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A HISTORICAL OVERVIEW OF THE NEUROLOGICAL DISORDERS ASSOCIATED WITH GASTROINTESTINAL AILMENTS FROM THE VIEWPOINT OF AVICENNA

POVIJESNI PREGLED NEUROLOŠKIH POREMEĆAJA POVEZANIH S GASTROINTESTINALNIM BOLESTIMA S AVICENNINA STAJALIŠTA

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SUMMARY

Reviewing historical medical manuscripts shows that neurological disorders have been previously described in the Islamic Golden Age. Ibn Sina, also known as Avicenna (980-1037 AD), was one of the most renowned scientists during this period. He widely practiced medi-

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cine, especially those disorders related to neurology, neurosurgery, and psychiatry in conventional medicine. In his extant book al-Qānūn fi al-Tibb (the Canon of Medicine), he claimed that some types of brain diseases can be related to the "marāqq" and called them marāqq-related disorders. From Avicenna's viewpoint, "marāqq" is considered a membranous structure in the abdomen. Ibn Sina has illustrated the association between the "marāqq" and the brain through some direct and indirect pathways. As a result, some disturbances in the "marāqq" can influence the brain, which can contribute to the pathogenesis of a number of brain diseases. Accordingly, those patients who regularly had gastrointestinal discomforts experienced a higher prevalence of headache, melancholia, and epilepsy. This study aimed to explore the relationship between abdominal and brain diseases from Avicenna's viewpoint. Furthermore, the definition, clinical manifestation, and therapeutic strategies of marāqq-related disorders were described.

***Keywords**: traditional medicine, Avicenna, marāqq, history of neurology, marāqq-related disorders*

Introduction

The Golden Age of Islam was a prominent era in various medical branches during the medieval period, dating from the 9th to the 12th century AD (Dalfardi et al., 2014; Moosavi-Asil et al., 2020). This was a flourishing scientific period in the Islamic civilization, and there were some influential and renowned scientists in the field of medicine, such as Rhazes (865-925 AD), Haly Abbas (930-994 AD), Avicenna (980-1037 AD) and Jorjani (1042-1137 AD) (Bahrami et al., 2020; Moosavi-Asil et al., 2020). The scientists of this age were familiar with other types of traditional medicine (TM), such as ancient Greece, Egypt, India, and China. They mainly used the theories of Hippocrates and Galen. Based on their observations and experiments, they also added new scientific theories to existing medical information. For example, Avicenna's *Canon of Medicine* (written in 1025 AD) was used as the main reference textbook in European universities until the seventeenth century AD and later in the Middle East (Bahrami et al., 2020; Dadmehr et al., 2018; Gorji & Khaleghi Ghadiri, 2002; Shoja et al., 2009).

Ibn Sina (known as "Avicenna" in the West) was a great physician and philosopher. He practiced widely in the field of medicine, particularly in disorders related to neurology, neurosurgery, and psychiatry in conventional medicine (Dadmehr et al., 2018; Zargaran et al., 2013). Avicenna has introduced the idea that some types of brain diseases, such as headache, melancholia, and epilepsy, can also be related to different body organs, including the *marāqq*, and called them *marāqq*-related disorders (Avicenna, 2005). From his viewpoint, the *marāqq* is considered a membranous structure in the ab-

domen (Avicenna, 2005; Minaei et al., 2018). Avicenna clarified that these groups of brain diseases present with *marāqq*-related manifestations in addition to their specific clinical features. He described the clinical manifestations and the specific treatment of them in detail. The association between the *marāqq* and the brain can be explained via specific direct and indirect pathways. Avicenna mentioned that some disturbances in the *marāqq* can influence the brain, potentially contributing to the pathogenesis of a number of brain diseases. Accordingly, those patients who regularly had gastrointestinal (GI) discomforts experienced a higher prevalence of headache, melancholia, and epilepsy (Avicenna, 2005).

Recent studies proposed that some brain diseases, including epilepsy, migraine, anxiety, and depression, may have GI comorbidities. The majority of patients with functional GI disorders may have depression and anxiety as psychiatric comorbidities (Lee et al., 2017). Moreover, some GI disorders, such as GI bleeding, peptic ulcer disease, inflammatory bowel disease, and functional GI disorders, are associated with epilepsy (Keezer et al., 2016). Also, patients with GI symptoms may have an increasing headache frequency (Cámara-Lemarroy et al., 2016; van Hemert et al., 2014).

Although another physician named Rhazes (2000) mentioned a brief explanation about some *marāqq*-related disorders in his book before Avicenna, the scope of what Avicenna introduced — the anatomical structure of the *marāqq*, its related disorders, and their specific treatment modalities — was clearly greater and more comprehensive than the information about the topic before him by other well-known scholars like Rhazes (2000) and Haly Abbas (2008), and also thereafter by Jorjani (2012). This concept has not been properly considered until now.

In this historical article, we aimed to introduce the contributions of Avicenna to the development of the concept of *marāqq*-related disorders, their diagnosis, and related therapeutic strategies by reviewing his viewpoints in the *Canon of Medicine*. Moreover, the viewpoints of other scientists on this subject have also been reviewed.

The canon of medicine

Ibn Sina gathered all the medical knowledge of his predecessors, such as Aristotle, Galen, and Rhazes, and then improved his own knowledge obtained from experiences and observations (Mazengenya & Bhikha, 2018; Shoja & Tubbs, 2007). The *Canon of Medicine* (*al-Qānūn fī al-Tibb*) was the main

manuscript written by Avicenna on medicine, where he collected all of the existing medical sciences in his time (Faridi et al., 2010). This comprehensive encyclopedia consists of five volumes; the first volume is about general anatomy and principles of medicine *kullīyāt*. The other volumes cover materia medica *mufradāt*, diseases of the special organs, general medical conditions and traumatic injuries, and finally, formulary *qarābādīn*, respectively (Avicenna, 2005; Shoja et al., 2009). An overview of this textbook indicates that Avicenna was aware of the human body and its associated diseases. He recorded his observations and related therapeutic methods and then described them in a practical approach for colleagues and later groups (Mazengenya & Bhikha, 2018; Nejabat et al., 2012).

Claudius Galen (120–200) is generally considered to be the father of anatomy. Between the Corpus Galenicum and the Renaissance, the studies of the great Muslim scholars who published on human anatomy long before Andreas Vesalius (1514–1564 AD) played a major role in the advancement of anatomical knowledge (Alghamdi et al., 2017). Ibn Sina paid special attention to learning anatomy, and most of his findings in the field of the structure of the human body were novel in his time. His contributions to the field of human anatomy display significant advances in the subject between those of Galen and Vesalius. In the third volume of the *Canon of Medicine*, at the beginning of each chapter, he presented a brief description of the devoted anatomy of each organ based on a clinically oriented approach. Later, this approach became the paradigm of modern clinical anatomy. Ibn Sina believed that in order to learn the general principles of medicine and acquire the ability to analyze the diseases of different organs, pupils must first learn the anatomy of these organs (Behbahani et al., 2017; Dadmehr et al., 2018; Mazengenya & Bhikha, 2018; Shoja & Tubbs, 2007). Furthermore, in the third volume, Avicenna discussed diseases occurring in special organs in separate chapters. In this regard, he explained the etiological factors, symptoms, signs, and treatment methods of each disease in detail (Avicenna, 2005; Shoja & Tubbs, 2007; Shoja et al., 2009).

Ibn Sina had a major focus of interest in the field of neurology and assigned the first chapter of this volume to neurological and neuropsychological disorders (Avicenna, 2005; Dadmehr et al., 2018). In the *al-Kitāb aṯ-Ṯāliṯ* [book III or third volume], *al-Fann al-Awwal* [Part I], Ibn Sina described numerous disorders like headache, vertigo, insomnia, dementia, melancholia, mania, epilepsy, stroke, paralysis, tremor, etc. He classified some of these disorders, such as melancholia, epilepsy, and headache, into two main groups.

Firstly, those which are caused by diseases of the brain itself. Avicenna classified the above-mentioned diseases into four types based on four different humors, including blood, phlegm, black bile, and yellow bile [brain diseases with intracranial origin]. Secondly, the brain is healthy in the first place, but these diseases may originate from other body organs. It is believed that there is a relationship between brain diseases and some body organs such as the stomach, the spleen, the *marāqq,* and so on. Thus, disorders of these organs contribute to the pathogenesis of a number of brain diseases, and different brain functions can be affected secondarily [brain diseases with extracranial origin] (Avicenna, 2005).

Definition and function of the *Marāqq*

In the chapter on general management in visceral injuries, Ibn Sina declared that "Galen mentioned the anatomy of the *marāqq,* and we [also] mentioned it in the [chapter of] anatomy". According to Avicenna's definition, *marāqq* is a fascia anatomically located in the abdominal region (Avicenna, 2005; Dadmehr et al., 2018). In the chapter on the esophagus and stomach anatomy [Faṣl f ī Tashrīḥ al-Mirī wa al-Miʿdih], he clarified different layers of the abdominal wall in detail. Ibn Sina stated that "[over the viscera] there are *tharb* [omentum], *bārīṭārūn* [visceral layer of peritoneum], *marāqq* [parietal peritoneum], muscles, and skin ... outer layer of *ṣifāq* [parietal peritoneum] called *marāqq* which has various functions ..." (Avicenna, 2005; Dadmehr et al., 2018; Minaei et al., 2018). He intelligently defined that the peritoneum consists of two layers: the parietal (outer) layer, which covers the abdominopelvic wall, and the visceral (inner) layer of the peritoneum, which covers the visceral structures. This definition of the peritoneum persists in the current anatomy (Mazengenya & Bhikha, 2018). Ibn Sina believed that the *marāqq* connected the abdominal viscera together and to the spine. Additionally, it has a connection with the chest fascia (pleura and pericardium) (Avicenna, 2005; Dadmehr et al., 2018).

Avicenna described the outer layer of the peritoneum [equivalent to parietal peritoneum], which surrounds the digestive tract (stomach, liver, spleen, intestine, etc.), as the *marāqq* (Avicenna, 2005; Dadmehr et al., 2018). He defined the abdominal wall layers in detail and provided more accurate descriptions of the structure of the *marāqq* and its functions. Ibn Sina suggested the outer layer of the peritoneum with the abdominal muscles and skin together (all layers of the abdominal wall) as a functional unit in the abdominal wall and considered it a more comprehensive definition of the *marāqq* (Avicenna,

2005; Dadmehr et al., 2018). However, other scholars of medieval Persia, like Rhazes, Haly Abbas, and Jorjani, have another explanation for this structure, including abdominal wall muscles (Dadmehr et al., 2018; Haly Abbas, 2008; Jorjani, 2012; Rhazes, 2000). Abu al-Qasim Al-Zahrawi, popularly known as Albucasis (936-1013AD), was a prominent medical scientist who was born in Andalusia (Spain) (Anjum, 2013). He considered all layers of the abdominal wall as the definition of the *marāqq* (Abulcasis, 2004). This structure naturally participates in several physiological functions, some of which include a contribution to peristalsis, urination, the exodus of bloating, and uterine contractions (Avicenna, 2005; Dadmehr et al., 2018; Minaei et al., 2018).

Marāqq-related disorders

In the *Canon of Medicine*, the association, *mushārakat,* between the *marāqq* and some body organs like the brain through the vessels, fascia, and nerve sheaths is well described (Avicenna, 2005; Dadmehr et al., 2018). Avicenna believed that the fascia network has a widespread distribution in the entire human body. According to him, fascia is classified as a nervous tissue with biological properties and mediating and communicating roles among body organs. Moreover, special substances can move through the fascia (Avicenna, 2005). The *marāqq* is considered a fascia that has a connection with another fascia like the chest fascia (pleura and pericardium); thus, it can transport special substances such as wind, *rīḥ,* (which is created by an impact of heat on each of four humors in the human body) and vapor, *bukhār,* (which is considered a fine part of those humors) through the vessels, fascia, and nerve sheaths toward the central nervous system (Avicenna, 2005; Dadmehr et al., 2018).

This is considered the underlying mechanism of *marāqq*-related disorders and their corresponding therapies. Therefore, any functional impairment in the *marāqq* has severe effects on the brain and can transport some substances to the brain, which may cause *marāqq*-related disorders. Examples of these disorders include:

– Melancholia

Avicenna mentioned that melancholia, *mālinkhūliyā,* is a mental disorder caused by the effect of black bile on the brain. This disorder has a chronic nature, and episodes of recurrence may also be experienced. Its symptoms include a sorrowful mind, fear, self-laughing, hopelessness, crying, speaking meaninglessly, suspicion without any apparent reason, a decrease in physical

activity, and preoccupation with death. Melancholia is classified into three categories; one of them is associated with the *marāqq*. It seems that the clinical findings of *marāqq*-related melancholia have some similarities with major depressive disorder (Avicenna, 2005; Dalfardi et al., 2014; Yousofpour et al., 2015).

Other scientists, such as Rhazes, Haly Abbas, Albucasis, and Jorjani, introduced this disease in a separate chapter in detail (Haly Abbas, 2008; Jorjani, 2012; Rhazes, 2000; Abulcasis, 2004). Moreover, there are some similarities in their approach in describing this disease.

– Epilepsy

According to the *Canon of Medicine*, the term *ṣar* ʿ (falling sickness) demonstrates an epileptic seizure or epilepsy. Avicenna elucidated the clinical manifestations and also therapeutic methods of different types of *ṣar* ʿ in detail (Gorji & Khaleghi Ghadiri, 2002). This disease presents with weakness, falling down, epigastric pain or pressure, paresthesia on the tongue and extremities, confused speaking, impaired respiration, cyanosis, vomiting, contractions in muscles, and sometimes bowel or bladder incontinence, and unconsciousness (Dadmehr et al., 2018; Gorji & Khaleghi Ghadiri, 2001). Ibn Sina divided epilepsy into two main categories: those that originate from diseases of the brain itself and other types associated with organ diseases like the *marāqq*. In *marāqq*-related epilepsy, the epileptic seizure originates from the *marāqq* (Avicenna, 2005; Dadmehr et al., 2018). Ibn Sina's approach to *marāqq*-related epilepsy is considered unique, a perspective not clearly mentioned in the textbooks of other scholars such as Rhazes, Haly Abbas, Albucasis, and Jorjani.

– Headache

Several types of headaches and their related therapeutic approaches were mentioned by Avicenna (Gorji & Khaleghi Ghadiri, 2002). One of them is related to the *marāqq*. This type of headache occurs in the forehead area and is accompanied by *marāqq*-related manifestations (Avicenna, 2005). Ibn Sina's point of view in describing this disease has not been clearly considered by other scholars.

– Mental confusion and delusion

Ibn Sina described two types of mental confusion, *ikhtilāṭ odh-dhihn,* and delusion, *hadhayān*. These originate from diseases of the brain itself and other types that are related to the diseases of other organs, such as the *marāqq*

(Avicenna, 2005). Ibn Sina's description of this disease may be considered innovative. Rhazes, Haly Abbas, Abulcassi, and Jorjani have not directly indicated this disease.

A review of TM textbooks revealed Albucasis described a type of vertigo, *duwwār,* and dizziness, *sadar,* associated with diseases of other body parts, including the *marāqq* (Abulcasis, 2004). However, a study of the *Canon of Medicine* shows that Ibn Sina did not consider this disease (Avicenna, 2005).

Clinical manifestations

In each of the above-mentioned disorders, in addition to the clinical manifestations of any disease separately, the patients experience symptoms and signs related to the *marāqq*. These clinical manifestations include flatulence, loose stool, sour eructation, pain, burning, and distention in the stomach and *marāqq*, drooling [water brash], pain between two shoulders (Arzani, 2008; Avicenna, 2005; Chashti, 2008), heaviness in the *marāqq*, dyspepsia, nausea, borborygmus (Avicenna, 2005; Chashti, 2008), constipation (Chashti, 2008), polyphagia (Arzani, 2008; Chashti, 2008), and slimming (Arzani, 2008).

Treatment

Several therapeutic methods based on the types and causes of each disease have been demonstrated, including resolving causal issues, dietary advice, avoidance of predisposing factors, herbal medicine therapies, and manual intervention as needed (Avicenna, 2005). According to Ibn Sina's viewpoint, for the management of those patients who have *marāqq*-related disorders, along with the specific treatments of melancholia, epilepsy, and headache, therapeutic plans should be focused on the *marāqq* disturbances. Some proprietary treatments, which Avicenna and other TM scholars recommended, are as follows:

1. Nutritional advice

To control the course of the disease and improve a patient's quality of life, consumption of some foods is recommended, e.g., milk, eggs, chicken, barley water, whey *mā'-oljubun*, spinach, lettuce, and apple (Arzani, 2008; Avicenna, 2005; Chashti, 2008).

2. Medications

Numerous medicinal herbs alone or in combination are suggested for the treatment of these diseases; some of them are listed in Table 1 (Arzani, 2008; Avicenna, 2005; Chashti, 2008; Dadmehr et al., 2018).

Table 1. Some medicinal herbs suggested for *marāqq*-related disorders in the TM textbooks.

Scientific name	**Common name**	**TM name**
Juniperus sabina L.	Savin	*Abhul*
Artemisia absinthium L.	Wormwood	*Afsantīn*
Cuscuta epithymum Murr.	Epithymum	*Aftīmūn*
Matricaria chamomilla L.	Chamomile	*Bābūnaj*
Dracocephalum moldavica L.	Dragonhead	*Bādranjbūyih*
Viola odorata L.	Sweet Violet	*Banafsaj*
Cucumis melo L.	Melon	*Biṭṭīkh*
Melilotus officinalis (L.) Pall.	Sweet clover	*Eklīlulmalik*
Cichorium intybus L.	Chicory	*Hindibā*
Coriandrum sativum L.	Coriander	*Kuzburah*
Cassia fistula L.	Golden shower	*Khīyarshanbar*
Prunus dulcis (Mill.) D.A.Webb	Almond	*Lawz*
Pistacia lentiscus L.	Mastic	*Maṣṭakī*
Cucurbita pepo L.	Pumpkin	*Qar'*
Anethum graveolens L.	Dill	*Shibat*
Tamarindus indica L.	Tamarind	*Tamri Hindī*
Rosa damascena Herrm.	Damask rose	*Vard*
Papaver somniferum L.	Opium Poppy	*Khash Khāsh*

3. Manual intervention

– Application of liniment form of drugs, *ṭilā,* on the *marāqq* [abdomen] (Chashti, 2008).

– Application of plaster form of drugs, *ḍimād,* on the *marāqq* [abdomen] (Chashti, 2008).

– Placing a cloth containing warm wheat bran and salt on the *marāqq* [abdomen] (Arzani, 2008; Chashti, 2008).

– Topical administration of certain oils (e.g., rose, mastic, and hyacinth oil) on the *marāqq* [abdomen] or stomach (Arzani, 2008; Chashti, 2008).

– Use of cupping therapy (dry and wet) on the *marāqq* [abdomen] (Avicenna, 2005; Chashti, 2008).

– In some cases, phlebotomy may also be applicable (Arzani, 2008; Avicenna, 2005; Chashti, 2008).

Conclusion

In this study, we presented the concept of *marāqq*-related diseases by reviewing Avicenna's teaching and discussing it from a TM viewpoint. Ibn Sina paid special attention to human anatomy. At the beginning of the chapter on the anatomy of the stomach and esophagus in the *Canon of Medicine,* he described the layers of the abdominal wall in detail. He provided a more comprehensive and precise definition of the *marāqq* and described its functions clearly compared to other scholars, such as Rhazes, Hally Abbas, Abulcasis, and Jorjani. In the *Canon of Medicine*, the interaction of the brain and the diseases of other body organs is considered, and some direct and indirect pathways are reported. As a result, some disturbances in the *marāqq* contribute to the pathogenesis of a number of brain diseases. In this regard, those patients who regularly had certain GI discomforts experienced a higher prevalence of headache, melancholia, and epilepsy. Reviewing the viewpoints of Ibn Sina and other scholars during the Golden Age of Islam displays that Ibn Sina contributed to the development of the concept of *marāqq*-related disorders, their diagnosis, and related therapeutic strategies in the *Canon of Medicine*. He provided a more specific classification of these diseases than other scholars, playing a significant and influential role in this subject.

Although a relationship between certain brain diseases and GI tract disorders has been considered in both TM and conventional medicine, each with its own paradigms, they present different definitions, etiological factors, classifications, and therapeutic methods, which are not exactly the same.

TM scientists, such as Avicenna, predominantly employed the theories of two Greek scientists, Hippocrates and Galen, in the field of neurology. They not only confirmed the theories of these two Greek scientists but also promoted them with their own original experiences. Ibn Sina, for example, recognized the etiology, manifestations, and treatments of neurological disorders based on the basic principles of humoral medicine.

The pathophysiological mechanisms of disorders involving different organs are not well-known; however, this study suggests that the concept of a reciprocal relationship between the brain and other organs, along with related pathologies, was recognized by TM scholars based on the basic principles of TM.

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Conflicts of interest

The authors declare that they have no conflict of interest.

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SAŽETAK

Pregled povijesnih medicinskih rukopisa pokazuje da su neurološki poremećaji već bili opisani u islamskome zlatnom dobu. Ibn Sina, poznat i kao Avicenna (980. – 1 037.), bio je jedan od najpoznatijih znanstvenika toga vremena. Djelovao je u mnogim područjima medicine. Posebno je proučavao poremećaje vezane uz neurologiju, neurokirurgiju i psihijatriju u konvencionalnoj medicini. U svojoj knjizi „al-Qānūn fī al-Tibb" (Kanon medicine) tvrdio je da se neke bolesti mozga mogu povezati s „marāqqom" i nazvao ih poremećajima povezanim s marāqqom. S Avicennina stajališta, „marāqq" je membranska struktura u abdomenu. Ibn Sina ilustrirao je vezu između „marāqqa" i mozga pomoću nekih izravnih i neizravnih veza. Kao rezultat toga, neki poremećaji u „marāqqu" mogu utjecati na mozak, što može pridonijeti patogenezi brojnih bolesti mozga. Sukladno tome, pacijenti s redovitim gastrointestinalnim tegobama imali su učestalije glavobolje, melankolije i epilepsije. Cilj je ovog istraživanja bio istražiti odnos između bolesti abdomena i mozga s Avicennina stajališta. Opisana je i definicija, klinička manifestacija i terapijske strategije poremećaja povezanih s „marāqqom".

Ključne riječi: *tradicionalna medicina, Avicenna, marāqq, povijest neurologije, poremećaji povezani s marāqqom*