

Andreas Vesalius as a renaissance innovative neuroanatomist: his 5th centenary of birth

Andreas Vesalius como neuroanatomista inovador renascentista: seu 5^o centenário de nascimento

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ABSTRACT

Andreas Vesalius (1514-1564) is considered the Father of Modern Anatomy, and an authentic representative of the Renaissance. His studies, founded on dissection of human bodies, differed from Galeno, who based his work on dissection of animals, constituted a notable scientific advance. Putting together science and art, Vesalius associated himself to artists of the Renaissance, and valued the images of the human body in his superb work *De Humani Corporis Fabrica*. This paper aims to honor this extraordinary European Renaissance physician and anatomist, who used aesthetic appeal to bind text and illustration, science and art. His achievements are highlighted, with an especial attention on neuroanatomy. Aspects about his personal life and career are also focused.

Keywords: neuroanatomy, history of medicine, Vesalius.

RESUMO

Andreas Vesalius (1514-1564) é considerado o Pai da Anatomia Moderna e um autêntico representante da Renascença. Seus estudos, baseados na dissecação de corpos humanos, diferiam dos de Galeno, que baseava seu trabalho em dissecação de animais, constituiu-se em um notável avanço científico. Reunindo ciência e arte, Vesalius associou-se a artistas da Renascença e valorizou as imagens do corpo humano em seu soberbo trabalho *De Humani Corporis Fabrica*. Este artigo visa honrar esse extraordinário médico e anatomista da Renascença europeia, que fez uso do apelo estético para coligar texto e ilustração, ciência e arte. Suas realizações são realçadas, com atenção especial na neuroanatomia. Também são colocados em foco aspectos da sua vida pessoal e de sua carreira.

Palavras-chave: neuroanatomia, história da medicina, Vesalius.

Andreas Vesalius (31 December 1514, Brussels – 15 October 1564, Zante) combined the skills of physician, anatomist, teacher, philologist, artist, philosopher, and poet, was a man worthy to be known as “*un uomo universal*”, in the booming Renaissance meaning. He may be considered the best scientist of the Renaissance since Leonardo da Vinci^{1,2}.

The 5th centenary of his birth gives the opportunity to pay tribute to this gifted man.

VESALIUS' TRAJECTORY

Vesalius studied Medicine in Louvain and Paris (1533-1536), where he obtained the degrees of Bachelor and of Doctor of

Medicine (1537). Immediately nominated Professor of Surgical Anatomy in Padua, he stayed there between 1537-1542^{3,4} (Figure 1).

Before Vesalius time, Galen (Claudius Galenus [129-216(?)] pontificated among the anatomists, hindered by religious norms that only permitted to dissect animals. Despite this, Galen was one of the most influential anatomists ever, remaining uncontested for 1300 years⁴. Such norms were changed by Pope Sixtus IV (1471-1484) who issued a bill permitting studies on human bodies, confirmed by Clement VII (1523-1534)⁵. Initiated by artists occurred a change in the way of studying anatomy, among them was Leonardo da Vinci (1452-1519), who performed dissections of human cadavers. His work and his drawings provided

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⁵The authors are sorry to notify that Professor Moscovici died on 25th September, 2014. The present paper now represents a homage to the personality, his life and deeds.

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Figure 1. Vesalius Portrait (Vesalius's *Fabrica*, 1555)⁷.

realistic anatomical illustrations^{1,6}. A short time later, Vesalius began to dissect human cadavers, revealing novel anatomical details, in disagreement with many longstanding Galen's findings². Considered a heretic by Galen's followers, among them his former teacher Jacobus Sylvius, whose request to renounce his heretical statements, Vesalius denied⁶. He counted with many defensors, as students and numerous physicians, as Ambroise Paré (1510-1590) who popularized Vesalius' ideas among surgeons³.

Vesalius introduced a revolutionary concept of teaching based on dissection, observation, and use of illustrative

sketches, combined with a critical spirit and a sense of experiment. The usefulness of the sketches resulted in the *Anatomicae Tabulae*, published in 1538. Dissection became a practical activity, different from the traditional way, exerted by assistants, with a doctor of Medicine reading Galen's books, and without manual labor⁶.

He married Anne Hamme (1534), and about a year later, they had Anne, their only daughter³. Possibly to have a pretext to leave the position as imperial physician first of Charles V and after of Philippe II and go back to Padua, he engaged in a trip to the Holy Land in 1564. He died tragically on his way home, in a shipwreck^{2,3}.

VESALIUS' ANATOMY

The publication of his masterpiece, the *Fabrica*, and the partial digest, the *Epitome*, in 1543, represented a breakthrough for the knowledge of anatomy of the human body, being still considered the jewels of medical literature and anatomic iconography^{2,3,4} (Box 1). There is a plethora of anatomical data with details of rare precision, and descriptions and illustrations of all bodily systems⁴. Leonardo's meticulous and artistic anatomical drawings were quite unknown to the scientific world, whereas the *Fabrica* caused an immense commotion, mainly among physicians and surgeons⁶.

His illustrations, famous not only for their artistic excellence, but also because many displayed the human body (skeleton, muscular system, others) in dynamic positions of real life situations, and with panoramic landscape backgrounds. Some illustrations may permit inferences about behavior, e.g., the skeletons postures may suggest ways of thinking, concern with life and death (Figure 2).

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 Brain⁷. The abridged *Epitome*, intended to be "the guide, index, and compendium of the *Fabrica*", was dedicated to "the students as a handbook for dissections and

De humani corporis fabrica libri septem, the *Fabrica*, 1st edition, came to light in 1543, by the printer Johannes Oporinus, from Basel. It is one of the most influential books on human anatomy, and considered one of the great scientific and artistic oeuvre of mankind. The *Fabrica* is illustrated with detailed illustrations, printed with woodcut engravings, in Venice, with the identity of the artist is uncertain. Possibly the contribution was of one of the artists, the Flemish Van Calcar, and possibly of others, of the atelier of master Titian, and some of the plates are credited to Vesalius. It is constituted by 7 books, comprising all systems of the human body. The *Fabrica*, 2nd edition, released in 1555, dedicated to Charles V, is considered more sumptuous than the 1st one. There are also corrections, decrease of redundancies, as well as inclusion of physiological experiments, by means of nervous section, e.g., section of the recurrent nerve, with consequent laryngeal paralysis. *De Humani corporis fabrica librorum Epitome*, the *Epitome*, printed in 1543, was intended by Vesalius to be a very brief descriptive book, being a remarkable condensation of the 1st edition of the main book. It has 6 chapters, the 5th concerned with The brain and the nervous system. These oeuvres constitute a milestone in the study of human anatomy and neuroscience. However his work was not limited to these publications, including, among others: *Paraphrasis in nonum librum Rhazae*, 1st Vesalius book, with Paraphrase of the ninth book by the most famous Arab physician Rhazes [addressed] to King Almansor, deals with treatment of diseases affecting the various parts of the body, with several editions, between 1537 and 1592.

Box 1. *De Humanis corporis fabrica libri septem*, or the *Fabrica*, and others^{3,7,8}.

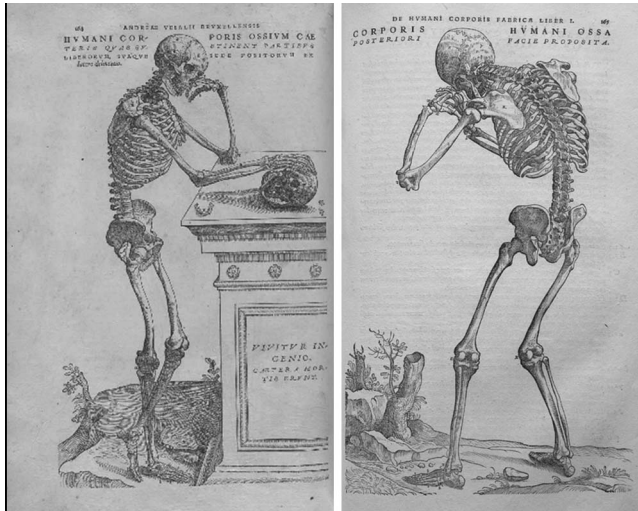


Figure 2. Illustrations from Vesalius' *Fabrica* (1555)⁷. Skeletons and their expressive postures.

to 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"^{1,6,8}, which merits here a special mention (Box 2).

VESALIUS AS A PHYSICIAN

After his publications, as he felt that he had already overcome the lamentable situation of anatomical knowledge, he decided to start medical practice, as traditionally members of his family were at service of the holy Roman emperor as physicians for at least four generations^{2,3,9}. He received the position of imperial household physician (1544), leaving his

post in Padua. However, his traditionalist new colleagues, condemned Vesalius's modern perspective^{2,6}. However, he maintained interest in anatomy, and participated in postmortems in a nearby School of Medicine, and while acting as a military surgeon during the Emperor's various battles². Surgery and anatomy were then considered of little importance in comparison to the other branches of Medicine. However, Vesalius believed that surgery had to be grounded in anatomy⁶.

Over the next years he traveled with the court, treating injuries from battle or tournaments, performing postmortems, administering medications, and writing private letters addressing specific medical questions. He wrote a pamphlet on blood letting, a popular treatment for a variety of illnesses, supported by his knowledge of the vascular system, showing how anatomical dissection could be used to test speculation, and underlining the importance of understanding the structure of the body in Medicine^{2,6}. He also became the first person to describe mechanical ventilation, an outstanding achievement in Anaesthesia¹⁰.

FINAL REMARKS

This tribute to Vesalius honors his detailed dissection of the human body, which reconsidered profoundly Galen's millennial findings, and connected anatomy to high quality artistic illustrations. This distinguished him from his contemporaries, some with relevant contributions to anatomy. Vesalius set a solid foundation of anatomy, paving the way for its further development in the next centuries. Thus he may be seen as the Father of modern anatomy, and an authentic representative of the Renaissance in the field of science and art.

The *Fabrica* is an extended and profusely illustrated book, while the *Epitome*, appears in a condensed format. Vesalius begins the chapter of the *Epitome*, concerning The Brain and the Nervous System, with the statement: The brain, the seat of the animal and the principal faculty, lies in the skull and admirably fits the form of the cavity in the upper region of the head which it occupies throughout its length. Some excerpts, cited in an abridged form, follow. The opening of the vault of the cranium shows (Figures 3A, 3B, 3C and 3D) the cerebrum protected by a tough membrane (dura mater), and after its removal, right and left parts of the brain, joined at the midline base, and continuous with the dorsal medulla (oblongata and spinalis) may be seen. The dura mater sends a fold between the two parts of the cerebrum (falx cerebri), and between the cerebrum and the cerebellum (tentorium cerebelli). The exposed cerebrum permits to see the internal structures in axial sections at several levels; the upper level reveals two large cavities (lateral ventricles), the cortical convolutions, subcortical white matter, caudate nucleus, thalamus, and the choroid plexus; a deeper level shows subcortical structures, as the thalamus, globus pallidus, putamen and caudate nucleus, internal and external capsules, and the intervening white matter, as well as the cerebral cortex. Ablating the posterior part of the cerebrum reveals the cerebellum and the upper brain stem, and after flipping anteriorly the cerebellum, the entire brain stem and upper spinal cord are disclosed. Internally, the lateral ventricles are in connection with the 3rd one, and the latter continues with a canal (aqueduct) that ends in the 4th ventricle. Inside the ventricles may be seen a plexus or network (choroid plexus). The septum (septum pellucidum), corpus callosum, the vault (fornix), and the cerebellum, and their relation with these cavities are described. A basal view of the cerebrum reveals the seven pairs of nerves (cranial nerves), the 1st pair represent the optic nerves, which end in the tunic of the eye. The organ of smell (olfactory tract and bulb), not classified as a nerve, is described at the base of the brain. Then Vesalius continues with detailed description of the cranial, spinal, and peripheral nerves (Figures 4A, 4B and 4C). He also offers functional considerations proper of his time, citing the phlegm of the brain and its flow through a funnel shaped channel (infundibulum) down to the nostrils, after having been distilled by a quadrate gland (pituitary gland). And follows with the reflection that the vital spirit adapted in the plexus, and from the air drawn to the ventricles by the breath, the inborn force of the brain's substance creates the animal spirit of which the brain makes use partly for the functions of the chief portion of the mind.

Box 2. Neuroanatomical observations from the *Fabrica* and the *Epitome*^{1,3,7,8}.

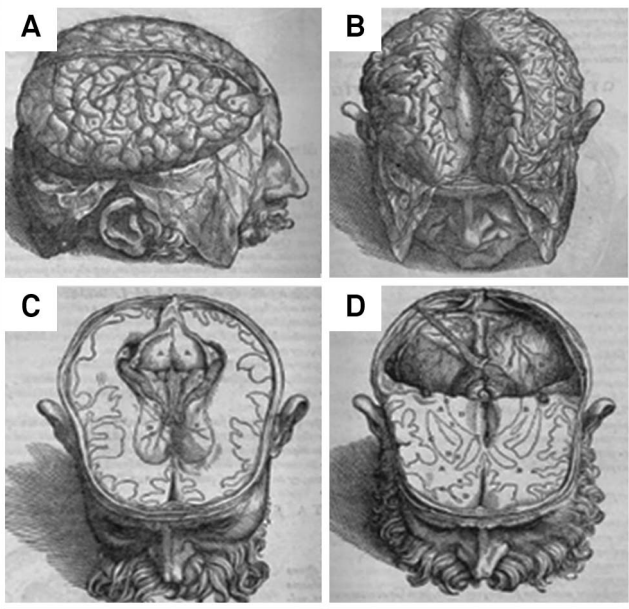


Figure 3. Illustrations from Vesalius' *Fabrica* (1555)⁷. Series of brains (description in Box 2).

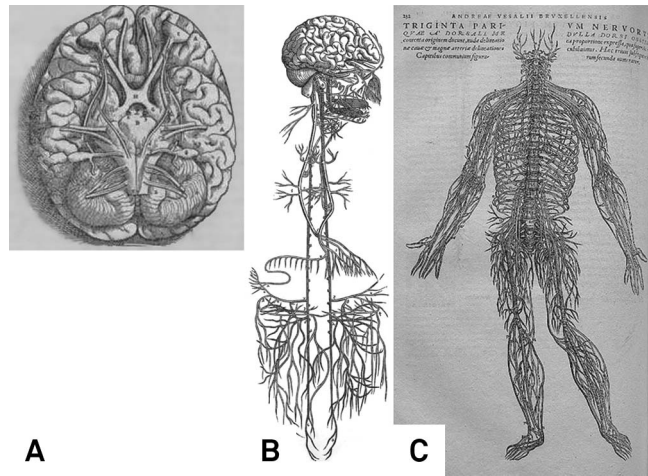


Figure 4. Illustrations from Vesalius' *Fabrica* (1555)⁷. Peripheral nervous system (A and B: Cranial nerves; C: Spinal nerves).

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