Adv Physiol Educ 45: 154–159, 2021;
doi:10.1152/advan.00218.2020

american physiological society

ADVANCES IN PHYSIOLOGY EDUCATION

HISTORICAL PERSPECTIVES

Giovanni Maria Lancisi (1654–1720) and the modern cardiovascular physiology

Andrea Paleari, Egidio Paolo Beretta, and Michele Augusto Riva
School of Medicine and Surgery, University of Milano-Bicocca, Monza, Italy

Abstract

Giovanni Maria Lancisi (1654–1720) was one of the most important Italian physicians of the modern age. Orphaned of his mother, he spent his early years in the city of Orvieto; when he was 12, his father brought him back to Rome and enrolled him to study medicine at the Sapienza University in Rome. His dedication to study and work soon led him to increasingly important positions. Within a few years, the fame of Lancisi became such that he was appointed the personal physician of three popes. In *De Subitaneis Mortibus* (1707), he described the pathophysiology of heart diseases, identifying the cause of sudden deaths in structural anomalies of the heart, lungs, and brain. He also wrote about cerebral localizations and first discussed the physiological mechanisms of urine formation and excretion. In 1717, Lancisi described the pathogenesis of malaria and the close correlation between its onset and the swampy waters of the Tiber River, proposing the draining of marshes to eradicate malaria. In the posthumous *De Motu Cordis et Aneurysmatibus* (1728) he described for the first time heart dilatation and aneurysms of the great vessels, providing a fundamental contribution to the history of cardiovascular physiology. Proof of his interest in medical education is the establishment of an academy and the donation of a library to the hospital, bridging the gap between theory and practice in medical training. Over the centuries, Lancisi's memory has faded, but his work is still relevant for anyone practicing the medical profession.

cardiovascular physiology; eighteenth century; Giovanni Maria Lancisi; history; Modern Age

INTRODUCTION

Giovanni Maria Lancisi (1654–1720) was a pioneer in the study of cardiovascular pathophysiology in a period of development of "cardiocentric" theory, which revalued the role of the heart as the center of the human body and the source of life (1). Until the 1700s, physicians maintained the notion derived from Hippocratic writings that the heart could not be affected by diseases (*cor aegrotari non potest*). Lancisi was the first scholar to challenge this theory and to study the pathophysiology of the cardiovascular diseases. The publication of his treatise *De Subitaneis Mortibus* (1707) may be considered "the birth-year of Modern Cardiology" (2).

EARLY YEARS AND EDUCATION

Giovanni Maria Lancisi (Fig. 1) was born in Rome on 26 October 1654. His mother, Anna Maria Borgiani, died giving birth to Giovanni. His father, Bartolomeo Lancisi, entrusted the young Giovanni to the care of a sister-in-law, a Franciscan tertiary nun who lived in the city of Orvieto. Giovanni remained there until his aunt's death in 1666, when, at the age of 12, his father brought him back to Rome. Bartolomeo Lancisi immediately realized that his son was gifted with uncommon intelligence, and so he enrolled him at the Roman College, where he studied with considerable success. He came out sufficiently educated in literature and philosophy, so, after some initial theological studies, he was enrolled in the Medical School at the Sapienza University in Rome (3). On 2 September 1672, at the age of only 18 years—an event out of the ordinary even for the time—he graduated in Philosophy and Medicine. He believed that his studies were too theoretical, so he started to attend some of the most important hospitals in Rome as an apprentice. In the Hospital of the Holy Spirit, which was the most important structure in Rome for the treatment of medical and surgical pathologies since its foundation in 1198 (4), he chose as his mentor Giovanni Tiracorda (1617–1695), who was the personal physician of some popes. A deep bond of respect, esteem, and affection grew immediately between the teacher and his pupil. After 4 years, in 1676, Lancisi was appointed as attending physician in the same hospital (3). In 1678, he was admitted as a fellow at the "Collegium Picenum" to continue with medical training under the direction of Tiracorda; he made notations of the results of his early studies, publishing 20 volumes in that period. In 1681, he became a member of the Academy "Congresso Medico Romano," where his path crossed that of Diacinto Cestoni (1637–1718), a biologist and researcher of the highest level who for a long time had studied scabies. Unlike the other scholars of his time, Cestoni believed that scabies did not have a spontaneous onset but on the contrary that it was caused by a parasite, the so-called *pellicello* identified by Cestoni with a microscope (5). The physician Giovanni Cosimo Bonomo (1666–1696), an admirer of Cestoni, revealed these dissertations on the origin of scabies to Lancisi, so that he could discuss them with his

Correspondence: M. A. Riva (michele.riva@unimib.it).
Submitted 12 November 2020 / Revised 14 December 2020 / Accepted 21 December 2020

Figure 1. Giovanni Maria Lancisi (1654–1720). Image from the first edition of *De Motu Cordis et Aneurysmatibus* (1728) (14).

academic colleagues (5). Actually, Lancisi did not recognize the scientific validity of these theories and rejected the idea that parasites were at the origin of the disease; the discussion, however, showed the growing interest for the application of the microscope to medicine (6).

AT THE COURT OF THE POPES

In 1684, when he was 30, he was appointed as lecturer of Surgery and Anatomy at the Sapienza University, collaborating with Marcello Malpighi (1628–1694) in studies on the embryology of the heart (7). In the same period, he was appointed as personal physician of Pope Innocent XI (1611–1689), also participating in his necroscopy in 1689 (8). Similar to other kings and noblemen of that period, Innocent XI suffered from gout, probably due to genetic predispositions and diet; from 1682, he spent most of his time in bed because of this disorder (8). The pope died on 12 August 1689, after 2 months of acute fever, and Lancisi was not able to identify the cause of the disease. During the autopsy, Lancisi found several cysts in the pope's kidneys and two huge renal stones, a 9-ounce stone in the left kidney and a 7-ounce stone in the right kidney (8). At that time, the association between uric acid and kidney stones was not known, so Lancisi could not imagine the kidney complication, which probably led the pope to chronic kidney failure and then to death. Other physicians objected to the approach of Lancisi to the last and fatal illness of the pope, and the death of Innocent XI disgraced him to the point that he was removed from his role at the papal court.

After the death of the pope, Lancisi was nominated as Professor of Theoretical Medicine (1696) and then Professor of Practical Medicine (1702) at the Sapienza University. He came back to the papal court in 1699, when the health of Innocent XI's successor, Innocent XII (1615–1700), deteriorated. He took care of him until his death (6); Lancisi was then appointed as physician for the Conclave and as personal physician of the newly elected Pope Clement XI (1649–1721) (9). In 1706, the pope requested him to investigate the causes of an epidemic of sudden deaths that occurred in Rome in the biennium 1705–1706. The phenomenon took place during a period of great internal political instability, during the War of the Spanish Succession, which led to the intensification of imperial hostility toward the Papal State, surrounded by the Austrian army (10). To avoid panic caused by the sudden deaths—considered by the population as a sign of divine punishment—Clement XI ordered Lancisi to deal with the problem, which he did by performing a large number of autopsies (10). His observations were published in the aforementioned treatise, *De Subitaneis Mortibus* (1707) (Fig. 2) (11). Even though we do not know the real reason for this increase in deaths in the city of Rome in the early 1700s, it is possible that it was caused by epidemic infectious diseases that often affected the city in that period. Therefore, it comes as no surprise that in the following years Lancisi studied some malaria epidemics that swept through Rome, finding an association with the Tiber River flooding and the swampy areas near Rome (12). In his treatise *De Noxiis Paludum Effluviis Eorumque Remediis* (1717), Lancisi asserted that poisonous vapors of swamps (*effluvia animata*) were the cause of malaria, sustaining that mosquitoes might play a role. "[Mosquitoes]" he stated, "always inject their salivary juices into the small wounds which are opened by the insects on the surface of the body. [Because] all their viscera are filled with deleterious liquids... no controversy can arise among professional men concerning the harmful effect which the insects of the swamps, by mixing their injurious juices with the saliva... inflict upon us" (12). Lancisi also proposed the draining of marshes to eradicate malaria, even though he went unheard. Although theories of Lancisi appear to be pioneering and modern, the hypothesis of the *effluvia animata* and the role of mosquitoes were still mixed with ancient notions relating to the spontaneous generation of insects. The technical and cultural conditions for acceptance of the brilliant intuitions of Lancisi did not yet exist. It took another 150 years to return to discussion of the relationship between swamps, disease, and mosquitoes (13).

LAST YEARS OF LIFE AND LEGACY

In the last years of his life, Lancisi again focused his attention on the study of diseases of the heart and the great vessels, particularly the aorta. The results of his observations

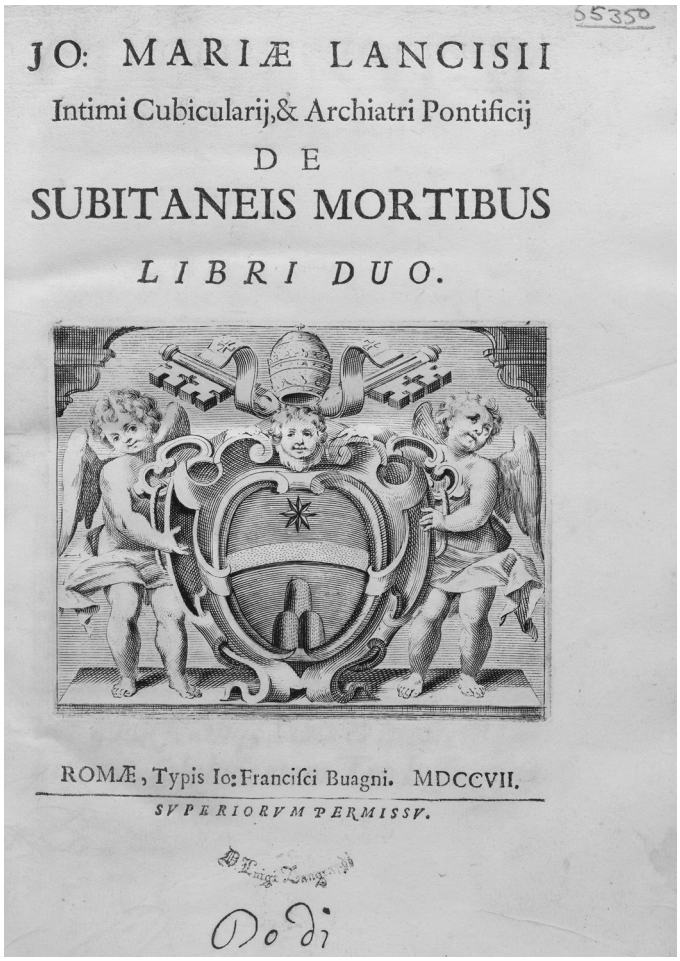

Figure 2. Frontispiece of *De Subitaneis Mortibus* (1707) (11).

were posthumously published in the treatise *De Motu Cordis et Aneurysmatibus* (1728) (Fig. 3) (14). In those years, his contribution was not limited only to scientific aspects; he also tried to reform the education of future generations of physicians. At that time, medical students had mainly a theoretical and philosophical education at the university, without direct contact with patients. For this reason, after completing their studies the young physicians had to carry out a period of practical apprenticeship in a hospital, as did the young Lancisi. On the other hand, in the hospitals theoretical notions were lacking and the medical practice was mainly empirical. In his writing *De Recta Medicorum Studiorum Ratione* (1715) Lancisi proposed a modern medical training model, based on the two pillars "learning in the hospital" and "learning in the library" (15). On one hand, the student was to attend visits to the sick, and on the other hand, he was to deal with the new philosophy of nature in the library. The aim he pursued was to bridge the gap between theory and practice. In the early years as an apprentice at the Hospital of the Holy Spirit, Lancisi had suffered the lack of medical texts at the disposal of the hospital (15). Moreover, he reported that moments of theoretical discussion were absent in the hospital, whereas on the other hand there was no practical training during studies at the University. For this reason, on 25 April 1715 Lancisi founded the Accademia Lancisiana within the Hospital of the Holy Spirit. This was an association of medical scholars with the aim of encouraging the discussion and sharing of knowledge of medicine and surgery within the hospital. Lancisi donated his wide collection of medical treatises to the Academy, thus constituting the first nucleus of the Bibliotheca Lancisiana. The Library was created as a place for education of physicians and surgeons of the Hospital of the Holy Spirit, so they could complete their practical formation with a strong theoretical preparation (15). Lancisi wanted to offer young physicians and surgeons a medical education with a broad selection of medical books, creating "a place where professors and physicians can gather" (16). Today, the Library, part of the hospital, holds ~23,000 volumes and 300 published and unpublished manuscripts (15).

Lancisi died on 20 January 1720; his death was described in a letter from the physician Pietro Assalti (1680–1728) to Giovanni Battista Morgagni (1682–1771). The letter also contains the results of his autopsy. The cause of death was probably a bowel (duodenal) infarction. Assalti wrote in his letter that "the stomach was dark in color, both internally and externally, but from the pylorus to most of the duodenum the tissue appeared completely necrotic; inside it contained a viscous liquid, similar in appearance to a black sludge (residue of olive oil)." He was buried in the Hospital of the Holy Spirit.

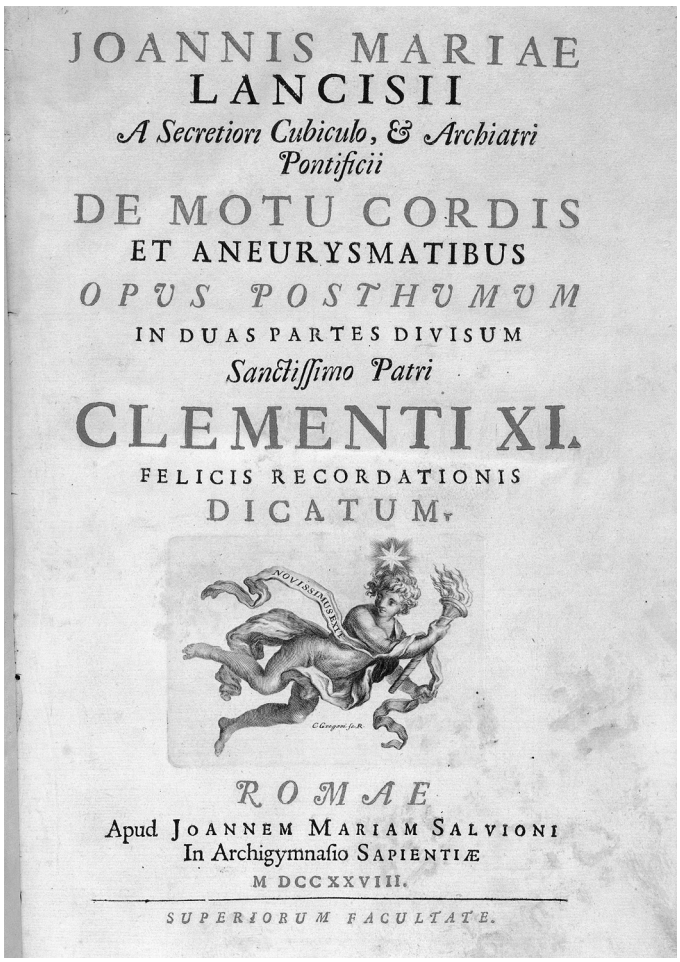

Figure 3. Frontispiece of *De Motu Cordis et Aneurysmatibus* (1728) (14).

THE CONTRIBUTION OF LANCISI TO THE HISTORY OF PHYSIOLOGY

Like other Italian physicians of that time, such as Giorgio Baglivi (1668–1707) and Bernardino Ramazzini (1633–1714) (17–19), Lancisi maintained the theories of Neo-Hippocratism, developed in England by Thomas Sydenham (1624–1689), who urged a return to the Hippocratic ideal of bedside observation and case histories. Not only was he a skilled clinician, but he also provided important contributions to physiology, and particularly to cardiovascular physiology, through systematic autopsies. Since the midsixteenth century, human postmortem dissection had been used to define the anatomy and, by inference, the physiology of the cardiovascular system (20–22). William Harvey (1578–1657) made use of human and animal dissections to observe valves within the veins of the limbs, understanding that blood was pumping from the left ventricle into the arteries and then passed the veins and back again to the right heart, thus demonstrating the blood circulation. Furthermore, he incised the aorta in beating hearts of deer, calculating stroke volume and cardiac output and realizing that the liver could not produce so much blood in such a short period (22). Indeed, until the discoveries of Harvey, the liver was considered the organ for converting absorbed food into blood and changing the black blood into the red one (23), as per the medical theories of Galen. As known, Harvey's theory was supported by the discovery of capillaries by Marcello Malpighi through the microscope. In addition to the studies of Harvey and Malpighi, the discovery of the lymphatic system played a fundamental role in denying this false theory, demonstrating that ingested food did not pass through the liver. Even studies on lymphatic system were conducted through human and animal dissections, performed by Gaspare Aselli (1581–1626), Jean Pecquet (1622–1674), Olaus Rudneck (1630–1702), and Thomas Bartholin (1616–1680) (23). Human autopsies and animal vivisections appeared to be fundamental for the development of modern physiology, anticipating the claim of Albrecht von Haller (1708–1777) that "physiology is an animated anatomy." The fall of the ancient physiology by Galen, based on hepatocentrism (i.e., liver at the center of the human organism) (24), and the advent of a new physiology based on blood circulation and cardiocentrism were also demonstrated by the interest in blood transfusion. The first significant experiments on blood transfusion between different individuals, or even different species, were performed in the second part of the 1600s. Seventeenth-century physiologists and physicians were unaware of the dangers of such experiments; the first attempts of blood transfusion had a random success. In Rome, Giovanni Guglielmo Riva (1627–1677), who was active in Rome at the Hospital of the Holy Spirit during the same years as Lancisi, conducted some experiments of blood transfusion from animals to humans. Furthermore, he contributed to the description of the lymphatic system and to the end of ancient theories, revaluating the role of the heart in human physiology (23).

Lancisi knew the studies of Riva on blood transfusions and lymphatic system well, as he had the opportunity to work in the same hospital; he also collaborated with Marcello Malpighi at the Sapienza University in the last decades of the 1600s. He was furthermore aware of the experiments performed by William Harvey, whom Lancisi considered "the inventor of modern medicine" (10). Therefore, in this context, it is not surprising that Lancisi showed a specific interest in cardiac physiology. His contribution to this discipline appears clear in two masterpieces: *De Subitaneis Mortibus* (1707) (11) and the posthumous *De Motu Cordis et Aneurysmatibus* (1728) (14). In *De Subitaneis Mortibus*, Lancisi was a pioneer in analyzing the physiopathology of human circulation and of the respiratory function (25). According to Lancisi, life was related to the equilibrium between the functions of three organs: the heart, the brain, and the lungs. He argued that sudden death could derive from alteration of respiratory, cardiovascular, or nervous system (7). On the basis of several autopsies, Lancisi claimed that "cardiac" sudden deaths could derive from structural anomalies of the heart and great vessels. In his opinion, the disorders of the heart could be caused by either systolic or diastolic dysfunction (7). The author tried to explain the mechanisms of heart failure in this famous passage: "... the movement of the heart and the large vessels is divided into systole and diastole. Although one of these at least may be the active agent as a result of these movements, each is necessary to life. For that reason, it may come about that a sick man dies suddenly if the heart cannot contract in its alternate motion. This

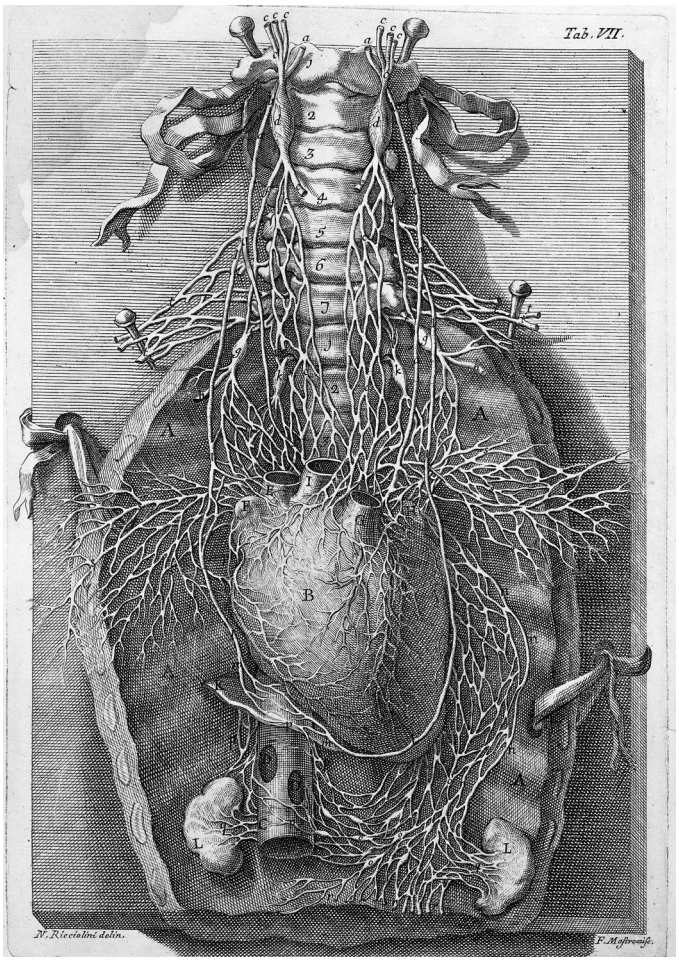

Figure 4. The innervation of the heart. Image from the first edition of *De Motu Cordis et Aneurysmatibus* (1728) (14).

normally happens when its structure is seriously weakened, or when there is a serious defect in the aforementioned fluids. He may die suddenly if it cannot expand in its other motion. This may easily happen as a result of a persistent spasm of the same organ or causes which hold it in with great power, or a contraction of course, or a tumor of the heart, the pericardium or the adjacent" (25). In particular, he modernly argued that cardiac failure could be caused by a reduction of blood in the heart and that recurrent syncope could be a predictor of sudden death in some patients. Recently, some modern authors have found the earliest description of *commotio cordis* in this treatise (26).

In *De Motu Cordis et Aneurysmatibus*, Lancisi reported the different conditions that could cause enlargement of the heart and the vessels, analyzing anomalies of cardiac structure and function (27). In the first part of the work, he described the physiology of the heart in prenatal life. In this section, he made a mistake, claiming that the heart had to contract in a single time, albeit with an atrio-ventricular succession. He also described cardiac innervation with accuracy (Fig. 4). In the last chapters, he focused on cardiac dilatations, maintaining that the most frequent increase in heart volume is due to dilatation by the mechanical push of the blood that stagnates in the heart because of an obstacle to its discharge. In other conditions, the toxic humors in the blood could weaken the heart fibers, causing dilatation of the heart. Furthermore, he recognized the role of the alterations and calcifications of the heart valves in cardiac dilatation. In this treatise, he first described a clinical sign, named after him, in which a large venous wave is visible in the jugular vein in patients with tricuspid regurgitation (Lancisi's sign). According to him, this sign could predict a right heart enlargement (27).

Finally, other contributions of Lancisi to the history of physiology should be mentioned. In *Dissertatio de Sede Cogitantis Animae* (1712) he wrote about cerebral localizations and specific cortical functions (16). He identified the corpus callosum as the structure related to superior psychic functions, in opposition to the theory of the pineal gland of Descartes (16). *Tractatus de Urinis* (1696) first discussed the physiological mechanisms of urine formation and excretion (28, 29). The manuscript was probably written with the intention of making a teaching text for a university course at the Sapienza University in Rome. In this work, he maintained that blood fermentation contributes to the formation process of the urine together with a mechanical filtration mechanism, based on blood pressure action in the arteries and capillaries. In this way, Lancisi found a compromise between the advances in iatrophysics and those of iatrochemistry (28). In that period, indeed, the two schools of thought often conflicted among scholars and practical physicians. Iatrophysics attempted to explain physiological phenomena in mechanical terms, following the laws of physics, whereas iatrochemistry related medicine to chemical processes (30).

In conclusion, the works of Giovanni Maria Lancisi represented a milestone in the history of cardiovascular physiology. They were immediately spread in Italy and in the rest of Europe, thus influencing other medical authors and scientists. Their role was decisive in the birth of cardiology as a new discipline, in the period of passage from a hepatocentrism to a cardiocentrism model. They also contributed to the development of a new approach to the study of human diseases, based on systematic autopsies, which inspired the concept of morbid anatomy of Giovanni Battista Morgagni. In all these works, Lancisi tried to find a synthesis between mechanical and chemical theories, founding a new way to study the physiological processes. For all these reasons, the figure of Giovanni Maria Lancisi and his pioneering texts deserve to be remembered and known by modern physiologists. His interest in medical education—shown by the foundation of the Bibliotheca Lancisiana and the Accademia Lancisiana—makes him even more worthy to appear in the pages of a journal dedicated to physiology education.

DISCLOSURES

No conflicts of interest, financial or otherwise, are declared by the authors.

AUTHOR CONTRIBUTIONS

M.A.R. conceived and designed research; E.P.B. and M.A.R. interpreted results of experiments; M.A.R. prepared figures; A.P. and M.A.R. drafted manuscript; E.P.B. and M.A.R. edited and revised manuscript; A.P., E.P.B., and M.A.R. approved final version of manuscript.

REFERENCES

1. **Riva MA**, **Riva E**, **Spicci M**, **Strazzabosco M**, **Giovannini M**, **Cesana G.** "The city of Hepar": rituals, gastronomy, and politics at the origins of the modern names for the liver. *J Hepatol* 55: 1132–1136, 2011. doi:10.1016/j.jhep.2011.05.011.
2. **Porter IH.** The nineteenth-century physician and cardiologist Thomas Bevill Peacock (1812–82). *Med Hist* 6: 240–254, 1962. doi:10.1017/S0025727300027393.
3. **Capparoni P.** *Profili Bio-bibliografici di Medici e Naturalisti Celebri Italiani dal sec. XV al sec. XVIII*. Rome: Istituto Nazionale Medico Farmacologico, 1925–1928.
4. **Riva MA**, **Cesana G.** The charity and the care: the origin and the evolution of hospitals. *Eur J Intern Med* 24: 1–4, 2013. doi:10.1016/j.ejim.2012.11.002.
5. **Montesu MA**, **Cottoni F.** Bonomo GC and Cestoni D. Discoverers of the parasitic origin of scabies. *Am J Dermatopathol* 13: 425–427, 1991. doi:10.1097/00000372-199108000-00016.
6. **Riva MA**, **Borghi L**, **Pagni F.** The first recorded use of microscopy in medicine: Pope Innocent XII's autopsy report. *Lancet* 388: 559, 2016. doi:10.1016/S0140-6736(16)31210-7.
7. **Fye WB.** Giovanni Maria Lancisi, 1654–1720. *Clin Cardiol* 13: 670–671, 1990. doi:10.1002/clc.4960130917.
8. **Riva MA**, **Testa F**, **Cesana G**, **Castagna F.** Pope Innocent XI's renal stones: an example of medical correspondence. *Intern Emerg Med* 13: 307–308, 2018. doi:10.1007/s11739-018-1800-7.
9. **Riva MA**, **Belingheri M**, **Cesana G.** Pulmonary tuberculosis in Pope Clement XI. *Lancet Respir Med* 6: 497–498, 2018. doi:10.1016/S2213-2600(18)30241-8.
10. **Donato MP.** The mechanical medicine of a pious man of science: G. M. Lancisi's *De subitaneis mortibus* (1707). In: *Conflicting Duties: Science, Medicine and Religion in Rome, 1550–1750*, edited by Donato MP, Kraye J. London: Warburg Institute, 2009.
11. **Lancisi GM.** *De Subitaneis Mortibus*. Rome: Francesco Buagni, 1707.
12. **Lancisi GM.** *De Noxiis Paludum Effluviis Eorumque Remediis*. Rome: Giovanni Maria Salvioni, 1717.
13. **Coluzzi M**, **Corbellini G.** I luoghi della mal'aria e le cause della malaria. *Med Secoli* 7: 575–598, 1995.
14. **Lancisi GM.** *De Motu Cordis et Aneurysmatibus. Opus Postumum in Duas Partes Divisum*. Rome: Giovanni Maria Salvioni, 1728.

15. **Conforti M**, **Fiorilla M.** Geografi di terra e non di carta. La biblioteca Lancisiana come strumento di formazione del medico. *Med Secoli* 14: 499–513, 2002.
16. **Di Ieva A**, **Tschabitscher M**, **Rodriguez y Baena R.** Lancisi's nerves and the seat of the soul. *Neurosurgery* 60: 563–568, 2007. doi:10.1227/01.NEU.0000249283.46514.93.
17. **Bianchi T**, **Belingheri M**, **Nespoli A**, **De Vito G**, **Riva MA.** Occupational risks in midwifery: from Bernardino Ramazzini to modern times. *Saf Health Work* 10: 245–247, 2019. doi:10.1016/j.shaw.2018.11.002.
18. **Marinozzi S**, **Conforti M**, **Gazzaniga V.** L'ippocratismo di Bernardino Ramazzini per la costruzione di una medicina sociale. *Med Secoli* 23: 465–493, 2011.
19. **Riva MA**, **Belingheri M.** Bernardino Ramazzini in the fourth industrial revolution. *Am J Ind Med* 62: 631–632, 2019. doi:10.1002/ajim.22993.
20. **Riva MA**, **Belingheri M.** An aortic calcification in a seventeenth-century autopsy report: the case of Cardinal Camillo Melzi. *Atherosclerosis* 280: 199–200, 2019. doi:10.1016/j.atherosclerosis.2018.11.034.
21. **Riva MA**, **Borgalli F**, **Murru F**, **Belingheri M**, **Cesana G.** A bone in the heart: the strange case of Pope Urban VIII. *Intern Emerg Med* 14: 191–192, 2019. doi:10.1007/s11739-018-1942-7.
22. **Thiene G**, **Saffitz JE.** Autopsy as a source of discovery in cardiovascular medicine: then and now. *Circulation* 137: 2683–2685, 2018. doi:10.1161/CIRCULATIONAHA.118.033234.
23. **Riva MA**, **Benedetti M**, **Vaglienti F**, **Torre C**, **Baggieri G**, **Cesana G.** Guglielmo Riva (1627–1677) and the end of hepatocentrism: a 17th-century painting. *Vesalius* 20: 69–72, 2014.
24. **Orlandi R**, **Cianci N**, **Invernizzi P**, **Cesana G**, **Riva MA.** "I miss my liver." Nonmedical sources in the history of hepatocentrism. *Hepatol Commun* 2: 982–989, 2018. doi:10.1002/hep4.1224.
25. **McDougall JI**, **Michaels L.** Cardiovascular causes of sudden death in "De Subitaneis Mortibus" by Giovanni Maria Lancisi. A translation from the original Latin. *Bull Hist Med* 46: 486–494, 1972.
26. **Shivkumar K**, **Boyle NG.** Giovanni Maria Lancisi's description of commotio cordis. *Heart Rhythm* 17: 674–675, 2020. doi:10.1016/j.hrthm.2020.01.020.
27. **Latronico N.** *Il Cuore nella Storia della Medicina*. Milan: Recordati, 1955.
28. **Gazzaniga V.** Giovanni Maria Lancisi and urology in Rome in early modern age. *J Nephrol* 16: 939–944, 2003.
29. **Klaassen Z**, **Chen J**, **Dixit V**, **Tubbs RS**, **Shoja MM**, **Loukas M.** Giovanni Maria Lancisi (1654-1720): anatomist and papal physician. *Clin Anat* 24: 802–806, 2011. doi:10.1002/ca.21191.
30. **Riva MA**, **Cesana F**, **Achilli F**, **Scordo F**, **Cesana G.** The "thirsty dropsy": early descriptions in medical and non-medical authors of thirst as symptom of chronic heart failure. *Int J Cardiol* 245: 187–189, 2017. doi:10.1016/j.ijcard.2017.07.104.