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Cranial Nerve Anatomy in As-Safwa by Abu Nasr Al-Masihi

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Abstract

Introduction: Knowledge of cranial nerve anatomy has evolved over centuries, from the writings of Galen in the second century, who described 7 nerves, to Versailles in the 16th century, to our current 12-nerve anatomical understanding adopted under Soemmerring in the 18th century. The Arabic golden age of medical transcription is often overlooked, given that little of that period remained after the end of Islamic rule. Here we translate a chapter found in the medical text As-Safwa by Iraqi Physician Al-Masihi, as seen in the Wellcome Online Library. **Methods:** The manuscript of As-Safwa by Abu Nasr Al-Masihi, obtained from the Arabic Manuscripts Collection of the Wellcome Library (London), was reviewed, and the primary author translated relevant chapters on neuroanatomy of the cranial nerves. A transcript of the chapter was included as it is licensed under a Creative Commons Attribution 4.0 International License. **Results:** Abu Nasr S Al-Masihi was a physician who resided in Baghdad in the 13th century. He was known for having treated the Abbasid Caliph Al-Nasir li-Din Allah. Like what was commonly taught by his contemporaries, Al-Masihi described in "As-Safwa" seven cranial nerves. He disregarded the olfactory tract in his discussion and began with a discussion of the optic nerve. He singled out this nerve in describing its texture, as did Galen. **Conclusion:** The transcription of As-Safwa was completed decades following the fall of the Abbasids. Al-Masihi likely contributed to the House of Wisdom's efforts of medical knowledge documentation due to their association with the Royal families, which had sponsored the accumulation of scientific texts in Baghdad's libraries. However, the contributions of many of the physicians of their time will, unfortunately, remain unknown.

Keywords: Neuroanatomy, History of Medicine, Islamic Medicine.

INTRODUCTION

Abu Nasr Sa'id Ibn Abi Al-Khare Ibn Issa Ibn Al-Masihi was a physician who resided in Baghdad in the 13th century. He was known for having treated the Abbasid Caliph Al-Nasir li-Din Allah. The Caliph at the time was described to have come down with a severe ailment caused by a stone in his bladder. Abu Nasr Al-Masihi was then recommended to him as one of Iraq's finest physicians.[1,2] In this manuscript, we describe a chapter in his writings reflecting the knowledge regarding cranial nerve anatomy at that time.

The History of Cranial Nerves in the Middle Ages

Galen (129 – 210 AD) described 7 pairs of nerves in his notes. He considered the olfactory nerves a brain tract and not a cranial nerve. The first pair of nerves he referenced was the optic nerve, which he described as joined at the optic chiasm. He maintained, however, that there was no crossing of the nerve fibers at this junction. Additionally, he noticed that this nerve had a different texture than other nerves, with the inner part being softer than the outer. He noted that the oculomotor nerve provided movement function to the eye muscles and named it the second nerve. He did not write on the trochlear or abducens nerves. The trigeminal nerve was two separate pairs in his system: the third and fourth.[3,4] As for what is now known as the facial and vestibulocochlear nerves, he classified them as one pair of nerves (the fifth nerve in this system). Followers of Galen adopted this until Soemmerring correctly identified them as separate nerves in 1778.[3,5] Galen, however, correctly identified the functions of this nerve as that which "arrives on the face"

and serves the function of conveying auditory sensation. [6]

Galen's writings described the sixth nerve as a combination of the glossopharyngeal, vagus, and spinal accessory nerves. The seventh nerve was the hypoglossal nerve, which he said innervated the tongue muscles.[3,6]The seven-nerve system persisted in descriptions of cranial anatomy for centuries until Vesalius, and various modifications were made to the system during that time.[3,7] The 12-nerve classification was adopted by Soemmerring and is still in use today.[5]

During the immense translation efforts of the middle ages in the Arab and Islamic world, many influential scholars were responsible for preserving the contributions of their predecessors. Figures such as Avicenna, Albucasis, and Rhazes accomplished the immense task of translating the work of Hippocrates and Galen.

Abu Bakr Muḥammad ibn Zakariya al-Razi (865-925 AD), known as Rhazes in Latin, was one of the most prolific clinicians of the Middle Ages and possibly the most outstanding physician of the medieval times – a close contender for this title is Ali Al-Husayn ibn- 'Abd-Allah ibn-Sina, known as Avicenna (937 to 1037 AD). [8,9]

Rhazes' writings in *Kitab al-Hawi fi tebb* contained descriptions of the neuroanatomy of cranial and spinal cord nerves, which he used to localize lesions of the nervous system. [10]Although his work is known for following many of Galen's teachings, he did oppose some of his writings, most notably stating that the brain, spinal cord, and ventricular paired structure, contrary to what was believed prior to this, which was that these structures were singular organs. [11]However, his descriptions of the seven cranial nerves was identical to that of Galen. [10]

Little is described in the literature on the life and history of Al-Masihi, and his exact date of birth and death are unknown. His most notable work was a medical textbook titled "*Kitab Intikhab al-iqtidab*" which contained questions and answers on various medical topics. The book was organized into chapters discussing several diseases, their etiologies, and medications used in treatment. [2]In this article, we review his descriptions of the anatomy of the cranial nerves in a lesser-known book by Al-Masihi, called *As-Safwa.*

METHODS

The manuscript of *As-Safwa* by Abu Nasr Sa'id Ibn Abi Al-Khare Ibn Issa Ibn Al-Masihi was obtained from the Arabic Manuscripts Collection of the Wellcome Library (London), was reviewed, and relevant chapters (chapter 15) on the neuroanatomy of the cranial nerves were translated from Arabic. The translation was performed by the primary author, a resident physician in Neurosurgery fluent in both English and Arabic, and reviewed by the second author, who is also a resident physician in neurosurgery and fluent in both languages. Excerpts and screenshots of the original manuscript were included in this review under a Creative Commons Attribution 4.0 International License (https://creativecommons.org/licenses/by/4.0/). For the literature review, PubMed, the Wellcome Library Online, and online Google Scholar searches were used to perform a review using the keywords: Cranial nerves, Galen, Rhazes, Vesalius, History of cranial nerves, and History of Arabic medicine. Articles in English describ-

ing relevant cranial nerve anatomy by prominent historical physicians and scientists were included in the literature review.

RESULTS

As-Safwa

In the last paragraph of the manuscript of *As-Safwa,* it is noted that the transcription of this book was completed on the 21st of Shawwāl, 695 Hijri, which fell on August 23, 1296 AD – nearly three centuries after Rhaz'es' *Kitab al-Hawi fi tebb*. The last paragraph of this book (Figure 1) reveals the identity of the person who transcribed the notes of Al-Masihi: The transcriber went by the name of Ibn Ulkis Al-Mutabib, who was another Arab physician practicing near the end of the rule of the Abbasids.[12] He was the personal physician of the last Abbasid Caliphate in Baghdad, Al-Musta'sim Billah, who killed the Mongols upon their invasion of Iraq. Hulagu Khan, leader of the Mongols, ordered the killing of Al-Musta'sim on February 18, 1258 AD, by leaving him to starve to death in a closed chamber, surrounded by the empty plates of gold and gems he had collected during his rule of the caliphate. [12,13]It is said that following the death of the Caliph and the fall of the Abbasid empire in Iraq, Ibn Ulkis isolated himself from the public until his death. [12]

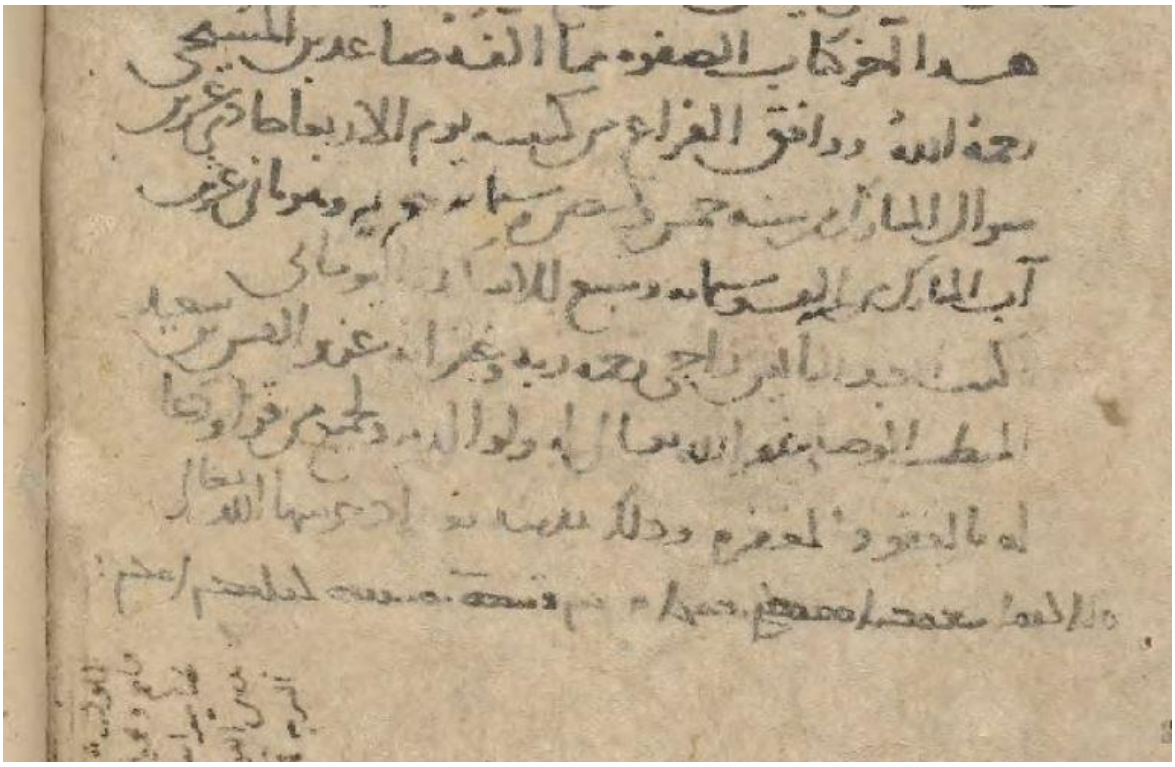

Figure (1): The last paragraph of "As-Safwa," in which the writer Ibn Ulkis Al-Mutabib attributes the teachings in this book to Abu Nasr Al Masihi and states that the work was completed on the 21st of Shawwāl, 695 Hijri.

The book starts with the teachings of Avicenna on humorism, with chapters regarding blood, phlegm, yellow, and black bile. In Chapter 15 (Figure 2), which carries the title "*On the dissection of nerves, starting with what initiates from the brain,"* Al-Masihi writes the following:

The nerve is an organ that originates from the brain and the spine to serve the purpose of sense and motion. Seven pairs of nerves originate from the brain, the first of which provides the eyes with a sense of sight. This nerve is hollow and starts at the end of the two frontal lobes. These two nerves come together in shape (X), then separate to arrive at its adjacent eye. The second pair of nerves originate behind the first pair and provide the eyes with the ability to move.

The third nerve originates behind the second, where the frontal lobes end and the hind lobes begin, at the base of the brain, and intermix with the fourth pair of nerves.

The third nerve divides into four parts: A) one of which travels to the gut and further divides there. B) A second part attaches to the fifth nerve, C) and a third part which divides into three parts:

1. one reaches the smaller (Al-mak), the two chewing muscles, the two temporal muscles, and the eyebrows and eyelids;
2. another which reaches the nose and its inner part and the more prominent (Al-mak),
3. Moreover, a third reaches some of the upper parts of the mouth, the gums, and the upper jaw. Furthermore, some of it branches to the outer part, so it reaches the tip of the nose, the upper lip, and the face's skin.

D) Most of the fourth part reaches the tongue and provides it with a sense of taste, and the rest reaches the roots of the teeth, the gums, and the lower lip.

The fourth pair of nerves reach the layer covering the palate and only provides it with sensation.

The fifth pair serves two functions for hearing and for moving the cheeks

As for the sixth pair, some reach the throat, some to part of the shoulder, some to the larynx and tongue, some to the heart, lung, and esophagus, and the biggest reach the diaphragm, the mouth of the stomach. The remains of this nerve reach the guts and meet the part of the third nerve.

The seventh pair originates from the back of the brain, where the spine starts, innervating the tongue and throat muscles.

DISCUSSION

Similar to what was commonly taught by his contemporaries, Al-Masihi described seven cranial nerves. He disregarded the olfactory tract in his discussion and began with a discussion of the optic nerve. He singled out this nerve in describing its texture, as did Galen. However, he mentions that the nerve is hollow instead of softer inside. He describes the chiasm and draws an "X" in his text about the crossover of nerves. His second pair of nerves describes the oculomotor nerve, which he notes provides the eye with movement. The third nerve in this chapter refers to a combination of the trigeminal, facial, and vagus nerves. The inclusion of the vagus nerve in

this nerve stands out as he describes later in this chapter that this nerve in the gut meets the sixth nerve. The fourth nerve, which joins the third nerve, had a specific function: to provide sensation to the roof of the mouth. The fifth pair of nerves in this chapter serves two functions: "hearing," which refers to the vestibulocochlear nerve and moving "the cheek," which would be the facial nerve. From the functions listed for the sixth nerve, Al-Masihi appears to have described a combination of the glossopharyngeal ("reaches the throat"), the spinal accessory ("the shoulder"), and the vagus nerves ("the heart, lung, and esophagus, and the most significant part reaches the diaphragm and the mouth of the stomach). Galen initially identified this group of nerves as the sixth nerve as well. [14]

The description of the seventh nerve is concordant with Galen's notes, which refers to the hypoglossal nerve, as it innervates "the muscle of the tongue." [6]

CONCLUSION

Abu Nasr Al-Masihi followed in the footsteps of the giants of the Islamic golden age of science and medicine. He provided a detailed description of the innervation of cranial nerves and their functions, and though there is no mention of Galen or Rhazes in this manuscript, the writing seems to agree with their knowledge of the seven-nerve classification. The solid scientific movement during the Abbasid times had been coming to an unfortunate end at the time that Al-Masihi was practicing medicine, for the Caliphates that had taken the throne near the end of the Abbasid empire did not show the same interest that their predecessors did in science. The House of Wisdom, which reflected the outstanding efforts of the scientific community in Baghdad to translate and produce literature in numerous fields, had come to a disastrous end in 1258 when the Mongols sieged Baghdad. The fate of thousands of manuscripts were to be thrown into the Tigris River. [15]It is said that so many of Baghdad's books had been in the Tigris that "a horse could walk across on them" and that the river "ran black with scholars' ink and red with the blood of martyrs." [16]

The transcription of *As-Safwa* was completed decades following the fall of the Abbasids and is one of the few remaining clues as to the history of medicine during that era. Al-Masihi and Ibn Ulkis' likely contributed to the House of Wisdom due to their association with the Royal families, which had sponsored the accumulation of scientific texts in Baghdad's libraries. However, the contributions of many of the physicians of their time will, unfortunately, remain unknown.

Figure (2): As-Safwa - Chapter 15 (left page): On the dissection of nerves, starting with what initiates from the brain.

Ethics approval and consent to participate

N/A (this study does not involve any human or animal subjects, no consent was required

Consent for publication

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Availability of data and materials

available online at https://wellcomecollection.org/works/cvq9w87r/items.

Author's contributions:

Hael Abdulrazeq: conceptualization, writing-original draft, data curation, investigation, methodology, supervision, validation, visualization, and writing review & editing. **Mousa Hamad**: methodology, supervision, validation, visualization, and writing review & editing **Aisha Obeidallah**: methodology, validation, visualization, and writing review & editing. [**Hebah Najib:** methodology, validation, visualization, and writing review & editing. **Peter Carmel**: conceptualization, data curation, investigation, methodology, supervision, validation, visualization, and writing review & editing

Competing Interests

None.

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