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Al-Razi's Anatomical Insights: A Detailed Review of *Kitab Al-Mansuri*

Mohsina[1,*], Imran Khan[2], Abdul Malik[3], Mohd Abu Bakar Qadri[2], Nafasat Ali Ansari[3]

Abstract

Al-Razi (865–925 CE), a leading physician of the Greco–Arab Golden Age, made foundational contributions to human anatomy through clinical observation and empirical analysis. This review explores Al-Razi's anatomical insights, particularly as recorded in his influential medical compendium Kitab al-Mansuri (The Book of Medicine Dedicated to al-Mansur). In this work, Al-Razi challenges the prevailing Galenic doctrines by prioritizing evidence-based understanding over uncritical acceptance of ancient texts. His method reflects a scientific rigor that was rare for his time, combining detailed observation with practical experience drawn from years of treating patients. The first chapter of Kitab Al-Mansuri is dedicated to anatomy, providing a structured overview of the human body. Al-Razi categorizes anatomical structures into simple organs (A'ḍā' Mufrada) such as bones and vessels, and compound organs (A'ḍā' Murakkaba) such as the eyes and limbs. This classification demonstrates a systematic approach to studying the human form and illustrates his understanding of both structure and function. His work shows an early recognition of the importance of physiological context in anatomical study. Through historical texts and modern evaluations, Al-Razi emerges not only as a pioneering physician but also as an early anatomist whose legacy influenced both Unani and Western medical traditions. His insistence on direct observation and clinical reasoning set a precedent for future generations, bridging the gap between theory and practice. Al-Razi's contributions underscore the enduring value of critical inquiry and empirical evidence in the advancement of medical science.

Keywords: *Al-Razi, Kitab Al-Mansuri, A'ḍā' Mufrada, A'ḍā' Murakkaba, Tashrīḥ*

INTRODUCTION

Al-Razi, also known as Rhazes in the West, was one of the most influential physicians during the golden age of *Greco–Arab* period. He was an alchemist, mathematician, philosopher, and astronomer as well [1–3]. His contributions to the understanding of human anatomy were monumental, particularly through his empirical observations, which helped to lay the groundwork for future developments in the field. Two major contributions of *Al Razi* to Unani medicine were the book *Kitab al-Mansuri* (Liber Al Mansoris), which was dedicated to the Samanid ruler of Ray and *Kitab al Hawi* (Liber Continens) meaning a comprehensive book or encyclopedia [4]. *Al-Razi's* writings focused on the human body's structure and function, offering critical insights into its various systems. His work differs from traditional Greek anatomical views, offering a more empirical approach, which later influenced both *Greco–Arab* and western medical schools.

This detailed review examines *Al-Razi's* anatomical insights as documented in his seminal works, particularly the *Kitab Al-Mansuri,* focusing

***Author for Correspondence**
Mohsina
E mail: mohsinaakhter.555@gmail.com

[1]PG Scholar, Department of Tashreeh-ul Badan, State Takmeel-ut-Tib College & Hospital, Lucknow, Uttar Pradesh, India
[2]Assistant Professor, Department of Tashreeh-ul Badan, State Takmeel-ut-Tib College & Hospital, Lucknow, Uttar Pradesh, India
[3]Retd. Professor, Department of Tashreeh-ul Badan, State Takmeel-ut-Tib College & Hospital, Lucknow, Uttar Pradesh, India

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on evidence-based medical knowledge.

Description of *Kitab Al Mansuri*

Razi's book of medicine, titled *Kitab al-Mansuri*, is a concise general textbook composed of ten chapters. He dedicated the work in 903 A.D. to the Samanid prince *Abu Salih al-Mansur Ibn Ishaq,* the Governor of Rey [5, 6]. This book was translated into Latin in the 15th century A.D. named as *Liber Al Mansoris* [7].

The first chapter of this book dealt exhaustively with Anatomy which mainly devoted to simple organs *(A'ḍā' Mufrada)* such as bones, nerves, muscles, veins and arteries, and compound organs *(A'ḍā' Murakkaba)* such as the eyes, nose, heart, and intestines [8, 9].

Description of Human Anatomy in *Kitab Al Mansuri*

Al-Razi contributed significantly to the understanding of human anatomy and physiology. *Al- Razi* provides detailed accounts of various anatomical structures and their functions in his book *Kitab Al-Mansuri.*

DESCRIPTION OF BONES *('IẒĀM)*

Bones serve as the body's framework, forming joints through protrusions and pits that allow movement. Ligaments connect bones, enabling coordinated motion – such as moving the entire hand from the shoulder. Bones themselves do not move independently but respond to nerve signals from the brain, which controls all sensation and movement [10].

Anatomy of the Skull Bone *(Tashrīḥ Al-Qiḥf/Al-Jumjuma)*

The skull is composed of 23 bones, including the frontal *('Aẓm al-Jabha)*, occipital *(Aẓm Mu'akhkhar al-Ra's/'Aẓm al-Qamaḥduwa)*, and bones near the ears and palate. It also includes 14 upper jaw and 2 lower jaw bones, along with the sphenoid bone (*Al-'Aẓm al-Watadī).* These bones are connected to joints called Suture *(Sha'n).* Each jaw contains 16 teeth, with variations in molar count. Including teeth and their roots, the total number of bones and related structures in the head is 55 [10].

Anatomy of Upper Limb *(Tashrīḥ Al-Tarf-e A'la)*

The clavicle is convex on the outer side and concave on inner side. One end is connected to the clavicle and the arm, and the other end is connected to throat above the chest. As it gets closer to clavicle, it becomes rounded [10].

The upper limb begins with the humerus, a single bone that fits into the shoulder socket and connects to the elbow. Below it is the radius and ulna, extending from the elbow to the wrist. The wrist contains eight carpal bones, which connect to the palm made up of metacarpals and phalanges. In total, each hand consists of 30 bones [10].

Anatomy of Lower Limb *(Tashrīḥ Al-'Iẓām al-Rijl)*

Its first bone is femur. It is a large bone which is convex on the top and concave on the inside and its upper end is rounded which is called head of femur *(Rummāna al-Fakhidh).* The total number of bones in the foot is 29 [10].

DESCRIPTION OF MUSCLES *(LAḤM 'AḌALĪ)*

Al-Razi referenced the influential Greek medical scholar Galen in his book *Kitab Al Mansuri*, noting that, according to Galen's anatomical studies, the human body contains a total of 529 muscles. It is composed of muscle fibers *(lehm),* nerves (*A'ṣāb),* and tendons *(Watr/Awtār),* responsible for voluntary movement. Each muscle ends in a tendon. There are 45 muscles in the face of which 24 are used to move eyes and eyelids, 12 are used to move the lower jaw and 9 are used to voluntary movement of face, in which one is in the inner skin of the face for the movement of opening the eyes. 2 muscle to move both sides of the nose, 2 are moving the lower lip and two for moving the cheeks [10].

The total number of muscles that move the head and neck is 23 while 9 muscles are involved in the movement of tongue. There are 32 muscles that help in movement of throat and larynx.

The human thorax relies on a highly coordinated network of muscles to facilitate movements, such as flexion and expansion, particularly during respiration. While not all act directly upon the chest wall, it is estimated that up to 107 muscles are functionally involved in supporting these motions through direct action or synergistic roles.

According to *Al-Razi,* seven distinct muscles are involved in the various movements of the shoulder joint, allowing for its wide range of motion. Additionally, he noted that 23 muscles contribute to the formation and function of the shoulder on each side of the body. When describing the elbow, *Al-Razi* identified two key muscles – one located on the inner side and the other on the outer side – responsible for the actions of flexion and extension. In the region of the arm, he described 17 muscles that support strength and movement. Furthermore, *Al-Razi* detailed the anatomy of the hand, stating that each palm contains 10 muscles, which enable the fingers to move inward toward both the thumb and the little finger, allowing for grasping and fine motor functions.

The lower extremities are powered by a complex arrangement of muscles that facilitate locomotion, balance, and fine motor control. Above the thighs, approximately 26 muscles contribute to the movement of the thighs at the hip joint which are responsible for actions like flexion, extension, abduction, and rotation of the thigh. In the movement of the legs, around 20 muscles work in coordination to enable walking, running, and postural adjustments.

Further down, about 28 muscles located above the legs contribute to the movement of the toes.

Additionally, 22 intrinsic muscles located in and above the foot are responsible for the finer and more precise movements of the toes which help maintain balance, support arches, and allow for complex toe motions [10].

DESCRIPTION OF NERVOUS SYSTEM *(NIẒĀM-I A‘ṢĀB-O-DIMĀG)*

Anatomy of Brain *(Tashrīḥ Al-Dimag)*

The brain is the central organ of the nervous system and controls all voluntary movements. A cavity at the base of the skull allows the spinal cord *(Al-Nukhā‘)* to pass through. The nervous system *(Niẓām-i A‘ṣāb-o-Dimāg)* coordinates body actions and sensations by transmitting signals. It is divided into two parts: the Central Nervous System *(Nizam-e-Asabi Markazi)* and the Peripheral Nervous System *(Nizam-e-Asbi Muhiti)* [10].

Anatomy of Nerves *(Tashrīḥ Al-A‘ṣāb)*

He described nerves as having both motor and sensory functions, originating in pairs from the brain and spinal cord. Following Galen, he identified 7 cranial and 31 peripheral nerves – divided into 8 cervical, 12 thoracic, 5 lumbar, and 3 sacral pairs. He used this segmental nerve knowledge to localize injuries, as seen in a case of paraplegia with preserved upper limb function due to an intact cervical spine [10].

He described nerves as having motor and sensory functions while enumerating seven cranial nerves from the optic to the hypoglossal nerves and 31 spinal nerves [8, 9]. He considered the olfactory nerve as part of the brain and thus did not include it as a cranial nerve. The third and fourth cranial nerves were parts of the trigeminal nerve, and the fifth cranial nerve was considered the combined facial and vestibulocochlear nerves. The sixth cranial nerve was the combined glossopharyngeal, vagus, and spinal accessory nerves.

Al-Razi gave elaborate descriptions of the spinal nerves and their intervertebral foramina. Some anatomical descriptions that Rhazes proposed were original and had not been reported before him. For

example, he is the first who described the recurrent laryngeal nerve as a mixed sensory and motor nerve [9, 11].

DESCRIPTION OF CIRCULATORY SYSTEM *(NIẒĀM DAWRĀN-I-KHŪN)*

Anatomy of Heart *(Tashrīḥ Al-Qalb)*

The heart is a conical, muscular organ resembling a pine fruit, located in the center of the thoracic cavity with its apex pointing down and slightly left. It is enclosed by a thick layer called the pericardium *(Gilaaf).* The heart has two main chambers *(batan),* each with openings that connect to the lungs for blood purification and circulation throughout the body [10].

DESCRIPTION OF SENSORY ORGANS *(HAWASE KHAMSA ZAHIRA)*

Anatomy of Nose *(Tashrīḥ Al-Anf)*

The nasal cavity is divided into two parts one extends to the mouth, and another extends to the sphenoid bone [10].

Anatomy of Eyes *(Tashrīḥ Al-Ayn)*

The eyes are made up of eight coats and three pairs of humor. *Al-Razi* defined the small muscles in the iris and their response to the intensity of light, thus identifying the pupillary reaction for the first time. *Al Razi* is also the first physician to recommend extraction for cataract operation [10].

Anatomy of Ear *(Tashrīḥ Al-Uzn)*

The ear canal is in Kurri called *Aẓm al-Ḥajrī* and has many twists and turns until it reaches the nerve endings of brain, where the sense of hearing *(Quwwat Sāmi'a)* is found [10].

Anatomy of Tongue *(Tashrīḥ Al-Lisan)*

The is a soft white muscular organ with many small blood vessels because the blood vessels seem red in color. There are many arteries and nerves under the tongue [10].

DESCRIPTION OF RESPIRATORY SYSTEM *(NIẒĀM-I-TANAFFUS)*

Anatomy of Trachea *(Tashrīḥ Al-Qasbatur Riya)*

Trachea is made up of lots of cartilage, two third of circle consists of a shape, between two edges two membranes pass straight and then the soft membrane are connected near the throat. *Al-Razi* did not provide a specific count of the cartilages [10].

Anatomy of Chest *(Tashrīḥ Al-Sadar)*

The chest is divided into two chambers. Each chamber enclosing the rib cage, thus providing two openings for respiration due to some reason one is not fit for function the other can done function as expediency has been laid in the creation of eye. Because air is very necessary for survival of life. It has taken care to continue the process of respiration [10].

Anatomy of Lungs *(Tashrīḥ Al-Riya)*

It starts from the extreme part of the mouth which reaches below the clavicle and divided into two parts and then branch by branch. A spongy layer forms around the lung which fills the lung cavity [10].

Anatomy of *(Tashrīḥ Al-Hijab Hajiz)*

It starts from the end of the sternum and passes downwards on both sides of the chest and connects to twelfth vertebra of the back, thus it is in between upper and lower cavity [10].

DESCRIPTION OF DIGESTIVE SYSTEM *(NIẒĀM-I-HAḌM)*

Anatomy of Liver *(Tashrīḥ Al-Kabid)*

The liver *(Kabid)* is located below the ribs on the left side, crescent-shaped with a concave lower surface touching the stomach and a convex upper surface attached to the diaphragm *(Hijab-e-Hajiz).* It

is held in place by strong ligaments *(ribatat)* [10].

Anatomy of Gallbladder *(Tashrīḥ Al-Marāra)*

It is located above the liver and has two ducts one is connected to concave liver and other has two branches. First branch joins the upper intestine and second joins lower part of stomach [10].

Anatomy of Spleen *(Tashrīḥ Al-Ṭiḥāl)*

The spleen is a rectangular organ on the left side of the abdomen, connected to the stomach and ribs by ligaments. It has two ducts – one linking to the stomach and the other to the liver [10].

Anatomy of Esophagus *(Tashrīḥ Al-Marī)*

At the back of the mouth, there are two openings – one for air, leading to the trachea *(Qaṣaba al-Ri'a)*, and the other for food and liquid, leading to the esophagus *(Marī)*. The esophagus lies behind the trachea, passes through the diaphragm, and connects to the stomach [10].

Anatomy of Stomach *(Tashrīḥ Al-Mi'da)*

He stated that the stomach is composed of three layers, the first layer is composed of longitudinal fibers, the second layer is composed of circular fibers, and the third layer is composed of oblique fibers [10].

G.6 Anatomy of Intestine *(Tashrīḥ Al-Am'ā')*

The intestines are divided into six parts: three small *(Am'ā' Diqaq)* and three large *(Am'ā' galeez).* The first small intestine, connected to the pylorus, is the duodenum *(Ma'y al-Ithnā 'Asharī).* The intestines contain small openings for nutrient absorption into the liver [10].

DESCRIPTION OF URINARY SYSTEM *(NIẒĀM-I-BAWL)*

Anatomy of Kidney *(Tashrīḥ Al-Kulyatayn)*

The kidneys are located near the liver on both sides of the back, with the right kidney slightly higher. Each has two ducts – one connects to a liver vessel, the other to the urinary bladder *(Mathāna)* via the ureter *(Ḥālibayn)* [10].

Anatomy of Bladder *(Tashrīḥ Al-Mathāna)*

He says that bladder is a container of urine. It is composed of two layers and has a voluntary muscle on the mouth of bladder [10].

DESCRIPTION OF REPRODUCTIVE SYSTEM (*NIẒĀM TANĀSUL/ TAWLĪD)*

Anatomy of Uterus *(Tashrīḥ Al-Raḥim)*

The uterus (*Raḥim*) [12] is located between the bladder *(Mathāna)* and rectum *(Maq'ad),* held by nerve-rich ligaments that expand during pregnancy and contract after delivery. It has two Fallopian tubes *(Qaazifayn)* and is connected to the ovaries *(Unsayyan),* which release ova to the cervix *('Unuq al-Raḥim)* and then to the vulva *(Furj)*. The uterus enlarges after childbirth but remains small before pregnancy [10].

Anatomy of Penis and Testicles *(Tashrīḥ Al-Qaḍīb and Khuṣyatayn)*

From the pubic region emerges a highly cavernous nervous body, beneath which are many large arteries. This body is called the penis. Then, from the peritoneum, two ducts emerge and divide into two branches. From these branches, the inner layer of the scrotum is formed. Inside this sac are two testicles. Along the edges of these testicles, there are many small vessels from which many small sacs are formed. On these sacs are white-colored glandular tissues, which cause the blood in this area to turn white and begin to acquire the properties of semen [10].

DISCUSSION

In his medical compendium *Kitab al-Mansuri*, *Al-Razi* presents a concise yet comprehensive overview of human anatomy and physiology. The first chapter is devoted to anatomy, detailing both

simple organs *(A'ḍā' Mufrada)* and compound organs *(A'ḍā' Murakkaba)* highlighting *Al-Razi's* significant contributions to early anatomical knowledge.

Al-Razi's most remarkable contribution was his detailed and systematic anatomical descriptions, which challenged the traditional Greek views. While *Galen's* anatomical knowledge was largely based on animal dissection and speculative reasoning, *Al-Razi* emphasized empirical observation and human anatomy. *Galen* described the nervous system in broad, often inaccurate terms, adhering to philosophical doctrines rather than clinical evidence. In contrast, *Al-Razi* provided a more precise and practical understanding, identifying 7 cranial and 31 spinal nerves and correlating neurological function with specific anatomical regions. He described nerves as having motor and sensory functions while enumerating seven cranial nerves from the optic to the hypoglossal nerves and 31 spinal nerves. He considered the olfactory nerve as part of the brain and thus did not include it as a cranial nerve. This empirical approach allowed *Al-Razi* to challenge and refine the Greek anatomical tradition, marking a pivotal shift toward modern medical science. He was among the first to develop a more empirical understanding of the body, departing from theoretical models to direct observation.

Al-Razi's descriptions of the circulatory and digestive systems were also advanced for his time. His examination of the heart, identifying its chambers and circulatory function, and his detailed analysis of the liver, spleen, and intestines, provided valuable insights into the physiological processes of the human body. The anatomical sections of his *Kitab al-Mansuri* were methodically organized, focusing on essential body systems, including the skeletal, muscular, and respiratory systems. His identification of the recurrent laryngeal nerve and its functions was another significant anatomical discovery.

Al-Razi was familiar with human anatomy including osteology, myology, neurology, and anatomy of the arteries and veins. He recognized different types of bones including long short, cortical cancellous and sesamoid bones as well as ligaments and tendons. He differentiated between ligaments, tendons, and nerves and recognized the role of the brain, spinal cord, and peripheral nervous system in the perception of senses and voluntary movements.

Al-Razi defined muscle *(ʿaḍala)* as a structure composed of flesh *(laḥm),* nerves *(aʿṣāb),* and tendons *(awtār),* formed for voluntary movement. Each muscle terminates in a tendon, anchoring it to bone and enabling purposeful motion. He also provided detailed descriptions of muscles, including the number of muscles in facilitating the movement of various body parts, noting 45 facial muscles responsible for moving the eyes, eyelids, jaw, nose, lips, cheeks, and facial expressions.

Additionally, *Al-Razi's* work in understanding the sensory organs was groundbreaking. His study of the eyes, particularly he defined the small muscles in the iris and their response to the intensity of light, thus identifying the pupillary reaction to light for the first time. *Al-Razi* is also the first physician to recommend extraction of lens for cataract highlights his expertise in ophthalmic surgery. His detailed exploration of the anatomy of the ear, nose, and tongue contributed significantly to a more accurate and comprehensive understanding of the human sensory systems, shedding light on how we perceive sound, smell, and taste through intricate physiological mechanisms.

CONCLUSIONS

Al-Razi's contributions to the field of medicine were not only a continuation of earlier Greco–Roman thought but a major leap forward through his empirical investigations and anatomical discoveries. His works, which were influential for centuries, demonstrated a profound understanding of the human body that was both precise and innovative, and they served as a cornerstone for future medical advancements in both the Islamic world and Europe. His emphasis on clinical observation and systematic study continues to resonate in modern medical practice today.

Al-Razi's discussions on anatomy in *Kitab al-Mansuri* reflect a deep and structured understanding of the human body, grounded in observation and clinical experience. He categorized anatomical

structures into simple organs, such as bones and nerves, and compound organs, like the heart and liver, describing their forms, functions, and interconnections. His work covers major body systems, including the skeletal, muscular, nervous, circulatory, and digestive systems.

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