The traditional diagnosis and treatment of respiratory diseases: a description from Avicenna's *Canon of Medicine*

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***Abstract*:** This article presents selected text on respiratory medicine from the famous book of medicine, *Al-Qanun fi al-Tibb* (the *Canon of Medicine*) by Avicenna (981–1037 AD), which was taught for 600 years as a standard text of medicine across medieval Europe. The authentic manuscript of the *Canon of Medicine* is located in the Central Library of the Tehran University of Medical Sciences, and the section on respiratory diseases was studied for the most relevant information – information that would be informative and interesting for present day physicians and pulmonologists. The results of the analysis are presented in the article. Respiratory diseases are discussed in depth in volume 3 of the *Canon of Medicine*. Avicenna discusses in detail the functional anatomy and physiopathology of the pulmonary diseases that were known in his time. He also describes the signs and symptoms of various respiratory diseases and conditions in the five chapters of volume 3 (breathing, voice, cough and hemoptysis, internal wounds and inflammations and principles of treatments) that are remarkably similar to those of modern pulmonary medicine. In addition, the herbal and nonherbal treatment of respiratory diseases and their signs and symptoms, mentioned in volume 2 of the *Canon of Medicine*, is also presented. In the time of Avicenna, the presentation of respiratory diseases, their treatment and their prognosis was much different than in modern times. There was more reliance on history, physical examination (which was mostly based on visual observation), individual variation, environmental factors, diet, and so on, for diagnosis and treatment. Nevertheless, going through a popular historic text such as the *Canon of Medicine* adds to our knowledge of the developments in the area of respiratory medicine at the time of Avicenna.

***Keywords*:** Avicenna, *Canon of Medicine*, history of medicine, respiratory diseases

Introduction

This article presents a synopsis of the respiratory diseases discussed in the famous historical text, the *Canon of Medicine* (*Al-Qanun fi al-Tibb)*, a magnum opus from the great medieval Persian physician (Abu Ali Sina) Avicenna (981–1037 AD). A quick glance at the *Canon of Medicine* shows that Avicenna relied heavily on history, physical examination, signs and symptoms, diet and lifestyle, environmental factors, individual temperament of the patient and visual observation in the diagnosis, treatment and prevention of diseases.

Thus, the respiratory diseases mentioned in the *Canon of Medicine* are mainly described or classified by Avicenna on the basis of gross medical examination and its interpretation. The clinical presentation of a number of respiratory diseases described by Avicenna would be expected to be different from today. Despite many limitations and the unavailability of modern instruments at that time, Avicenna adopted a scientific approach to the diagnosis and treatment, not only of respiratory disorders, but also more generally for the illnesses he treated and mentioned in the *Canon* [Sajadi *et al.* 2009].

This article presents selected text from the most authentic manuscript of the *Canon of Medicine* – the text that is most relevant to the current clinical pulmonology literature. Out of the five old manuscripts available from the Central Library and the Library of the National Museum of

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Figure 1. A portrait of Avicenna [From Shah, 1966].

History of Medical Sciences, Tehran University of Medical Sciences, the Arabic manuscript, handwritten by Mirza Mohammad Ali Tehrani in 1395 AH (1875 AD), was selected (Figure 2). This manuscript has also been authenticated and published in its original form by the Institute for Medical Sciences Studies, Iran University of Medical Sciences in 2004 [Ibn Sina, 2004]. In places where the Arabic language of the manuscript was illegible, and in order to further verify the English language of the manuscript, the authors of this article have used a Persian translation of the *Canon of Medicine* by Abdur Rahman Shafaghandi [Ibn Sina, 1978]. Notes have been added to places where they were required to convey the original concepts to the readers. Specific Arabic or Persian terminologies related to the diseases' names, signs and symptoms or anatomical structures are written in italics.

Description of respiratory diseases by Avicenna in the *Canon of Medicine*

Volume 3, section 10 of Avicenna's *Canon of Medicine*, entitled 'Lungs and Chest', deals with the diseases of the respiratory system (Figure 3) and is comprised of 5 chapters. The details are summarized in Table 1.

In addition, section 6 of the second volume of the *Canon of Medicine*, entitled 'Remedies and their characteristics', deals with various herbal and nonherbal treatments of diseases. In this section, Avicenna alphabetically gives a brief description and then (Figure 1) describes the therapeutic uses of herbal and nonherbal agents. Treatment of various signs and symptoms and respiratory disorders is also discussed under relevant herbs. A list of English and botanical names of herbs and a summary of their uses in respiratory disorders is given in Table 4.

Extracts from the *Canon of Medicine*

General introduction on breathing

Respiration is like a cardiac pulse, with two components of motion and rest. However, the difference between the two is that respiration can be brought under voluntary control and can be taken out of its normal pattern, while a cardiac pulse is entirely natural and involuntary. The heart receives fresh air from the lungs that helps it to perform its function normally.

Normal inspiration, associated with the drawing of fresh air inside, is accompanied by the expansion of the lungs and, if the lungs are unable to perform normal inspiration, tissues that surround the lungs partly perform the function of the lungs in getting fresh air inside and the respiration is set to its routine manner.

Similarly, expiration or – better said – the returning of air taken in previously, is carried out by the contraction of the lungs, which in turn is aided by tissues surrounding the lungs. Appropriate breathing without any problem or difficulty is related to the normal motion of diaphragm (*hejab-e-hajez)*. In cases where the diaphragm becomes weak in its action so that the breathing in and out does not take place normally, all the muscles of the chest help the diaphragm. When more assistance is required, the upper chest muscles and some of the lower chest muscles assist the diaphragm.

The origin of breathing is the brain and the spinal cord. Additionally, the spinal cord is the origin of the function of the diaphragm. (The fourth, fifth

Figure 2. Front page of the Arabic manuscript of the *Canon of Medicine* transcribed by Mirza Mohammad Ali Tehrani in 1395 AH (1875 AD). (Courtesy and Permissinon, Central Library and the Library of the National Museum of History of Medical Sciences, Tehran University of Medical Sciences).

Figure 3. First page of the volume 3, section 10 of the *Canon* that deals with the diseases of respiratory system. (Courtesy and Permissinon, Central Library and the Library of the National Museum of History of Medical Sciences, Tehran University of Medical Sciences).

Table 1. Chapter titles and a brief description of the respiratory diseases in the *Canon of Medicine*.

No.	Chapter title	Brief description
1	Breathing	This chapter deals initially with the anatomy of the larynx, trachea, lungs and diaphragm. Later, Avicenna describes normal breathing and various types of abnormal breathing patterns seen in different diseases. In the end, he discusses asthma and its treatment
2	Voice	Avicenna describes the production of voice and its disturbances in various disease conditions
3	Cough and hemoptysis	This chapter deals with cough, its various causes and treatment. Hemoptysis is dealt with separately, whereby its associated signs and symptoms, causes and treatment are discussed
4	Internal wounds (infections) and the inflammations of tissues surrounding the chest wall*	This chapter deals with tissues around lungs and their diseases and then discusses pneumonia and pleuritis. Avicenna also discusses tuberculosis and its signs and symptoms
5	The practical principles of the common treatment of diseases of lungs and tissues around it	This chapter deals with the treatment of tuberculosis, pneumonia and pleuritis

*Avicenna classified the diseases of the respiratory system outside the lung parenchyma as the diseases of tissues surrounding the chest wall.

Table 2. Effects of diet and environmental factors on respiratory diseases as mentioned in the *Canon of Medicine*.

Disease/Symptom	Aggravating factors	Relieving factors
Asthma [*rabv*]	Opium, bathing especially after meal, excessive sleep, especially after meal, drinking of water or alcohol after a meal, psychological factors	Chest massage, laxative, exercise
Hemoptysis	Garlic, onion, grief, screaming loudly, severe persistent cough, cold air, intercourse, alcohol	Butter, fresh and salt-free cheese, narcotics (fresh opium), diluted vinegar
Pleuritis (*zaat-ul-janb*)	Screaming loudly, autumn season and winter season	See treatment
Pneumonia (*zaat-ur-rieh*)	Old age	See treatment
Pulmonary tuberculosis (*sil*)	Autumn season	See treatment

Table 3. Chief presenting symptoms of major respiratory diseases mentioned by Avicenna.

Disease	Chief symptoms
Asthma	Dyspnea, rapid short breathing, severe asphyxia-like difficult breathing, breathing with exhaustion
Pleuritis	Fever, sharp pain in the flanks, dyspnea, cough
Pneumonia	High grade fever, dull pain, dyspnea, cough, sputum and a less frequent hemoptysis, unconsciousness
Pulmonary tuberculosis	Chronic fever that is more severe at night, sweating, sputum that maybe bloody, dyspnea, severe weakness

and sixth pairs of spinal nerves innervate many portions of diaphragm [Snell, 2004]).

For the assessment of health and the disease status of a person, variations in respiration and different types of respiration exist, and by observing his breathing, it is possible to evaluate the status of a person's health. Deep breaths, short breaths, rapid breaths, slow breaths, different breathing patterns, irregular breaths, breathing without difficulty, breathing with difficulty, strong breath, weak breath, warm breath, cold breath, normal and regular and each of these patterns of breathing can guide us to assess the status of human body.

Problems of breathing and their etiology

When there is a problem in breathing, it can be due to one (or more) of the following causes:

(1) Injury to respiratory organ(s) such as the larynx, lungs, trachea, bronchi, vessels, diaphragm and thoracic muscles and any thoracic deformity which thereby reduces the size of thoracic cage itself and thus causing reduced capacity to breathe or difficulty in breathing;
(2) Breathing problems due to damage to the (organ of the) origin of breathing;
(3) Breathing problems due to the surrounding organs – the problems that occur in

Table 4. Selected traditional remedies mentioned by Avicenna for the treatment of respiratory diseases in volume 2, section 6 of the *Canon of Medicine*.

Name of herb and part used	Application in respiratory diseases
Myrtle (*Myrtus communis* Linn.) Leaf and fruit	Used in the treatment of bronchitis and dyspnea. Also acts as expectorant
Opium (*Papaver somniferum* Linn.) Seed, extract, latex from capsules	Useful in the treatment of cough
Maiden hair fern (*Adiantum capillus-veneris* Linn.) Leaves and the parts growing above the ground	Very effective in relieving cough
Filber fruit (*Corylus avellana* Linn.) Seed	When mixed with diluted honey, it is useful in the treatment of chronic cough and hemoptysis
Grey oak (*Quercus baloot* Griffith] Fruit	Useful in the treatment of hemoptysis
Hyssop (*Hyssopus officinalis* Linn.) Aerial parts	Both dried aerial parts and their aqueous tea, when used with fig and honey, are effective in various chest diseases, bronchitis, chronic cough, severe inflammatory conditions and deep and difficult breathing
Water lily (*Nelumbium nuciferum* Gaertn.) Aeed	Completely resolves thick sputum
Celery (*Apium graveolens* Linn.) Seeds	Beneficial in the treatment of cough and bronchitis
Cinnamon leaves (*Cinnamomum tamala* (Ham.) Nees and Eberm) leaves	A medicine for cough
Plantain (*Plantago ovata* Forsk.) seeds and husk	Seeds are an effective treatment for hemoptysis
Almond (*Prunus amygdalus* Batsch) Seed kernel	Useful in the treatment of pleuritis (*zaat al-janb*), cough and hemoptysis
Myrrh (*Commiphora myrrha* (Nees) Engler) Gum resin	Effective for chronic productive cough due to the common cold and in the treatment of dyspnea; it also clears the voice
Water lily (*Nelumbium nuciferum* Gaertn.) flowers	Syrup is effective for the treatment of cough and chest pain
Squill (*Urginea indica* Kunth.) Bulb	Useful in the treatment of chronic cough and hoarseness
Garden cress (*Lepidium sativum* Linn.) Leaves and seeds	It is beneficial in the treatment of asthma
Ammoniacum (*Dorema ammoniacum* D. Don.) Gum resin	Beneficial in the treatment of asthma
Dried sea sponge	With olive oil, effective in the treatment of hemoptysis
Orris root (*Iris germanica* Linn.) Root, root-bark	Useful in the treatment of chronic rhinorrheas (conditions with chronic secretion coming out from nose)
Blepharis (*Blepharis edulis* (Forsk.) *Pers.*) Seeds	Taken with barley water, effective in resolving thick sputum. The seed is the most effective part and very useful for the treatment of asthma, bronchitis and pleuritis (*zaat al-janb*)
Oligochaeta (*Volutarella divaricata* Benth.) Seeds	Useful in the treatment of hemoptysis
Violet herb (*Violata odorata* Linn.) Flower and leaves	It is effective in the treatment of pleuritis (*zaat al-janb*) and cough

breathing are because of the stomach, liver, uterus, intestine and the other organs.

When respiratory muscles become weak and cannot move the thorax correctly, it is due to one of the following reasons:

(1) disorders of the muscle itself;
(2) disorders of the brain or spinal cord;
(3) weakness of the muscles due to a disease such as tuberculosis, and so on;
(4) compression of muscles by other organs, for example, when the stomach is full of food or gas, it compresses the diaphragm and the diaphragm cannot extend appropriately.

Short breaths. Breathing which is short because of pain is not due to reduced capacity of the thoracic cavity. The presence of pain makes this obvious, and the patient having this pain and shortness of breath, if he tolerates the pain, can breathe appropriately.

Halitosis. Smelly breath is because of putrid sputum or putrid inflammation that has localized in the respiratory organs, trachea or lungs.

The origins of dyspnea

(1) inflammation in the airways or the respiratory organs including larynx, trachea, bronchi, vessels, and lung parenchyma;
(2) accumulation of viscous sputum in the lung or a very large amount of liquefied sputum;
(3) pressure of adjacent organs on the lung and, because of this pressure, compression of the lung. This is because of the swelling of liver, stomach or spleen;
(4) dryness or shrinkage of the lung which can cause lung stiffness;

(5) disorders of the nerves or diaphragm that lead to breathing problems and should be named as 'difficult breathing'*;
(6) the thorax is so small that lungs cannot expand enough.

*Avicenna names this type of breathing problem as '*usrun nafas*'.

Asthma

Asthma is one of the pulmonary diseases. The patient suffering from asthma is forced to breathe rapidly, similar to a person with asphyxia or someone who is very tired and breathes with distress. Asthma in younger patients is difficult to treat; it continues to old age when it is even more difficult to treat. It is one of the diseases that are chronic and is not easily curable and has intermittent severe phases. Never use a single drug forever for the treatment of asthma, and change the type of drug – because if a drug is used for a prolonged time, the temperament of the body will adapt to it and will not be influenced by it.

Production of the voice and its disorders

The muscles of the larynx produce the voice. These muscles, in a precise manner, open and send out the voice and accentuate it. The lung (because of air) is the original source of the generation of the voice. The diaphragm and thoracic muscles actively support the generation of the voice. The origin of the voice is the air that starts vibration in the larynx. Thus, it must be known that whenever there is a problem with the voice, the cause is either the larynx itself or a disease affecting the diaphragm or thoracic muscles that help in the generation of the voice.

Causes of voice defects are of a number of types:

(1) simple illness (with or without sputum);
(2) spillage of nasopharyngeal discharges into the larynx;
(3) complete damage to a nerve (supplying the larynx);
(4) cutting of a nerve;
(5) inflammation;
(6) pain and distress;
(7) trauma and falling on ground.

Cough and hemoptysis

Cough is one of the means by which nature removes harmful things from the body. The role of cough is to minimize the harm that has affected the lungs and to remove it from the structures surrounding and related to the lungs. Cough is produced by the expansion and compression of the thorax and diaphragmatic motion.

The cause of cough has two aspects:

(1) The cause is in the lung itself and related specifically to the lung;
(2) The cause is related to the lungs; other organs also contribute to cough.

There are various presentations of cough:

(1) abrupt onset, starts suddenly;
(2) continuous, without break;
(3) cough with a past history, started a long time ago.

Types of cough

(1) wet cough;
(2) dry cough.

If *nazleh* (sinusitis) is present with cough, the patient feels that something spills down toward the chest and passes down the pharynx. Signs that are indicative of sinusitis are:

(1) sense of irritation in sinus passages;
(2) feeling of traction of skin in the frontal region;
(3) obstruction of nasal opening;
(4) the first stage is without any expectoration. After that, the phlegm that is discharged is of yellow and sometimes of green color. If the expectorated material is of green color, it may occasionally be accompanied by fever.

If the sputum is viscous, do not try to dry it; try to make its viscosity become less so that it breaks into small pieces and is gradually resolved. Breaking of sputum into small pieces is very important and is more significant than resolving it.

Hemoptysis. Hemoptysis has a number of presentations:

(1) Sometimes hemoptysis is abrupt and is from the mouth and originates from oral structures;
(2) Sometimes it is associated with a mild cough and clearing of the voice, due to blood present in the trachea;
(3) Sometimes blood comes out in the form of vomiting because it is related to the esophagus, gastric inlet, stomach or liver;

(4) Sometimes it is present with a cough, because it is related to the chest and lungs.

It is possible that hemoptysis may not be due to external factors (such as warm weather, food, leeches, etc) only, but that it is entirely due to internal causes, for example, blood and other vessels.

If the cause of hemoptysis is not due to (disease of the) blood vessels, a few possibilities can be considered:

(1) There is a lesion in the lung;
(2) Pus that comes out from the lung lesion;
(3) Bleeding due to a chronic necrotic lesion;
(4) A structural lesion to an organ that then becomes infected.

Differentiation of nasal bleeding from hemoptysis. You should accurately differentiate between nasal bleeding and hemoptysis. You must diagnose the type of bleeding – this can be done in a number of ways:

(1) Does the patient suffer from habitual nasal bleeding?
(2) Are any visual signs of nasal bleeding apparent?
(3) Is the patient relieved of headache after bleeding?

The visible signs of nasal bleeding are:

(1) Red discoloration of the face and eyes;
(2) Blood that comes out of the nose is devoid of froth;
(3) Blood from the nose is emitted abruptly.

If patients have severe pneumonia (*zaat-ur-rieh*) and pleuritis (*zaat-ul-janb*) with fever, they may emit hemoptysis with froth. Blood that comes out of the vessels (of the lungs) is not frothy and is warmer and resembles normal blood more than the blood that comes out of the lungs.

Hemoptysis due to inflammation (such as due to infection) has a number of signs:

(1) The hemoptysis is mild;
(2) Signs and symptoms of pneumonia and other infections are present.

Regarding treatment, opium induces sleep and suppresses irritating coughs.

Pain sensation in the chest and flank in general

Sometimes it happens that internal membranes, thin membranes lining the internal organs, thoracic muscles, and muscles around the thorax and ribs, develop severe painful inflammation. This painful inflammation is called *shooseh*, *barsam* or *zaat-ul-janb* (pleuritis). It is most common in autumn and winter.

Signs of pleuritis (*zaat-ul-janb*):

(1) It is always associated with fever;
(2) Sharp pain, similar to pricking of a needle, is felt beneath the ribs. This is because the affected organ is membranous and, most of the time, the pain is not felt except while breathing;
(3) Dyspnea, due to the pressure caused by inflammation that is associated with short breathing, is recurrent;
(4) Cough, which is dry at the beginning of *zaat-ul-janb*, can be later associated with sputum.

The reason for cough (in *zaat-ul-janb*) is that the lung is adjacent to the diseased structure (the pleura). It is thus affected by the lesion of the adjacent structure (the pleura).

Now let us see what are the differences between *zaat-ur-rieh and zaat-ul-janb*. In pneumonia (*zaat-ur-rieh*), the pulse is waveform, pain is dull and dyspnea is more severe than that in pleuritis (z*aat-ul-janb*). The breath of the patient with pneumonia is warmer than the one suffering from pleuritis.

Pneumonia (*zaat-ur-rieh*)

Pneumonia (z*aat-ur-rieh*) is febrile inflammation within the lungs. The inflammatory material of pneumonia is sputum and most of the time it is like phlegm (*balgham)*. It is possible that the inflammatory material of pneumonia is bloody. How can pneumonia be diagnosed?

(1) The patient has a high grade fever;
(2) There is a very severe dyspnea that resembles asphyxia. Since airways are narrowed due to lung inflammation, the patient must sit straight (to breathe comfortably);
(3) The breath that comes out is very hot;
(4) Pain and discomfort that radiate from the chest towards the first rib near the clavicle extend to the back and can be felt between the scapulae;

(5) Because of the severity of fever and its deleterious effects, the respiration is rapid and deep;
(6) The sleep of the patient is without control (similar to unconsciousness);
(7) The pulse of the patient is filiform. The pulse rate changes with the degree of fever; if the fever is severe, the pulse rate is high and if the fever is not severe than the pulse is slower.

Tuberculosis

Children with tuberculosis are more responsive to treatment than patients at an older age. It is possible that tuberculosis will not kill the patient in the short term and that the patient will be allowed a longer time to live. It is likely that a young tuberculosis patient will reach middle age and not die of the condition. The season in which the disease of tuberculosis is more prevalent is autumn. Autumn is also very harmful for patients with tuberculosis. Those that are between 18 and 30 years old are more predisposed to tuberculosis. Tuberculosis patients develop chronic fever that is more severe at night. Tuberculosis patients always sweat. It often happens that a plaster-like material comes out in the sputum of a tuberculosis patient [Fitzgerald and Haas, 2005].

It is possible that the cessation of the sputum coming out during coughing can be due to severe exhaustion of the patient. In this condition, it is possible that the patient's difficulty in breathing reaches such an extent that it is almost impossible to observe his breaths. It is common that the cough is severe in tuberculosis patients and that blood comes out with coughing (hemoptysis). The blood that comes out with the coughing is consecutive and recurrent. When antitussive drugs are given to a tuberculosis patient, the cough of the patient stops or becomes milder; however, because of the fact that the sputum is not released by cough, the patient dies.

Discussion

Several observations of Avicenna related to signs and symptoms (Table 3), aggravating and relieving factors and the treatment of pulmonary disorders are still (Table 2) valid and can be explained on the basis of modern scientific literature. For example, one of the important symptoms in the diagnosis of asthma is dyspnea during sleep that leads to awakening [Pascual *et al.* 2008]. In addition, Avicenna observed plaster-like material in the sputum of tuberculosis patients which is now known to be lithoptysis (stone spitting) [Fitzgerald and Haas, 2005]. This is seen in lower lobe tuberculosis due to the perforation of the bronchial lymph node.

Tuberculosis is most commonly observed in autumn, an observation made by Avicenna that is still true today [Ríos *et al.* 2000]. In addition, Avicenna mentioned that eating garlic can cause nose bleeds. Interestingly, epistaxis has been reported in susceptible individuals after eating ginger, garlic and *Gingko biloba* due to the anticoagulant activities of the bioactive natural products in these herbs [Krüth *et al*. 2004].

Avicenna describes 21 herbs for the treatment of respiratory disorders. Several of these herbs contain bioactive compounds that have analgesic, antispasmodic, bronchodilatory or antimicrobial activities and that provide a rationale for the treatment of various respiratory diseases in traditional and modern medicine. For example, the use of opium at that time for cough and hemoptysis, as described by Avicenna, has an established therapeutic basis in the form of natural opioids and their derivatives in current medical practice.

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Conflict of interest statement

None declared.

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