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# AVICENNA THE ANAESTHETIST

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## Introduction

A thousand years ago, there flourished a long and academically vibrant era in the Arab world. During this period, several scientific disciplines were pioneered: from astronomy to mathematics and from botany to medicine. Indeed, medieval medicine from the Arab world represents a tradition whose origins are multi-faceted. It marks the preservation of classical Greek and Roman medical traditions, augmented with practices from Persia, India and China, embodied in a corpus of literature that was advanced significantly by Muslim physicians. Of the latter, the oft-cited great triumvirate includes Rhazes of Persia (d. 925), Albucasis of Andalusia (d. 1013), and arguably the most influential, Avicenna of Transoxiana (d. 1037), who wrote the five-volume, encyclopaedic *al-Qanun fi'l-Tibb* (The Canon of Medicine).

Perhaps to the surprise of many who consider anaesthetics a discipline forged solely after the discovery of ether in the Victorian era, and although hitherto largely lost to the annals of history, Avicenna, the great polymath, contributed much to the practice of anaesthetics. Indeed, we may question if he was one of the earliest anaesthetists to have lived. For within his five volumes of the Canon of Medicine, passages relevant to anaesthetics can be found throughout. Firstly, he significantly advanced the theory of pain, both challenging and developing Galen's ideas. Secondly, Avicenna highlights a range of *taskin*, analgesic agents, and *mukbaddar*, anaesthetic agents that can be used prior to surgery. Finally, within the Canon, he provides the first description of endotracheal intubation ever recorded and also elucidates for the first time the procedure for a tracheostomy.

The majority of The Canon of Medicine has, unfortunately, never been translated into any modern language. Out of the five volumes of the Canon, only the first volume has ever been translated into English. Therefore, using original Arabic manuscripts dating back to 1593, this paper presents these intriguing insights using direct translations that highlight Avicenna's tremendous contribution to the

field of anaesthetics. In order to contextualise this contribution, a brief overview of Avicenna and the Canon of Medicine is provided, along with an overview of the classical medical paradigm utilised in his era, through which the science of health and disease was interpreted.

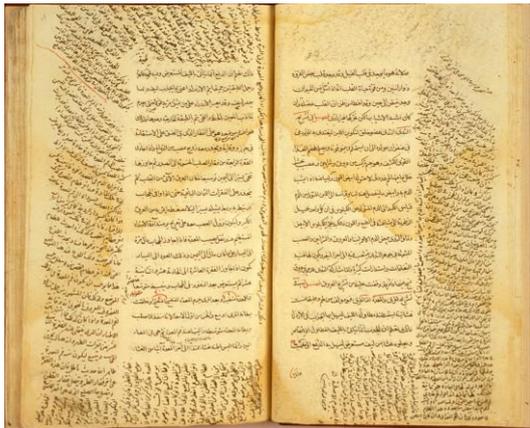
## **Avicenna**

Abu ‘Ali al-Husain ibn ‘Abdallah ibn Sina, known as Ibn Sina or the Latinised version of his name, Avicenna, was an eleventh century Persian scholar, born c.980 CE in the town of Afshana close to Bukhara in modern-day Uzbekistan. The son of a governor to one of the Sultan’s estates, he began his formal education at an early age, memorising the Qur’an by the age of 10 and beginning his study of medicine at the age of 16: by 18 he was a qualified physician and soon became famed for his successful treatment of many patients<sup>1</sup>.

Avicenna’s medical skill was noticed by the ruling establishment and he was brought to treat the Sultan of Bukhara, Nuh ibn Mansur, which he did successfully despite the most well-known physicians having been unable to do so. As reward, Avicenna requested only that he be granted access to the Sultan’s library and its rare manuscripts, thus providing the impetus to further his intellectual pursuits<sup>2</sup>.

After the death of his patron father, Avicenna began to wander around different towns in Khorasan (the ancient province spanning much of what is now West Afghanistan and East Iran), pursuing by night his intellectual endeavours through his writings and gathering a following of students, whilst continuing his work as a physician and administrator by day. He eventually settled in Hamadan, working as a court physician and it is here that he developed one of his most influential works, the Canon of Medicine. However, Avicenna lived through a period of great political instability and spent some time in prison, where he continued to work on his philosophical treatises, eventually escaping to Isfahan where he completed many of his major works. He returned to Hamadan where he died in 1037 CE.

Avicenna has been recognised as one of the great figures of intellectual history by both East and West: “Not only did he return Aristotle’s and Galen’s medical thought to the West after it had been lost for many centuries, but he also helped establish the physician as a gentleman, whose decorous behaviour admitted him to the most intimate circles of the wealthy and powerful”<sup>3</sup>. He is remembered in history as arguably the greatest polymath of the Islamic Golden Age.



The Canon of Medicine<sup>4</sup>



Avicenna<sup>5</sup>

### The Canon of Medicine

Avicenna wrote the *al-Qanun fi'l-Tibb* with the herculean intention of distilling all extant medical knowledge and practice. The Canon was completed in 1025, and is considered to be “the most influential Galenic document of the Middle Ages”<sup>6</sup>. It was translated into Latin by Gerard of Cremona (d. 1187) and formed the bedrock of medical curricula in universities across the world, from Baghdad to Montpellier and Leuven, for over six hundred years<sup>7</sup>, from late antiquity to the dawn of the Renaissance. A complete Latin translation appeared in 1473 and between 1500 and 1674 some sixty editions<sup>8</sup> of part or of the entire Canon were published in Europe for use in medical training at universities.

Meaning ‘law’, the *Qanun* became well known for its systematic approach towards bringing together the extant medical knowledge, whilst simultaneously advancing key concepts and procedures. These include

recognition of the contagious nature of many diseases and their means of spread, the first description of meningitis and the interaction between psychology and health. Kleinhenz notes: “Avicenna’s great work is so comprehensive, well-constructed and detailed that today it is still the foundation for medical training in some parts of the Middle East”<sup>3</sup>. The Canon of Medicine has for nearly a millennium given rise to what is referred to as ‘*Unani*’ medicine, which is still practiced widely in India and parts of the Mediterranean and Arab world today.

In the Canon, Avicenna defines medicine as “the science by which we learn the various states of the human body in health and when not in health, and the means by which health is likely to be lost, and when lost, is likely to be restored. In other words, medicine is the art whereby health is conserved and the art whereby it is restored after being lost”<sup>9</sup>.

The work is divided into five volumes discussing different aspects of medical science. Of these, as aforementioned, only the first volume has been translated into the English language to date.

- Book I: General matters relating to the science of medicine
- Book II: Individual drugs (alphabetically listed)
- Book III: Regional Diseases
- Book IV: Systemic Diseases
- Book V: the Pharmacopoeia

Avicenna’s main contributions to the field of anaesthetics can be divided into three main areas: his development of the theory of pain, his compendium of analgesic and anaesthetic agents, and finally, his descriptions of intubation and tracheostomy.

## **The Classical Theory of Temperaments and Humours**

Avicenna's works utilised what is commonly referred to as the classical theory of temperaments and the humours. Traditionally, the four temperaments included the hot, cold, wet and dry nature of organs, while the four humours included blood, phlegm, yellow bile and black bile. Bodily health, according to this classical theory, is determined by way of the proper balance of these four humours, which themselves can be affected by changes in the temperaments. If there is any imbalance in the four humours, illness will eventually ensue. Interestingly, the three major traditional medical systems that are still practiced today in various regions of the world, namely, Chinese, Unani and Ayurvedic, all subscribe to the same theory of temperaments and humours. The origins of humoral theory can be traced back to the ancient Egyptian and Mesopotamian physicians, after which it transferred to Hippocrates and the ancient Greeks and then eventually found its way to the library of Avicenna.

Some modern physicians have attempted to contextualise this classical paradigm in light of modern scientific knowledge. It is postulated that the four humours may actually refer to chemical classes of molecules derived from food such as proteins, lipids, carbohydrates and organic acids<sup>10</sup>. The temperaments, on the other hand, are the classical forerunners to a range of factors and parameters relating to bodily homeostasis. Illness thus ensues with temperament imbalances - that is when the homeostatic balance within the body is disrupted. Although the model of humours and temperaments has of course been superseded in the modern age with a more detailed and scientifically elaborate model, it is within this paradigm that Avicenna operated and thus within this paradigm that his contributions to anaesthetics are to be elucidated.

## **Theory of Pain**

Although references to pain are found scattered throughout the Canon of Medicine, Avicenna primarily discusses his theory of pain in the first volume. He uses the word *waja'*, or ache, as the generic term for pain and defines it as a feeling of incongruity<sup>11</sup> and that it is the opposite of pleasure, which is the feeling of a harmonising stimulus. He specifies the word *alam* to describe the painful subjective

experience that is perceived by the patient.

Within the classical paradigm, pain, Avicenna explained, is the by-product of a sudden change to the temperament of an organ; a change that would ultimately cause an imbalance in the four humours manifesting as an illness. If it were a slow, gradual change, pain would not result, and moreover, he explained that if the changes to the temperament of the organ persisted, even if they were sudden, then the pain would gradually disappear. Here, Avicenna alludes to the now well-established theory of desensitisation to a persistent stimulus.

Moreover, and in agreement with Galen (d. 210), Avicenna explained that nerves carry nociceptive pain sensations to the brain<sup>12</sup> which itself acts as the organisational centre and subsequent source of the painful feeling, or *alam*, experienced by the patient. However, he differed significantly with Galen in that he stated that the stimuli that initiate the change of temperament that ultimately causes pain, were not exclusively breaks of continuity, or physical injury to the organ, such as cutting or stretching. Rather, the stimuli are variable in nature and he elaborately categorises pain into 15 different varieties based upon causation. He further states that these stimuli do not all result exclusively from physical injury and furthermore pain may still continue even after the original stimulus has ceased, a concept that is consistent with modern pain theory, and one that acknowledges the neuropathic and psychogenic aetiologies of pain.

Moving on, whereas Galen had previously described four types of pain (pulsating, weighty, stretching and tearing) based solely on breaks of continuity, i.e. physical injuries, Avicenna details 15 varieties of pain based upon causation. These are: itching, pulsating, coarseness, pricking, stretching, tearing, fracturing, tenderness, piercing, stabbing, heaviness, numbing, pulsating, fatigue and biting<sup>11</sup>. The striking similarity this classification bears to modern classifications such as the McGill Pain Questionnaire, with 20 classifications of pain, of which 13 are common to Avicenna's list, is demonstrated in Table 1<sup>13</sup>.

Class	McGill Pain Questionnaire <sup>14</sup>	Avicenna's classification of pain	Arabic words
1	Pulsing, Throbbing, Bounding	Pulsating	الضرباني
2	Jumping, Shooting		
3	Stabbing, Lancing	Stabbing	المسقي
4	Sharp, Cutting, Lacerating	Tearing	المفسخ
5	Pinching, Gnawing	Pricking	الناخس
6	Tugging, Cramping, Taut	Stretching	الممدد
7	Hot, Burning		
8	Itchy, Tingling	Itching	الحكّاك
9	Heavy, Dull, Aching	Heavy	الثقيل
10	Tender, Taut	Tenderness, Compressing	الضاغط
11	Tiring, Exhausting	Fatigue	الإعيائي
12	Sickening, Suffocating		
13	Fearful, Terrifying		
14	Punishing, Cruel		
15	Wretched, Blinding		
16	Intense, Unbearable		
17	Penetrating, Piercing	Piercing	الثاقب
18	Numb, Squeezing	Numbing	القدر
19	Cold, Freezing	Biting	اللذاع
20	Dreadful, Nagging	Coarseness	الخشن

On closer analysis of the descriptor classes, it can be seen that the virtually all of the words that describe the sensory attributes of the painful experience, including the temporal, spatial and thermal properties (classes 1-10) as well as the miscellaneous properties (classes 17-20) are present in Avicenna's original classification. The classes virtually absent in Avicenna's classification are those describe the affective and evaluative qualities of the painful experience (classes 11-16). This is unsurprising,

however, as Avicenna's classification of pain was from the outset based upon causation and aetiology, rather than the evaluative attributes. Thus, it is quite remarkable that a classification system of pain developed by Avicenna in the eleventh century bears striking similarity to one that was developed almost a millennium later and is still used by anaesthetists today.

### **Analgesia & Anaesthesia**

The second main area to which Avicenna contributed a great deal was the field of analgesic and anaesthetic treatments. He referred to pain relief as *taskin*, which is etymologically derived from the root letters ن, ك, س and literally means in Arabic 'to make silent'. Applied in the context of pain, this term refers to analgesia. Avicenna emphasised the importance of investigating the underlying cause of the pain to provide effective analgesia. He provided three methods of achieving *taskin*: altering the temperament, neutralising the painful stimulus or alternatively, employing a drug from a range of anaesthetic agents<sup>13</sup>.

Firstly, regarding temperament change, Avicenna dedicated an entire chapter of his book to this, reflecting the importance he ascribed to such conservative measures. He suggested that factors affecting temperament include changes in food, sleep, rest, exercise, emotions and weather. Effective strategies to bring about temperament changes include "a long, gentle and relaxing walk ... a pleasant song, particularly if it induces sleep, and occupying oneself with that which one finds pleasurable is a strong analgesic"<sup>15</sup>. The association between psychological interventions and physiological health have been acknowledged in medical textbooks for millennia and such conservative measures are still often the first-line therapy recommended by health professionals today in the management of a wide range of chronic conditions.

More specifically, the distraction techniques advocated by Avicenna for the acute management of pain have parallels to a currently active area of research, namely the use of immersive virtual reality distraction therapy (VRDT). This has most effectively been used in the management of burn injuries,

with the anxiety-provoking dressing changes in burns patients described as arguably the most painful and distressing non-surgical procedure of all<sup>16</sup>. Research from a number of groups has established that immersive VRDT is a particularly effective technique to achieve analgesia<sup>17</sup>. For instance, SnowWorld, a 3D software package utilising VRDT developed by Patterson and Hoffman at the University of Washington<sup>18</sup> focuses on a pleasant virtual world in which background music is played, and where participants navigate an area shooting snowmen, igloos and penguins with virtual snowballs. According to Avicenna, such an immersive and sensory experience, involving changes in sound, weather and emotions, would cause a temperament change, ultimately resulting in *taskin*, or analgesia.

The second mode of analgesia that Avicenna suggested derived from deductive reasoning employing to the classical temperament theory. If indeed a temperament change could cause pain, then it would follow that providing a neutralising and opposite stimulus ought to reverse its effects. For example, a person may eat hot food and a severe headache may result from it. Here, he recommended tackling this malady by internalising the opposite, e.g. to drink cooled water<sup>19</sup>. Avicenna also advised physicians to consider extrinsic causes of pain, such as external heat, external cold, or intoxication, etc – because they could all be internalised and affect the body as a whole. For example, for fractures he suggested splinting to minimise movement as he explained it was not the fracture but the movement of the broken parts that is painful<sup>15</sup>.

Finally, Avicenna suggested use of anaesthetics, referred to as *mukbadder*, to tackle pain. This term had been in common use in Arabic texts prior to Avicenna and referred to a means of dulling the sensation. The second volume of the Canon was the definitive Materia Medica for over half a millennia and listed over 800 known drugs used at the time, including the *mukbadder*. These include several relaxants such as dill, linseed, melilot, chamomile, celery seed and bitter almond as well as ice-cold water for local anaesthesia<sup>20</sup>. Avicenna cites opium as the most powerful stupeficient, while those less powerful include mandrake (mandragora), poppy, hemlock (henbane), hyoscyamus and lettuce-seed. In addition, for each drug he provides a wealth of information within a systematic template. Typically, he provides

the drug's definition, advice on selection, key properties, drug effects, signs of overdose and their antidotes as well as providing alternatives.

To illustrate the level of detail included in Avicenna's *Materia Medica*, the entry on opium is translated below<sup>21</sup>. The entry occupies approximately half a page of the entire *Canon of Medicine*, a textbook that spans approximately 1,000 pages in its entirety.

### Opium

**Definition:** Opium is extracted from black poppy and induces sleep on smelling... and when it is heated on burning iron, it turns red.

**Selection:** The variety that should be utilised is resinous with an overpowering odour. It is soft and dissolves easily in water without thickening. Avoid the yellow variety that stains water and has a faint odour for that has been adulterated with the *glaucium flavum* (yellow horned poppy).

**Nature:** Cool and dry in spring

**Properties:** It is an anaesthetic and analgesic agent for use in all pains, whether ingested or applied locally. The typical oral dose is the size of a large lentil.

#### **Effects:**

- Tumours and warts: Stops abscesses forming.
- Wounds and ulcers: Dries ulcers.
- Joints: Upon mixing with egg-yolk and then heating, it dulls the pain of gout
- Organs of the head: If administered rectally, it is a hypnotic and induces sleep. When mixed with rose oil, myrrh and saffron, it effectively treats ear pain and relieves chronic headache. However, it also decreases the cognitive ability of the mind.
- Organs of sight: Relieves eye pain but many of the ancient physicians were cautious in its use because of its negative effects on sight.
- Organs of breathing: Treats severe cough.

- Organs of nutrition: Causes the relaxed stomach to contract and promotes constipation especially if ingested without castor-oil.
- Waste organs: Prevents diarrhoea and alleviates intestinal ulcers.

**Overdose:** Can kill by weakening bodily strength. The antidote is castor oil. The oral dose should not exceed two grains.

**Alternatives:** Opium is equivalent to thrice the amount of henbane and twice the amount of mandrake.

In the fifth volume, the Pharmacopoeia, Avicenna suggests the use of various recipes and mixtures of approximately 40 plants listed in the Materia Medica (volume 2) in order to achieve anaesthesia prior to surgery<sup>22</sup>. Accompanying each was a detailed description of the variety of methods for administration, including oral, inhalational and rectal<sup>23</sup>. The Spongia Somnifera, or the ‘Soporific Sponge’, was developed and enhanced during this time and contained the juice of mandrake (mandragora), various aromatics and narcotics. It was designed to be held under the nostrils of the patient in order to provide inhalational general anaesthesia prior to surgery and continued to be used in the medieval ages until the discovery of ether.<sup>24, 25</sup>

Moreover, Avicenna demonstrates his awareness of the strength, depth and time-dependent action of anaesthesia for use different types of operation. For example, he gives a dose of one *mithqal* of mandrake for 3-4 hours of general anaesthesia<sup>26</sup>, suitable for major operations such as amputation. Furthermore, Avicenna writes: “If it is desirable to get a person unconscious quickly, without his being harmed, add sweet-smelling moss or aloes-wood to the wine. If it is desirable to procure a deeply unconscious state so as to enable the pain to be borne, place daniel-water into the wine; or administer fumitory, opium, hyoscyamus (half dram dose of each); nutmeg, crude aloes-wood (4 grains of each). Add this to the wine, take as much as is necessary for the purpose. Or boil black hyoscyamus in water, with mandragora bark, until it becomes red, and then add this to the wine.”<sup>27</sup>

Not only does the concept of providing multimodal perioperative anaesthetic regimens continue in the world of anaesthesia today, but Avicenna – quite remarkably for his time – also alluded to another very important area in anaesthetics. He acknowledged that no effective analgesic is without risk and the approach to be taken therefore is to be aware of this risk and act in such a way as to minimise this risk prior to administration. This is to be achieved by taking into account the patient’s age, gender, co-morbidities, general energy and allergies – and he emphasised that every patient is unique and what may work in one patient will not necessarily work in another “if even double the recommended dose” is used<sup>28</sup>. This is without doubt the ancient forerunner of the pre-operative assessment performed routinely and diligently by the anaesthetist today<sup>29</sup>.

### **Intubation & Tracheostomy**

Avicenna is widely recognised as being the first person to have described the procedure of endotracheal intubation<sup>30</sup>. In his chapter on the treatment of respiratory distress, stridor and suffocation<sup>31</sup>, he describes both endotracheal intubation and also tracheostomy, to a moderately practical level of detail.

Regarding intubation and tracheostomy, Avicenna explains the steps concisely and clearly. “There is no harm in inserting something such as a cane/reed or its like around which some cotton is wound, to clear the airway and dilate it. One might also insert a tube made from gold or silver or their like into the pharynx to assist breathing”<sup>32</sup>. Avicenna continues to talk about the next step in airway management if this fails<sup>33</sup>. “And so, if the suffocation continues, and treatments are unsuccessful, then it will be beneficial to incise the trachea. The head is extended back and the skin is gripped and stretched back with hooks before the incision is made. The trachea is then exposed, and an incision is made in the middle between the two tracheal rings, whilst avoiding cutting the (cricoid) cartilage. The edges of the cut skin are turned outwards and stitched without damaging the underlying tissue”<sup>34</sup>. Perhaps somewhat surprisingly, both intubation and tracheostomy have retained the same core procedural steps as described by Avicenna a millennium ago, as well as, of course, their crucial and often life-saving roles in medical practice.

## **Conclusion**

Overall, it is evident that Avicenna contributed significantly to the field of anaesthetics, whether in theorising about pain within a classical paradigm and providing classifications that have stood the test of time, providing comprehensive lists of analgesic and anaesthetic treatments or providing one of the earliest descriptions of endotracheal intubation and tracheostomy. It ought to be remembered, however, that these extracts occupy only a small portion of the entire Canon of Medicine, a book of over one million words that essentially crystallised the entire corpus of extant medical knowledge.

By compiling this knowledge in a systematic and organised fashion, and by using eloquent, articulate and scientifically precise language, it is understandable how the Canon of Medicine became such an unprecedented success, and formed the basis of medical curricula for a millennium across the known world. Indeed, such was its influence that Sir William Osler, in the early 20th century, described it as a “medical bible” and “the most famous medical textbook ever written”<sup>35</sup>. It is somewhat surprising, therefore, that only a fifth of the Canon has hitherto ever been translated into English.

The legacy left behind by Avicenna in the field of medicine is significant, and specifically in the field of anaesthetics is evidently palpable. Having left such a great legacy in this field, the question remains as to whether we can refer to Avicenna as an ‘anaesthetist’. This essay has presented the evidence for ascribing such a title, but the answer to that question remains for the reader to decide. Regardless, his legacy lives on not only in the books of history but several medical projects and institutions have honoured his scientific contributions and are today named after him, perhaps uniquely, both in the East and in the West.

Indeed, Professor John Urquhart, at the Royal College of Physicians of Edinburgh was once asked “If the year were 1900 and you were marooned and in need of a guide for practical medicine, which book would you want by your side?” He replied, “My choice was Ibn Sina [Avicenna].”<sup>36</sup>

## Acknowledgements

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