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Review Article

Andreas Vesalius: novel anatomist of the Roman empire: a review article

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ABSTRACT

Andreas Vesalius, born in Brussels on December 31, 1514, and passing away in Zante in 1564, hailed from a distinguished line of physicians. He grew up in the coastal low countries, which were part of the seventeen provinces. These regions, now encompassing mainly The Netherlands, Belgium, Luxembourg, and the north of France, enjoyed a certain degree of cultural, economic, and political autonomy. In 1529, Vesalius left Brussels to pursue studies at the Catholic University of Leuven. from 1533 to 1536, he journeyed to France to further his medical education at the University of Paris. Vesalius' predecessors and contemporaries had also written about anatomical teaching, his work "De Humani Corporis Fabrica" is now widely regarded as a pivotal advancement in the methodology and teaching of anatomical science. Vesalius' predecessors and contemporaries had also written about anatomical teaching, his work "De Humani Corporis Fabrica" is now widely regarded as a pivotal advancement in the methodology and teaching of anatomical science.

Keywords: Brussels, Novel, Anatomist, Teaching, Education etc

INTRODUCTION

Andreas Vesalius, born in Brussels on December 31, 1514, and passing away in Zante in 1564, hailed from a distinguished line of physicians. He grew up in the coastal low countries, which were part of the seventeen provinces. These regions, now encompassing mainly. The Netherlands, Belgium, Luxembourg, and the north of France, enjoyed a certain degree of cultural, economic, and political autonomy. In the 15th and 16th centuries, these provinces were united under the successive rule of the Burgundian dukes and the Austrian and Spanish Habsburgs. Thanks to the flourishing development of their cities, these provinces boasted a remarkably prosperous economy, comparable to that of the northern Italian cities.[1]

Brussels, once a city of the-Duchy of Brabant in the southern portion of Belgium and the Holy Roman Empire, holds significance in the history of well-known anatomist Andreas Vesalius. The Vesalius family coat of arms, as depicted in his masterpiece, featured three weasels, reflecting the meaning of their surname. Hailing from a lineage of esteemed physicians and pharmacists, Vesalius's father, a pharmacist, and grandfather, a physician, served the Holy Roman Emperor.

In 1529, Vesalius left Brussels to pursue studies at the Catholic University of Leuven, where he delved into courses related to arts. A man of wealth during his time, he studied rhetoric, philosophy, and logic in Latin, Classical Greek, and Hebrew at the Collegium Trilingue. His interest gradually shifted toward medicine during his time in Leuven.

Subsequently, from 1533 to 1536, he journeyed to France to further his medical education at the University of Paris, which had long been the foremost medical school north of the Alps.[2] Instruction was primarily administered through lectures focused on specific texts in Latin, notably works

by Hippocrates, Galen, Avicenna, and Rhazes. During that era, Paris was at the forefront of embracing the Humanistic intellectual movement, which had been established almost two centuries earlier by Petrarch (1304-1374) in northern Italy, particularly in Padua. Afterward, he lectured in surgery and laid the groundwork for a lifelong commitment to studying and teaching human anatomy. While Vesalius' predecessors and contemporaries had also written about anatomical teaching, his work "De Humani Corporis Fabrica" is now widely regarded as a pivotal advancement in the methodology and teaching of anatomical science.[3]

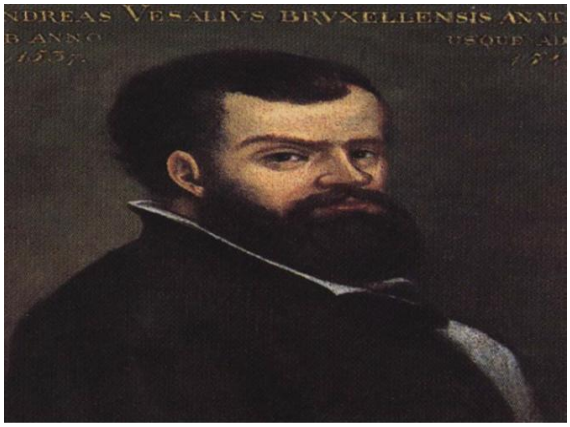

Figure 1: Portrait of Andrew Vesalius.[2]

Figure 2: Political map 1506-1559.[1]

EDUCATION AND TEACHINGS

After a study phase in Louvain, where he learned classical languages, went to medical degree in Paris in 1533, where he was student of the first French anatomist Johannes Quinterus of Andernach and Jacobus Sylvius. The lack of anatomy practical classes at the University of Paris took him in with his peers to visit at night, cemeteries outside the city in search of human bones. In 1537, after completing his bachelor's degree, he sought the University of Padua to perform his doctorate. At 23, after completing his doctorate, he was appointed Professor of Surgery at the University of Padua. As a teacher promoted a major change in the teaching of anatomy by assuming the role of dissecting the corpses made his lessons increasingly attractive to his students and colleagues. The second major innovation promoted by the teacher Vesalius was the development of anatomical drawings with didactic purpose and six of them were published as the tabulae sex Vesalius published the 'venesection letter', a contribution to an ongoing debate on the bloodletting procedure. Vesalius' letter went to great efforts to describe the exact arrangements of the azygous system of veins. This led to further study of the venous system by others, ultimately resulting in the observation of the venous valves, which would in turn formulate the foundations on which William Harvey postulated his theories of circulation.Following the success of the 'tabulae anatomical sex', Vesalius set to work on a greater work, titled 'De Humani Corporis Fabrica'.The majority of the illustrations were made by Jan Stefan van Kalkar, an artist associated with the school of Titian in Venice. Upon publication in 1543, 'De Humani Corporis Fabrica' revolutionized the way anatomy was taught forever.[4]

In 1543, Andreas Vesalius (1514 - ca. 1564) published de Humani corporis fabrica in Basel. It is widely regarded as either an imitation or a refutation of previous anatomical knowledge, particularly the treatises by the classical Greek physician Galen (129-after 216 A.D.). Through an analysis of Vesalius' study of the kidneys (Book V, chapter 10) and a comparison of Vesalius' and Galen's Greek text, it can be concluded that Vesalius closely reproduced Galen's model and text, essentially re-enacting the ancient practice of medicine and dissection.[5]

Figure 3: Andreas Vesalius as anatomist.

ANDREWS VESALIUS CONTRADICTIONS TO GALENS IDIOLISMS ON DISSECTION

In medieval universities, human dissections were generally rare, and public dissections were strictly regulated. During public anatomical lessons, three individuals were involved in conducting an autopsy. The Lector, or lecturer, would read and discuss from an authoritative text, typically Mondino dei Liuzzi's Anatomy. The Ostensor would indicate to the sector, usually a surgeon or barber, the specific body part to be dissected. The dissection would follow the text, unquestioned, and any findings within the body would only serve to confirm the text's statements. In his work De Humani corporis fabrica, Vesalius criticized both the medieval method of dissection and the reliance on authoritative texts for anatomy. Vesalius aimed to combine the roles of lector, ostensor, and sector. According to Vesalius, an anatomy lecturer should be capable of personally dissecting a cadaver and trust his observations over established texts. By relying on direct observation, Vesalius gradually began to question the accuracy of various anatomical assertions in Galen's anatomical treatises. Galen (ca. 130-200) was considered the foremost medical authority during the Renaissance, and his teachings were nearly unquestioned. He personified the idealism of Renaissance humanism, which placed great emphasis on ancient, particularly Greek, medical knowledge. Medical humanists of the time focused on reviving and adhering to the ancients' ideas. While Vesalius was somewhat ambiguous in his response to this idealism, he did find ancient evidence supporting the idea that anatomy should be based on personal experience gained through the dissection of human cadavers. However, he also had to confront the notion of Galen's infallibility. Vesalius reconciled this conflict between his observations and the humanistic ideal by noting that anatomy had reached a much higher level before Galen, in ancient Alexandria, and that Galen had relied excessively on animal dissection in his anatomical works.[6]

VESALIUS'S CONCEPT ON THE FEMALE GENITAL TRACT

Vesalius' works provide insight into his understanding of the female reproductive system. His Tabulae anatomicae sex (1538), the Fabrica (1543), the Letter on Chynaroot (1546), the Fabrica II (1555), and his letter to Falloppio (1564) demonstrate this progress chronologically. Vesalius' illustrations of the male and female reproductive systems reflect the Galenic theory of sexual isomorphism, a belief he upheld throughout his life. While he adhered to this theory, he made advancements in areas such as the structure of the uterus, surpassing his predecessors. For instance, he followed da Carpi's depiction of the uterus as "uterus simplex," but also introduced unique elements such as the epididymis-like structure of the oviducts, and eventually omitted mythical structures like the "ears" near the fundus uteri in his illustrations from 1543 onwards Chapters 15 to 17 of the fifth book of the Fabrica hold particular significance as they mark the first systematic and thorough description of these anatomical parts, accompanied by significant artistic innovation in the form of detailed illustrations. Before Vesalius, no anatomist had presented such intricate and artistic depictions of the female reproductive organs. However, it's important to note that these illustrations and accompanying text were produced during dissections, which may have led to some errors. For instance, Vesalius incorrectly identified the uterine tube as the equivalent of the complex canals through which male seed is expelled from the body. Another example of a misguided "observation," influenced by the prevailing functional theories of his predecessors, is Vesalius's imagined connection of blood vessels between the female internal organs and the breasts.[7]

VESALIUS DEPICTION ON URINARY SYSTEM

A first valuable and interesting document dealing with Vesalius and the kidney consists of the eyewitness report of Baldasar Heseler, a diligent and scrupulous German student of medicine (from Leignitz), which comprises reports of lectures on the 'Anatomy of Mundinus' given by Matheus Curtius at Bologna in January-February 1540 and of the anatomic demonstrations performed by Andreas Vesalius in conjunction with those lectures. After a long and complicated journey, this Latin text arrived in the Royal Library of Stockholm, and was found and translated by Ruben Eriksson in 1959.[9] On the morning of Monday January 20, 1540, at the church of San Francisco in Bologna, Matheus Curtius taught the anato my and physiology of the kidneys. In the late morning, Vesalius performed his tenth demonstration and used a dog and a human body for the dissection of the renal region. An important historical document related to Vesalius and the kidney recounts the firsthand observations of Baldasar Heseler, a meticulous German medical student from Leignitz. Heseler's account includes detailed reports of lectures on the 'Anatomy of Mundinus' delivered by Matheus Curtius in Bologna in January-February 1540, along with the anatomical demonstrations conducted by Andreas Vesalius. This Latin text eventually found its way to the Royal Library of Stockholm, where it was discovered and translated by Ruben Eriksson in 1959. On Monday, January 20, 1540, at the church of San Francisco in Bologna, Matheus Curtius lectured on the anatomy and physiology of the kidneys. Later that morning, Vesalius conducted his tenth demonstration, during which he dissected the renal region using a dog and a human body. This morning, D. Andreas demonstrated a kidney dissection, expanding on Curtius's earlier lecture. He carefully displayed the interior membrane lining the renal cavity, emphasizing the vena and arteria emulgens, and how they enter the renal substance, divide into branches, and form a filtering membrane. He explained the passage of urine into the renal cavity, its conveyance to the bladder through the ureter, and the premature emission of stones, sand, hairs, and blood. Additionally, he described how blood in the urine occurs when the orifices of the veins and arteries lose their retaining faculty. For those interested in

further study, Vesalius' comprehensive book "De Humani Corporis Fabrica" contains an in-depth section on the kidneys in book five, chapter 10Dc Renibus, titled "organis nutritioni." [1]

Figure 4: Anatomical drawings of kidneys.

VESALIUS CONCEPT ON RESPIRATOIRY SYSTEM

Andreas Vesalius (1515-1564), an anatomist, first documented many aspects of pulmonary ventilation in his book De Humani Corporis Fabrica Libri Septem. We examined a digital copy of De Fabrica (1543) and its English translation provided by Richardson and Carman (1998-2009) for mentions of pulmonary ventilation. We discovered that Vesalius understood the basics of tidal and forced respiration. He realized that air was carried into the lungs by atmospheric pressure, approximately 100 years before Borelli. He conducted an in vivo experiment on breathing, 120 years prior to John Mayow's artificial model. Additionally, he discussed positive pressure ventilation through tracheotomy and its life-saving impact, approximately 100 years before Robert Hook did.[8]

He was appointed as a teacher of both human anatomy and surgery. During the 6 years he held this chair, Vesalius engaged in impressive academic activities and published three masterly anatomic books: Tabulae anatomicae sex, de humani corporis fabrica libri septem, and epitome. The last two works contain anatomic woodcuts of incomparable artistic quality by Titian's pupils.[9] The fabrica is constituted by seven books-bones and cartilages, Ligaments and muscles, veins and arteries, nerves, organs of nutrition and generation, heart and associated organs, and brain. The abriged epitome, intended to be "the guide, index, and compendium of the fabrica", was dedicated to "the students as a handbook for dissections andto physicians and surgeons, who, preparing for an operation, had to recall the position and the form of a bone or of an organ". It contains six chapters, the 5th one concerning the "brain and the nervous system which merits here a special mention.[10] To learn more about vesalius and his achievement in creating De Fabrica, visit NLM's turning the pages project featuring this important work. To view selections from the library's collection of anatomical atlases, visit historical anatomies on the web.[11] He was appointed as a teacher of both human anatomy and surgery. During the six years he held this position, vesalius engaged in significant academic activities and published three masterful anatomical books: tabulae anatomicae sex, de humani corporis fabrica libri septem, and epitome. The latter two works feature anatomical woodcuts of exceptional artistic quality created by students of Titian.

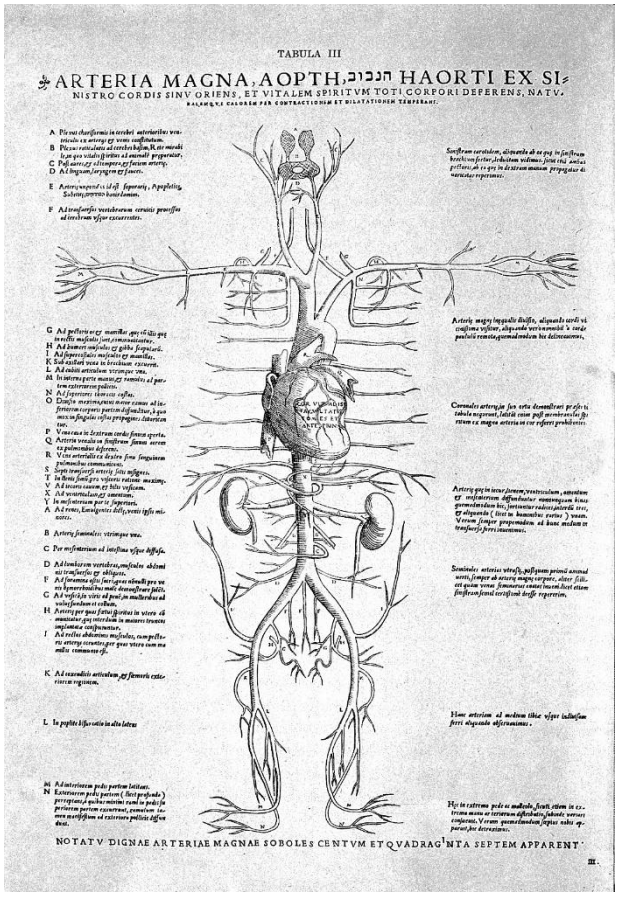

Figure 5: Arteria magna (the aorta) of Vesalius' tabulae anatomicae sex (Vesalius 1538).

*The heart is defined as "source of vital spirit and the arterial system"; the pulmonary vein is the structure which "brings air from lungs to the left ventricle". All of these ideas were strictly Galenic.[13]

The Fabrica is divided into seven books: bones and cartilages, ligaments and muscles, veins and arteries, nerves, organs of nutrition and generation, heart and associated organs, and brain. The abridged Epitome, intended as "the guide, index, and compendium of the Fabrica," was dedicated to students as a handbook for

dissections and to physicians and surgeons who needed to recall the position and structure of a bone or organ before an operation. It contains six chapters, with the fifth chapter specifically addressing the "brain and the nervous system," which merits special mention.

To learn more about Vesalius and his achievements in creating De Fabrica, visit the NLM's turning the pages project featuring this important work. You can also view selections from the library's collection of anatomical atlases at historical anatomies on the web.

VESALIUS CONCEPT ON CARDIOVASCULAR SYSTEM

Vesalius' observed that the pericardial anatomy: "The heart as a whole is usually covered by a membranous envelope which is not attached to any point. This wrap is much broader than the heart and has in its interior an aqueous humor.[12]

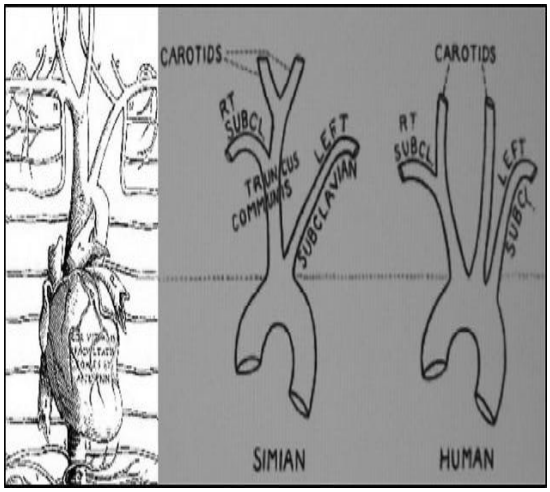

Figure 6: Vesalius' tabulae anatomicae sex (Vesalius 1538).

*Showing the heart and the structure of the carotids; on the right: structure of the carotids in human and simian, demonstrating that Vesalius represented in man the structure typical of simian, following Galen's anatomy.[14]

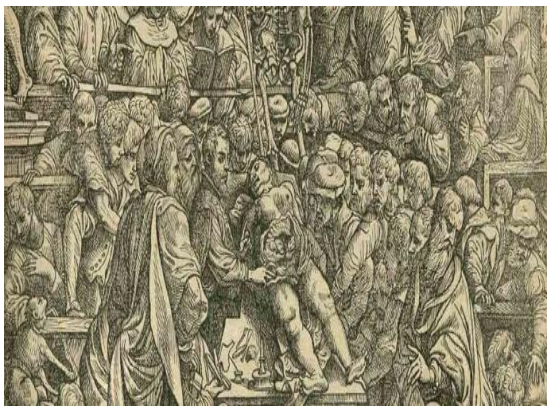

Figure 7: Andreas Vesalius De Fabrica.

ANDREAS CONCEPT ON NERVOUS SYSTEM

Some technical advancements, such as the preservation of brain tissue in alcohol for hardening and the staining techniques developed by Weigert, Marchi, and Nissl, which enabled refined macro-and microscopic examinations of the nervous system, were only introduced in the 19th century. The fourth book focuses on the peripheral nervous system. According to Vesalius, there are seven pairs of cranial nerves. His first pair corresponds to our optic nerve (Nervous opticus); the second pair pertains to our oculomotor, trochlear, and abducens nerves (Nervi oculomotorius, trochlearis, and abducens); the third pair encompasses a significant portion of our trigeminal nerve (Nervus trigeminus); the fourth pair aligns with our maxillary nerve (Nervus maxillaris); the fifth pair includes our facial and vestibulocochlear nerves (Nervi facialis and acusticus); the sixth pair comprises our vagus and accessory nerves (Nervi vagus and accessorius); and the seventh pair consists of our hypoglossal and pharyngeal nerves (Nervi hypoglossus and pharyngeus). Vesalius notes thirty pairs of spinal nerves, and his descriptions of the brachial and sacral plexuses are remarkably close to modern understandings. However, his teleological explanations regarding their functions are notable, particularly concerning the path of the recurrent nerves (Nervi recurrentes). The seventh book delves into the brain, wherein he accurately describes the cerebral membranes, ventricles, and cerebrum, relying on a series of horizontal sections. He also explores the brainstem and cerebellum. Though Vesalius expressed skepticism about the existence of the reticular plexus in humans, he provided a biased account of the infundibulum based on an incorrect physiological theory concerning the secretion of "pituita," which he regarded as the stagnant refuse of the ventricular system. Additionally, a chapter in the third book is dedicated to the blood circulation within the nervous system, albeit with inevitable errors stemming from Vesalius' Galenic views on blood distribution. It is worth noting that Vesalius rightly emphasizes the segmental nature of blood circulation in the spine.[14]

CONCLUSION

From the above description we can conclude that Andreus Vesalius was a pioneer in human cadaveric dissection of different systems and he was the only novel laureate who could initiate human dissection instead of animal.

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