

## Anatomical study in the Western world before the Middle Ages: historical evidence

*Andrea Alberto Conti, Ferdinando Paternostro*

Dipartimento di Medicina Sperimentale e Clinica, Università degli Studi di Firenze, Florence, Italy

**Summary.** Although modern anatomy is commonly retained to begin in the XVI century, the roots of anatomical study in the Western world may be identified beforehand. An anatomical practice was present in the Western world well before the Middle Ages, starting in ancient Greece. Hippocrates of Cos (V-IV centuries B.C.) provided descriptions of the heart and vessels, and the so-called “Hippocratic Corpus” largely deals with anatomy. Aristotle of Stagira (IV century B.C.) was one of the first well-known scholars of the past to perform dissections of animals. The anatomical interest of Aristotle contained a “physiological” background too, since he was convinced that all parts of human organisms had one or more specific functions. Galen of Pergamum (II century A.D.) was the performer of hundreds of dissections of animals, and he described a great number of anatomical parts of apes, dogs, goats and pigs. The anatomical system of Galen became a gold standard for medicine for more than a thousand years, and in the Middle Ages (V-XV centuries A.D.) the human anatomy that was taught and acquired in European universities remained based on Galenic anatomy. In conclusion, Greek-speaking scholars between the IV century B.C. and the II century A.D. set the basis for the systematic dissection of animals and the comparative investigation of animal anatomical findings. These scholars also began to study the structures of the human body, interestingly taking into account the relationship between the macroscopical morphology of observed structures and their more evident functions. ([www.actabiomedica.it](http://www.actabiomedica.it))

**Key words:** Anatomy, History of Medicine, Hippocrates of Cos, Galen of Pergamum, Medical Education, Aristotle of Stagira

Modern anatomy is commonly retained to begin in the XVI century, with subsequent major achievements in the sixteen hundreds. Nevertheless, the roots of anatomical study in the Western world may be identified well beforehand. Even before the Middle Ages an ample anatomical practice was present in the Western world, starting in ancient Greece. Not by chance does the term “Anatomy” derive from Greek and it means “cutting, dissection” (1). Precisely this word can be found in the texts of Greek philosophers, naturalists and physicians of ancient times, including Aristotle, Plato, Hippocrates, Erasistratus, Herophilus and Galen (2).

Prior to the Greek civilization, in ancient Egypt human bodies were cut and opened in a religious per-

spective: they had to be emptied so as to allow embalming and mummification. Even if a direct and pragmatic interest for the anatomical structures of the human body was not present as such, it was Egyptian medical knowledge, as transcribed in the Ebers and Edwin Smith papyri, that permitted Greek and Roman physicians to have access to a basic sphere of reference for frequent diseases. It also set up a number of long-lasting indications for the treatment of an array of pathological conditions, ranging from limb injuries to head wounds, even using the first rudimental “surgical” techniques (3).

Historically speaking, the study of anatomy in the Western world first developed in structured terms in ancient Greece. Interestingly, in this context, in the

V-IV centuries B.C. famous Greek artists were real masters in depicting and sculpturing human bodies, showing in particular a notable attention towards muscles and limbs. The man who is considered the father of Western medicine, namely Hippocrates of Cos (460-375 B.C.), together with his School, provided interesting descriptions of the heart and vessels (4,5). In the so-called "Hippocratic Corpus", a collection of dozens of medical writings, attributed to Hippocrates, to his contemporaneous followers, but also to physicians living in successive periods, many references to anatomy are present. "The Heart" is one of the treatises included in the Corpus and it is known to be one of the first sources in Western medicine describing great vessels, the valves of the heart and the pericardium (6).

The philosopher and scientist Aristotle of Stagira (384-322 B.C.) may be considered one of the first well-known scholars of the past to perform the dissections of animals. The anatomical interest of Aristotle also contained a "physiological" background, since he was convinced that all the parts of human organisms had one or more specific functions (7). His pupil Diocles (born in the IV century B.C.) is retained to be one of the first Greeks to have performed the dissection of human bodies, and his textbook on animal anatomy is by many regarded as the first systematic reference manual on this subject in the Western world (8).

Between the IV and the III centuries B.C., in Alexandria of Egypt, the physicians Herophilus and Erasistratus began to practice animal vivisection in a systematic way, becoming the promoters of major achievements in the evolution of the anatomical study of human beings too. Herophilus (335-280 B.C.), in particular, studied at length the brain and nerves, the ovaries and what were later called the "Fallopian" tubes, the liver and pancreas, the salivary glands and the eyes. He also investigated the human arterial pulse to formulate a diagnosis of different pathologies. Erasistratus of Ceos (305-250 B.C.), by some medical historians considered as a pioneer not only in the area of animal anatomy but also in that of animal "physiology", studied the human pulse, and more in general the blood vessels and the anatomical structure of the human heart as a pump. In consequence of the investigations of Herophilus and Erasistratus, two body systems were clearly identified at the time, the nervous

one (including the brain but also the muscles) and the vascular one (including the heart and vessels). In contrast to previous periods, Greek physicians from the III century B.C. onwards began to retain the peripheral pulse directly connected with the heart, differentiating its regular beat from irregular spasms and tremors, and attributing these latter disorders to the brain and to the nervous apparatus. They therefore operated a clearly anatomical, and in part functional, distinction between at least two major human systems (9-11).

Among ancient physicians, Rufus of Ephesus (80-150 A.D.), an author of treatises on pathology and dietetics, had a primary role in the history of anatomy thanks to his practical effort in elaborating a lexicon of anatomy directed to his followers. In his fundamental text "On the names of the parts of the human body" he wrote a guide for a precise and shared nomenclature in anatomy, on the basis of his strong convictions that such an enterprise would have avoided, or at least limited, misunderstandings not only in the practice of anatomy, but in the whole of medicine (12). In approximately the same period, the physician Soranus of Ephesus (98-138 A.D.), representative leader of the methodic school of medicine, provided original information on the anatomy of the female genitalia. His original contributions in the implementation of obstetrics, contained in the fundamental text "On midwifery and the diseases of women", largely influenced the practice of midwifery till the XV century (13).

What Aristotle represented for philosophy in the Western world, Galen of Pergamum (129-216 A.D.) represented for medicine. A man of letters, a philosopher and a physician, Galen was performer of hundreds of dissections of animals, evidencing and describing a great number of anatomical parts of, among others, apes, dogs, goats, sheep and pigs. Galen considered his anatomical studies as the foundation of a global medical awareness, and he was a very skilled "sector" and a genuine researcher (14). The anatomical system of Galen, established on the basis of three connected systems, the arterial, the venous and the nervous ones, became a gold standard for anatomy, and more in general for medicine as a whole, for more than a thousand years. The human anatomy that was taught and acquired in European universities from the XII century onwards, remained profoundly based on the Galenic anatomical

system (15,16), thus influencing Western medicine for the entire Middle Ages (V–XV centuries A.D.).

The authority of the philosopher Galen was so high, and the relevance of Galenic medical mastery so ample, that only an anatomical revolution, occurring in the XVI century thanks to the Flemish Renaissance physician and anatomist Andreas Vesalius (1514–1564), was able to supersede his anatomical thought. In practice, Vesalius wrote the first modern textbook of human anatomy, divided in several volumes and complemented with many anatomical tables, containing the description of the hundreds of dissections that he had personally performed, from the time he was a student of medicine (17–19).

The anatomical study in the Western world thus begins well before the Middle Ages, as evidenced in this diachronic survey that provides historical highlights that document this. In effect, Greek-speaking scholars between the IV century B.C. and the II century A.D. set the basis for the systematic dissection of animals and the comparative investigation of animal anatomical findings. These scholars began to study the structures of the human body, also taking into account, to the extent possible for the state of the art at the time, the relationship between the macroscopical morphology of observed structures and their more evident functions.

## Acknowledgements

The Authors would like to thank Professor Luisa Camariora, B.A., M.Phil., for her correction of the English.

**Conflict of interest:** Each author declares that he or she has no commercial associations (e.g. consultancies, stock ownership, equity interest, patent/licensing arrangement etc.) that might pose a conflict of interest in connection with the submitted article

## References

1. Conti AA. Reconstructing medical history: historiographical features, approaches and challenges. *Clin Ter* 2011; 162: 133–6.
2. French R. The Anatomical Tradition. In: Bynum WF, Porter R (eds). *Companion Encyclopedia of the History of Medicine*. London: Routledge; 1993.
3. Loukas M, Hanna M, Alsaiegh N, Shoja MM, Tubbs RS. Clinical anatomy as practiced by ancient Egyptians. *Clin Anat* 2011; 24: 409–15.
4. Smith WD. *The Hippocratic Tradition*. Ithaca: Cornell University Press; 1979.
5. Porter R. *The Greatest Benefit to Mankind: A Medical History of Humanity from Antiquity to the Present*. London: Harper Collins; 1997.
6. Cheng TO. Hippocrates and cardiology. *Am Heart J* 2001; 141: 173–83.
7. Carlino A. *Books of the Body: Anatomical Ritual and Renaissance Learning*, transl. by Tedeschi J. and Tedeschi A.C. Chicago: University of Chicago Press; 2000.
8. Grmek MD. (ed.) *Western Medical Thought from Antiquity to the Middle Ages*. Cambridge: Harvard University Press; 1998.
9. Richardson R. *Death, Dissection and the Destitute*. London: Routledge & Kegan Paul; 1987.
10. Porter R. (ed.) *The Cambridge Illustrated History of Medicine*. Cambridge: Cambridge University Press; 1996.
11. Lawrence C, Neve M, Nutton V, Porter R, Wear R. *The Western Medical Tradition: 800 BC to AD 1800*. Cambridge: Cambridge University Press; 1995.
12. Bujalkova M. Rufus of Ephesus and his contribution to the development of anatomical nomenclature. *Acta Med Hist Adriat* 2011; 9: 89–100.
13. Karamanou M, Tsoucalas G, Creatsas G, Androutsos G. The effect of Soranus of Ephesus (98–138) on the work of midwives. *Women Birth* 2013; 26: 226–8.
14. Feher M. (ed.) *Fragments for a History of the Human Body*. New York: Zone; 1989.
15. Conti AA, Gensini GF. The late medieval evolution of medical education and organization in Florence. *Minerva Med* 2008; 99: 95–6.
16. Siraisi NG. *Medieval and Early Renaissance Medicine: an Introduction to Knowledge and Practice*. Chicago–London: University of Chicago Press; 1990.
17. O'Malley CD. *Andreas Vesalius of Brussels 1514–1564*. Berkeley: University of California Press; 1964.
18. Orlandini GE, Paternostro F. Anatomy and anatomists in Tuscany in the seventeenth century. *Ital J Anat Embryol* 2010; 115: 167–74.
19. Conti AA. Historical evolution of the concept of health in Western medicine. *Acta Biomed* 2018; 89: 352–4.

Received: 19 October 2019

Accepted: 13 November 2019

Correspondence:

Andrea Alberto Conti, MD, PhD, MPH,  
Dipartimento di Medicina Sperimentale e Clinica,  
Università degli Studi di Firenze,  
Largo Brambilla 3, I-50134,  
Florence, Italy.  
Tel. +39/055/2758419;  
Fax +39/055/2758411;  
E-mail: andrea.conti@unifi.it