Rimini. Archivio Vescovile, Vicariato di S. Ermete, VVi10 (Possessi della Parrocchia di S. Lorenzo a Monte – 1749); [entries: c. 6r; 20 settembre 1749; c. 2r; 25 settembre 1749].
15. Kumar S, Selim MH, Caplan LR. Medical complications after stroke. *Lancet Neurol*. 2010;9:105–118. doi: 10.1016/S1474-4422(09)70266-2.
16. Ramos-Murguialday A, García-Cossio E, Walter A, Cho W, Broetz D, Bogdan M, Cohen LG, Birbaumer N. Decoding upper limb residual muscle activity in severe chronic stroke. *Ann Clin Transl Neurol*. 2015;2:1–11. doi: 10.1002/acn3.122.

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