

Research Article - History of Anatomy and Embryology

# Erasistratus of Chios: a pioneer of human anatomy and physiology

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## Abstract

Erasistratus of Chios (310-250 BC) was one of the great Greek physicians of antiquity. Historical investigation reveals that he was an innovative anatomist, neuroanatomist and a pioneer of human physiology. His accurate discoveries formed the basis of positive sciences and ameliorated medicine.

## Keywords

Erasistratus, Herophilus, ancient Greek physicians, history of medicine.

## Introduction

Erasistratus of Chios (310-250 BC) was one of the great Greek scientists whose prominent discoveries concerning the human body composed the basis of positive sciences and medicine (Wiltse and Pait, 1998; Acar et al., 2005). Indeed, Erasistratus in addition to Herophilus of Chalcedon (335-280 BC) were pioneers of scientific anatomy, since deploying for the first time the method of human body dissection (Dobson, 1927; Bay and Bay, 2010). Hence, it is quite reasonable that Erasistratus is considered as a great anatomist and a master of experimental physiology (Acar et al., 2005). Unfortunately though, the studies of Erasistratus have been lost entirely and only a few details of his marvelous work may be recovered from the writings of Galen (Rocca, 1997, 2003). The present manuscript aims to underline the impact of ancient Greek heritage in current medicine and emphasizes to the remarkable discoveries of Erasistratus referring to human anatomy and physiology.

## Background

Erasistratus was a Greek physician, born in the island of Chios (310-250 BC) that has been taught by Theophrastus (Mavrodi and Paraskevas, 2014). As well as Herophilus, who is considered as the “father” of scientific anatomy (Wiltse and Pait, 1998; Acar et al., 2005; Bay and Bay, 2010) Erasistratus belonged in the scientific Alexan-

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drian mileu and worked at the Herophilean Medical School in Egypt during the Hellenistic period (Durant, 1934; Wiltse and Pait, 1998; Crivellato and Ribatti, 2007). Through this period, Ptolemies achieved to transform Alexandria to the intellectual and scientific center of the Western World (Persaud, 1984). In fact, it was Ptolemy I who permitted for the first time, in approximately 300 BC, the human body cadaveric dissection in medicine (Wiltse and Pait, 1998).

Both Herophilus and his younger contemporary Erasistratus dissected an abundance of human cadavers and subsequently provided astonishing descriptions of the brain, the nerves and the cardiovascular system in addition to descriptions of physiological mechanisms (Castiglioni, 1958; Wiltse and Pait, 1998; Crivellato and Ribatti, 2007). That was a great moment in medicine that actually formed the basis of scientific and clinical anatomy plus physiology (Wiltse and Pait, 1998) and almost eliminated the improbabilities into which Aristotle has fallen due to the religious “fear of the corpse” (Durant, 1934; Gordon, 1949).

This sole opportunity to dissect, although short-lived, accounts for marvelous advances in the knowledge of human anatomy and physiology (Potter, 1976; Wiltse and Pait, 1998).

## **Erasistratus’ eminent contributions**

### **a. Nervous System**

Erasistratus in addition to Herophilus is also credited with one of the first detailed descriptions of the cerebrum and cerebellum (Wiltse and Pait, 1998). Erasistratus was the first to describe the nerves as anatomical structures originating from the substance of the human brain (Crivellato and Ribatti, 2007). He and Herophilus suggested that there are two kind of nerves: a) the sensory nerves (αίσθητικά νεύρα) and the b) motor nerves (κινητικά νεύρα) and that the nerves “that make voluntary motion” originate from the cerebrum and the spinal marrow (Garofalo, 1988; Crivellato and Ribatti, 2007).

Furthermore, he emphasized to *dura mater* (παχεῖα μῆνινξ) (Galen, edited 1962), which he long considered as the command seat of cognitive, motor and sensory functions of the human (Crivellato and Ribatti, 2007; Bhogal et al.2015). As so, he used to claim that the cause of delirium was a disorder of the meninx activity and that lethargy arose from a malfunction of the psychic faculty in the meninx as well (Garofalo, 1997).

### **b. Cardiovascular System**

Erasistratus was the first physician who recognized the heart’s activity as a “pump” contracting perpetually, due to its “intrinsic force” (Bestetti et al., 2014). The heart’s construction and activity may be compared with the ingenious mechanism known as the Ctesibius pump. That pump was invented by Ctesibius of Alexandria in approximately 250 BC. The pump consists of two identical cylinders, just like the two heart chambers, each with a piston, that converge in a chamber with valves that open and close alternately in order the water to pass through without interruption, just like the blood in the heart (Shapiro, 1964).

Another great innovation of Erasistratus, was the meticulous description of all four heart valves. In particular, he observed the presence of two and three cusps respectively in the bicuspid and tricuspid valve, in addition to the sigmoid shape of the valves of the pulmonary artery and the aorta (Mavrodi and Paraskevas, 2014).

Additionally, Erasistratus approached the anatomical description of blood movement, considering the heart as the common origin of both arteries and veins (French, 1978; Mavrodi and Paraskevas, 2014). Although Erasistratus recognized that arteries connected with the left ventricle and veins with the right one, he wrongly believed that arteries transported the *pneuma*, since they remained empty at dissection (Cockle, 1860) and consequently he could not observe the functional continuity between veins and arteries (Bestetti et al., 2014).

Nevertheless, regarding the vascular system he discovered the progressive subdivision of vessels till the point that, due to their minor diameter, it was no longer efficient to make the distinction between arteries and veins. (Androustos et al. 2013) Erasistratus observed that such small vessels were always filled with blood and named them “*synanastomoses*”. After a long period, they were denominated as “*capillaries*” (Dobson, 1928).

### c. Other contributions

Erasistratus is the first physician that may be credited with abandoning the ancient humoral theory of Hippocratis. Unfortunately though, Galen returned to that ancient theory four centuries later (Wiltse and Pait, 1998).

Moreover, Erasistratus and Herophilus opposed to the theory of Aristotle who suggested that the human heart is the center of both intellect and emotions. In fact, Herophilus claimed that Aristotle’s theory is an error (Peck, 1965) and in addition to Erasistratus attempted to prove that the brain is the center of consciousness (Wiltse and Pait, 1998). However, due to the great influence of Aristotle it has been extremely difficult to break utterly with the idea that the human heart is the command seat of emotions.

In collaboration with Herophilus, Erasistratus also improved on the understanding of respiration. In particular, he was the first who recognized an essential relation between the respiratory and vascular system (Von Staden, 1989. 1992). Finally, both of them improved our knowledge concerning the heart beat (Wiltse and Pait, 1998).

## Conclusion

Conclusively, a meticulous historical investigation reveals that Erasistratus was an eminent, skilled anatomist, neuroanatomist (Wiltse and Pait, 1998; Crivellato and Ribatti, 2007) and an innovator in human physiology (Acar et al. 2005). Without his astonishing, accurate observations medical knowledge would not have progressed that rapidly.

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