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CONTRIBUTION OF UNANI SCHOLAR IN TASHREEH OF DIMAGH AND NUKHA

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ABSTRACT

The detailed overview of the significance of the human brain and spinal cord in both Unani and classical medical traditions emphasizes the importance of the brain (Dimagh) as the central organ of the nervous system, linking it to vital functions such as consciousness, creativity, intelligence, memory, language, and emotion. The spinal cord (Nukha) is also highlighted as a crucial component within the vertebral canal. The three meninges—dura mater, arachnoid, and pia mater—are identified as the protective coverings of both the brain and the spinal cord.The contributions of renowned Unani scholars like Buqrat (Hippocrates), Herophilus, Galen (Jalinoos), Zakariya Razi, Ali ibn Abbas Majusi, and Ibn Sina (Avicenna), noting their significant work in the anatomy and understanding of the brain and spinal cord. These scholars not only described the structure of the brain but also provided insights into its functions, laying the foundation for modern anatomical understanding. The primary aim of the study seems to be an exploration of the historical evolution of brain and spinal cord anatomy (tashreeh-e-dimagh and nukha), particularly focusing on the contributions of Unani physicians. The research involves gathering material from classical Unani texts such as *Kamil-us-Sana*, *Al-Qanoon fit Tibb*, and *Kitab al-Mansoori*, as well as from modern books, journals, and research papers. The paper aims to recognize the impact of Unani physicians in the field of brain and spinal cord anatomy and hopes to provide valuable material for further research in this area.

KEYWORDS: Brain (dimagh), spinal cord (Nukha).

INTRODUCTION

The brain, or *dimagh*, holds a central place in the human body, serving as the seat of consciousness, creativity, intelligence, memory, language, and emotion. It is responsible for regulating a majority of the body's functions, including the processing, integrating, and coordinating of information received from the sensory organs, and making decisions about the instructions that are sent to other parts of the body.[1] These functions elevate the brain to one of the most crucial organs within the human body.

Historically, both Greek and Arab scholars considered the brain to be one of the vital organs, reffered to as *Aaza'a Ra'eesa*, highlighting its importance.[2] Unani medicine, particularly, made significant strides in the field of brain anatomy, with early physicians recognizing the brain as the organ responsible for intelligence and consciousness. Alcmaeon, who identified the brain as the site of sensation and cognition, marked an important early understanding of its role in mental processes. Hippocrates, who emphasized the brain as the superior organ controlling bodily functions, was an influential figure in the development of early medical thought. Herophilus, often regarded as the "father of anatomy," made pioneering discoveries about the brain, particularly distinguishing between the brain and cerebellum, identifying key structures such as the brainstem, spinal cord, and meninges, and even describing the internal surface of the skull and cranial sutures.[3,4] Galen, a Roman physician, expanded on Herophilus's findings by performing dissections, discovering structures like the corpus callosum, ventricles, and meninges, and providing detailed accounts of their functions.[5]

LITERATURE REVIEW

Alcmaeon(500B.C) of Croton, proposed that the brain is the center of cognition and sensation.[3] He emphasized that the brain (*dimagh*) played a central role in both intellectual activities and sensory experiences. His claim that the brain is the "hegemonic" part of the body underscores the importance he placed on it as the seat of thought and reason.[6,7,8]

Hippocrates' suggested that the brain was responsible for cooling the body through some kind of secretion[4,5,25] The two hemispheres of the brain, which are separated by a structure called the *falx cerebri*, are membranes that divides the brain into two halves. The description of the carotid and vertebral arteries, indicates that these are the main arteries that supply blood to the brain.[6] The membranes surrounding the brain are known as the meninges and the spinal cord emerge from the brain, at the level of the medulla oblongata, and runs down the back.[7,9]

Hippocrates, on the other hand, proposed a theory of the spine that still had elements of speculative thinking, such as "mucous connections" between vertebrae, which were likely his interpretation of ligaments and tissues that connect bones. His description of the spine as being made up of vertebrae linked by anterior and posterior nerves also shows how early physicians understood the spinal structure as central to bodily functions.[4,11]

Aristotle (*Arastu*, 384 B.C.) describes two hemispheres of the cerebrum, and distinguishes the cerebellum (“parencephalis”) as a separate structure at the back of the brain with distinct appearance and texture. Additionally, there’s the belief that the heart, rather than the brain, was the seat of intelligence.[6,12,13]

The brain is divided into two hemispheres (left and right), each enclosed by protective membranes. His view of the cerebellum being located at the caudal end of the brain was part of his broader attempt to categorize and understand the body. The claim that the cerebellum has *“no continuity with the organs of sense”* also made.[4,11] He describes the two meningeal layers of the brain: the dura mater and pia mater, with their specific names in Arabic, "Umm-e-galeej" for dura mater and "Umm-e-raqeeq" for pia mater.[13]

Herophilus recognized the brain as the seat of intelligence.[12] The brain is divided into several parts, with two major sections being the cerebral hemispheres (the cerebrum) andthecerebellum, Cerebrum, Cerebellum, Brainstem.[14] He believed that the ventricles of the brain were the seat of both the soul and mental functions.[15]

Erasistratus, noticed that the cerebrum had a more complex surface with folds, and he proposed that the extent of these convolutions was related to intelligence.[12] He added more clarity to the concept by dividing the brain into four main cavities (or ventricles).
Galen of Pergamon (129-200 A.D.), described the meninges, the protective coverings of the brain. He recognise the corpus callosum was significant. He observed bundle of nerve fibers connecting the left and right cerebral hemispheres, allowing for communication between the two sides of the brain. He understood that the brain contained a series of fluid-filled spaces (ventricles). These ventricles are part of the cerebrospinal fluid (CSF) system, which plays an important role in cushioning and protecting the brain. The Aqueduct of Sylvius connects the third and fourth ventricles in the brain and is responsible for the flow of cerebrospinal fluid. The choroid plexus is a network of blood veins that connects the brain's ventricles. Galen recognized it as a mixture of veins and arteries, which is produces cerebrospinal fluid. The pineal gland ("conarium") because of its pinecone-shaped appearance it is situated near the center of the brain and close to the aqueduct connecting the third and fourth ventricles. The fornix is a major fiber tract in the brain that connects various parts of the limbic system, including the hippocampus, to other structures such as the hypothalamus. Galen describes it as a "white-colored long arch" resembling a vaulted roof, likely because of its curved, arched shape. It provides a structural connection between parts of the brain involved in memory and emotion.[19,20]

Galen's understanding of the brain's role in sensation and voluntary movement, particularly his concept of the *hegemonikon*. In Galen's philosophy and medical theory, the brain holds a central, dominant position in the body, as it is responsible for coordinating and controlling sensation and voluntary motion, which were considered essential functions of the human body.[10,16,17,18] He described the vermis as a narrow, worm-like structure that lies between the two hemispheres of the cerebellum.

Galen describe the spinal cord as "hard, hollow, and articulated" was based on his observations and dissections, which were ahead of his time. He emphasized the importance of the spinal cord in transmitting signals between the brain and the rest of the body. The nerve pathways emerging from the spinal cord, likening them to branches of a tree, was an important contribution to the understanding of human anatomy.

Hunayn Ibn Ishaq recognized the complex structure and functions of the brain and its connection to the nerves. His observation that the brain is composed of two hemispheres, separated by a transparent membrane.[21,22]

Ali Ibn Rabban identified the brain's protective layers—two membranes, one delicate and rich in blood vessels for nourishment, and the other thick and close to the skull for protection. The division of the brain into three lobes—anterior(muqaddam dimagh), middle(ausat

dimagh), and posterior(moakhar dimagh)also shows his awareness of the distinct functional regions of the brain.[23]

Mohammad bin Zakariya Razi described the brain as a soft organ with cavities, *butun-e dimagh* (ventricles) and these ventricles had important functions related to the flow of vital fluids. According to him the two main membranes (meninges) that protect the brain Dura mater (Umm-i-Ghaliz) dura mater is the outermost layer and is tough and thick.Pia mater (Umm-i-Raqiq) is the innermost and thinnest layer, directly attached to the surface of the brain. It is a delicate membrane that closely follows the contours of the brain and spinal cord, covering all the folds and crevices. The pia mater is highly vascular, that supply the brain with nutrients.

Ibne Abbas Majūsi's the forebrain is larger and softer than the hindbrain. It is associated with the origin of the spinal cord (Nukha) and sensory nerves (A'sab-e hissiyah). Majūsi suggests that the hindbrain is harder. A thick membrane separating the forebrain from the hindbrain that splits into two layers might describe the meninges, particularly the dura mater, which is the tough, outermost layer of the brain and spinal cord. This membrane helps protect the brain and spinal cord from injury and infection. He identified four cavities or ventricles in the brain, which correspond to the lateral ventricles (in the forebrain), the third ventricle (in the middle brain), and the fourth ventricle (in the hindbrain). These cavities contain cerebrospinal fluid, which cushions the brain and removes waste products.The "two bulging processes" in the ventricles that help with the sense of smell(olfactory bulbs) which are involved in processing sensory input related to smell.[24,25,26]

Abu Sahl Mashihi, described, *umm-e-Jafia* and *umm-e-Raqeeqa*. These membranes serve to protect the brain and spinal cord. His description of the brain's ventricles, divided into three, the pineal gland as a "pine cone-shaped gland" situated between the anterior and posterior ventricles.[27] He proposed a division of the brain into two parts, based on the location of certain sutures and structures. The "posterior portion" is described as being located near the lower end of the lambdoid suture.

Avicenna (Ibn Sina), recognized that the brain is responsible for motion and sensation. The cerebellar vermis is part of the cerebellum and plays an important role in coordinating movement and balance. Avicenna's term for the caudate nucleus as the "tailed nucleus" or "nucleus caudatus" is a reflection of its shape, which has a tail-like structure. This nucleus is involved in the regulation of voluntary movements, learning, and motor control. According to him the brain's temperament being "cold and moist" the balance of fluids and the brain's function in a way that allowed for mental clarity and the prevention of overheating or excessive dryness, which could impair function. The anterior (front) part of the brain is "soft" because it is associated with sensory functions such as hearing and smell. The posterior part of the brain, being "hard," is more associated with motor functions, particularly in the motor cortex in the frontal lobe. During early embryonic development, the brain divides into Prosencephalon (forebrain), Mesencephalon (midbrain) and Rhombencephalon (hindbrain) Develops into the cerebellum, pons, and medulla, all of which are involved in motor control and coordination. The brain's cerebrum is divided into two hemispheres by the longitudinal fissure, which runs along the midline of the brain. This fissure separates the left and right hemispheres.

Ibn Sina described the brain as being covered by two types of membranes. The "thin membrane" (raqiq), the delicate innermost layer that closely adheres to the surface of the brain and spinal cord, following its contours. The "thick membrane" (galij), dura mater, the tough outer layer that provides protection against physical damage and helps enclose the brain in a protective environment. The dura mater is one of the three layers of membranes (meninges) that cover the brain and spinal cord. It provides protection and is involved in the compartmentalization of the brain. Falx Cerebri (Tayyi-e-muqaddam) is a crescent-shaped fold of dura mater that lies in the longitudinal fissure of the brain, separating the two hemispheres. Tentorium Cerebelli (Khaimta-e-almikh) is a horizontal fold of dura mater that separates the cerebellum from the inferior part of the occipital lobes. Falx Cerebelli (Tayyi-e-muakhar) falx cerebelli is a smaller, sickle-shaped fold of dura mater that partially separates the two hemispheres of the cerebellum.[6,28,29,30,31]

Avicenna's (Ibn Sina) view on the spinal cord. In his work *The Canon of Medicine*, The comparison of the spinal cord to a canal arising from the brain, as a conduit for nerves, Avicenna highlighted its fundamental importance in conveying sensory and motor messages across the body. His recognition of the vertebral column's protective function over the spinal cord demonstrates an early understanding of the need for safeguarding the spinal cord's delicate structure, which is essential for the body's coordination and communication.[32]

Ismail Jurjani proposed that the brain is divided into two parts along a *sagittal* line from the anterior to the posterior, describing the brain's left and right hemispheres. According to him, the brain's temperament is *cold and moist.* The anterior part of the brain being "soft" and posterior part of the brain being "hard" to the motor functions that control movement, as these areas involve more robust structures like the cerebellum and brainstem. Torcular Herophilli (Mashirah) is the point where the venous blood from different parts of the brain converges.

Jurjani described two "protuberances" in the anterior brain that were associated with the sense of smell.

Olfactory bulbs, which are located at the front of the brain and are involved in processing smell. The two membranes help in cushioning and protecting the brain, and they also allow for movement necessary for brain function. He describes the ventricles in the brain as cavities that are interconnected. These cavities serve various functions, including the circulation of cerebrospinal fluid. He mentions two membranes that cover the brain. The *outer membrane (Umm-e-Galij),* which is thick and attached to the skull. The *inner membrane (Umm-e-Raqeeq),* which is thin and attached directly to the brain. This inner membrane is termed "Mother of the Brain" (Umme Raas), suggesting its protective role.

Ibn Rushd describe natural form of the head is described as a round shape, flattened on both sides, similar to how a wax sphere would appear if pressed from both sides. There are multiple cavities (ventricles) inside the brain, each connected to the others. Anterior Ventricles located at the front (anterior) part of the brain. Middle Ventricle Situated in the center (middle) of the brain. Posterior Ventricle Found at the back (posterior) of the brain. From the anterior ventricles, two processes resembling "nipples" (*Halimat-e-sadin*) extend toward the ethmoid bone (located near the nose), which is perforated with many holes. This bone serves as a crucial point in the structure of the skull. *Umm-e-Galij (Outer Membrane)*is the thicker membrane that attaches to the skull and *Umm-e-Raqeeq (Inner Membrane)* is the thinner, delicate membrane that is directly attached to the brain. It is also called as *Umme Raas*, meaning "*Mother of Brain."* The outer membrane has holes at two near the ethmoid bone *(Azm-e-Mushfaath).*and near the parietal bone (*Azm-e-Yafaug),* which is spongy in nature.

He said that the column of vertebrae surrounds the spinal cord in the same way the skull surrounds the brain, he was recognizing the structural and functional similarities between these two critical components of the nervous system. Both the spine and the skull provide physical protection for their respective contents—the brain and spinal cord—while also serving as structural supports.

According Ibn al-Hubal al-Baghdadi, brain is housed in the skull, this "chamber" is formed by the bony structures, including the frontal bone, occipital bone, parietal bone, and sphenoid bone. These bones provide a protective cage for the brain and are positioned to allow for the "visualization of eyes," The brain is divided into an anterior and posterior part. The brain contains three ventricles, with the largest being in the anterior lobe, involved in the perception of sensory information. *Pia mater* is described as the thin membrane that is directly attached to the brain .The *Dura mater,* a thick, tough membrane, is attached to the cranium and forms protective layers. The *Dura mater's* firm connection to the skull highlights the importance of protecting the brain from injury. Beneath the separating membranes, there is a *sinus*, (*muasserah),* where blood drains from the vessels. He views the idea of "psychic Pneuma" and the transformation of blood into the brain's substance reflects a metaphysical approach to medicine.[33]

Allama Nafees provides a detailed description of the brain's composition and its Mizāj (temperament) in relation to its biological elements. The brain is made up of nerve fibers, grey matter, and white matter**.** Grey matter consists of the nerve cell bodies and has more water content compared to white matter, which is primarily made up of nerve fibers. The Mizāj of the brain is described as *Bārid-Raṭab* (cold and moist) compared to other organs. This means the brain has a predominance of *Rukn-e-Ma (water)* and *Rukn-e-Arḍ* (earth). The *Rukn-e-Ma* and *Rukn-e-Arḍ* represent the watery and earthy elements in the body, which are important for maintaining the brain's moisture and consistency. The moisture in organs is attributed to *Rukn-e-Hawā (air*) and *Rukn-e-Ma.* The balance of these elements helps in maintaining the brain's required moisture for proper functioning. The *Magz* (medulla) of the brain is described as being more *Bārid* (cold) than that of the spinal cord because it contains oily substances. This suggests that when the magz of the brain is exposed to heat, its fluid content drains out, leaving behind more viscous, earthy matter. The brain receives a higher *blood supply* than other organs, but there is an absence of *kinetic movement* within the brain.. The *Raṭab Mizāj* (moist temperament) of the brain is due to a higher water content compared to the spinal cord. This water content plays a significant role in the functionality and protection of the brain. *Grey matter* is more water-dense, while *white matter* consists mostly of nerve fibers. This distinction reflects the varying functions of these two types of brain tissue—grey matter being involved in processing and white matter in signal transmission.[34,35]

Ibn al-Quff describes the brain as being divided both lengthwise (into two halves) and widthwise. The anterior ventricle being described as "soft" and associated with sensory nerves, while the posterior ventricle is "hard" and linked to motor nerves, mirrors modern ideas about the functional division of the brain in relation to sensory and motor processing. Though he may not have known the exact neural pathways, Ibn al-Quff's approach shows an early recognition of brain specialization. The vermis, as described, serves as a passageway for material from the anterior to the posterior ventricle. It is noted to have wide edges, particularly in the anterior ventricle, to accommodate the flow of thick blood. The anterior ventricle has two nipple-like processes arising from each half, which are said to store memory. The *alyata'an* serves as a muscle that aids in the transformation of pneuma (spiritual or life force) from the anterior to the posterior ventricle, which constricts during this movement. The space where blood oozes out is referred to as the "*berka"* or "*tank,"* which transforms blood before it reaches the *dooda* The brain matter contains round, red-colored components called gyri(*tajrida*). The

brain is surrounded by two main membranes: the pia mater (Umm Raqiq) which is thin and connects to the brain, and the dura mater (Umm Jafia), which is thicker and attached to the skull. Some appendages from the dura mater extend out through the skull in the form of sinuses. Waste materials from the brain are described as being produced due to vapors from the body or as a result of metabolic by products. The thin or liquid waste is decomposed and emerges through the sinus(*shaion*), while thicker waste is disposed of through the brain's internal pathways. Wastes in the anterior ventricle pass through the Dura mater and eventually reach the nostrils, while those from the middle and posterior ventricles are discharged through the mouth via vessels that run toward the superior palate.[36,37,38]

According to Ibn al-Quff spinal cord as a messenger of the Brain Just like a river connects to the ocean, the spinal cord serves as the communication pathway between the brain and the rest of the body, transmitting signals that control sensation and movement. The spinal cord begins as a thick structure but gradually becomes thinner as it descends into the intervertebral space. The membranes surrounding it, the dura mater and pia mater, protect the spinal cord, and they are enveloped by a third tough membrane that helps cushion and support it during movement. These layers help the spinal cord to stay intact even as the vertebral column moves (e.g., bending or twisting).The spinal cord has two essential functions—conveying sensations and controlling movements. For organs closer to the brain, these functions are controlled directly by the brain, but for organs farther away, the spinal cord bridges the gap. Without the spinal cord, signals from the brain would struggle to reach distant body parts, so the spinal cord ensures that movement and sensation can occur over long distances.

DISCUSSION

Alcmaeon (500 BC) recognized the brain as the site of sensation and cognition. He was the first to suggest that the brain governs intelligence and the senses. Hippocrates (460-377 BC) Known as the "father of medicine," Hippocrates viewed the brain as a gland responsible for cooling the body by secreting mucus. However, he also acknowledged the brain as the organ of consciousness and responsible for unique human behavior.Aristotle (384 BC) Described the brain's anatomy, including the meninges (the protective layers covering the brain), which he named the *dura mater* and *pia mater*. He was the first to recognize the brain as a paired organ, likely referring to the two cerebral hemispheres, and described the cerebellum and brain ventricles. Herophilus (300 BC) Often regarded as the "father of anatomy," Herophilus made major contributions to understanding brain anatomy. He named various brain structures, including the *spinal marrow* (now known as the brainstem and spinal cord), and described the meninges as resembling the fetal membrane. He also discovered the *arachnoid mater*, a delicate brain covering, and the ventricular system responsible for producing cerebrospinal fluid (CSF).Erasistratus (310 BC) Built upon Herophilus' work by offering a more detailed account of the brain's ventricular system, describing four main cavities (Herophilus had only mentioned three). He also noted the brain's sulci (grooves) and gyri (ridges) and discovered the connection between the brain's cavities and the spinal cord. Galen (1st century AD) A renowned Roman physician, Galen made significant contributions to the understanding of human anatomy, including the discovery of the corpus callosum, pineal gland, infundibulum, vermiform process, and the superior and inferior colliculi. Ali Ibn Rabban Al-Tabari (838–870 AD) made important distinctions about the brain's protective and nutritional membranes, noting the delicate inner membrane (pia mater) and the thicker outer membrane (dura mater) that protected the brain. Mohammad bin Zakariya Razi (850–923 AD) further explored the internal structures of the brain, describing the brain's ventricles. His account of four interconnected cavities reflects the early recognition of the fluid-filled spaces within the brain, which are important for understanding brain function. These ventricles correspond to the forebrain, middle brain, and hindbrain, and their interconnectedness laid the foundation for later studies in cerebrospinal fluid dynamics.

Ibne Abbas Majūsi (1010 A.D.): He divided the brain into two parts and described two membranes that cover the brain. These membranes were named *umm-e-Jafia* (rough outer membrane) and *umm-e-Raqeeqa* (smooth inner membrane). He stated that the material of the nerves and the brain is the same, but the difference is that the brain is softer than the nerves.

Avicenna (Ibne Sina, 980–1037 A.D.) discovered the cerebellar vermis (a part of the cerebellum) and the caudate nucleus, naming them "vermis" and "tailed nucleus" or "nucleus caudatus." These terms remain in use in modern neuroanatomy and neurophysiology. Avicenna divided the brain into two parts the anterior part of the brain as soft, associated with the sense organs, particularly hearing and smell. The posterior part was considered hard, as it contains the majority of motor nerves and the spinal cord. Ibn-e-Rushd (Averroes, 1126–1198 A.D.):Brain membranes Ibn-e-Rushd discussed the brain's membranes in his book *Kitabul Kulliyat*. According to him, the brain is covered by two membranes: The outer membrane is thick and attached to the skull. The inner membrane is thin and attached directly to the brain. He referred to this as *Umme Raas* (the "Mother of the Brain").

Ibn Hubal Baghdadi (1121-1213 AD) suggested that the head is the "house" or "chamber" of the brain, placed high in the body for the proper functioning of the eyes, an early recognition of the brain's role in sensory processing.

He described the brain as consisting of two parts: the anterior (front) and posterior (back), with three interconnected ventricles, important for the flow of what he called "psychic pneuma" (spiritual or vital fluid).Ibn Hubal's concept of the brain's texture and division into regions, along with the role of "muasserah" (a sinus beneath the separating membrane), reflects a combination of anatomical and humoral theories where blood and fluids were thought to contribute to the brain's functions. Ibn Quf (1233-1286 AD) description of the brain as a white, moist organ with a soft texture ties into ancient concepts of the brain's physical properties. His division of the brain into different ventricles (anterior, middle, and posterior) and their varied softness is an early recognition of the brain's compartmentalized structure. The mention of the "vermis" (also known as the vermis cerebellum, part of the brain involved in motor control) connects to more advanced understanding of brain anatomy, as does the idea of storage areas for memory. His description aligns with humoral theory, suggesting that the brain's composition is based on nerve fibers, grey matter, and white matter. Allama Nafees adds to the concept that the brain's major composition consists of nerve fibers (associated with transmission of impulses), grey matter (responsible for processing information), and white matter (connecting different regions of the brain).

CONCLUSION

A paper discussing the contributions of Unani physicians to brain anatomy (Tashreeh-e Dimaghi) and how their work laid the foundation for modern neuroanatomy. The paper highlights the historical achievements of prominent figures such as Buqrat, Aristotle, Herophilus, Galen, Razi, and Ali Ibn Abbas Majoosi. These physicians made groundbreaking discoveries, including the identification of the brain's membranes, the ventricular system, and various other anatomical structures. By showcasing their observations and research, the paper emphasizes the depth of knowledge present in ancient Unani literature, which is considered evidence-based and advanced for its time. The aim of the paper is to encourage further research in the field and inspire scholars to explore and build upon the foundations laid by these ancient physicians.

Conflict of interest

- No any conflict of interest.

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