Ophthalmology in ancient india, Sushruta's time and the modern era

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While reading an article related to the history of Indian ophthalmology, I came across this description of a surgical procedure: "The doctor warmed the patient's eye with the breath of his mouth. He rubbed the closed eye of the patient with his thumb and then asked the patient to look at his knees. The patient's head was held firmly. The doctor held the lancet between his fore-finger, middle-finger and thumb and introduced it into the patient's eye towards the pupil, half a finger's breadth from the black of the eye and a quarter of a finger's breadth from the outer corner of the eye. He moved the lancet gracefully back and forth and upward. There was a small sound and a drop of water came out. The doctor spoke a few words to comfort the patient and moistened the eye with milk. He scratched the pupil with the tip of the lancet, without hurting, and then drove the 'slime' towards the nose. The patient got rid of the 'slime' by drawing it into his nose. It was a matter of joy for the patient that he could see objects through his operated eye and the doctor drew the lancet out slowly. He then laid cotton soaked in fat on the wound and the patient lay still with the operated eye bandaged. It was the patient's left eye and the doctor used his right hand for the operation."

This is the description of an operation that was performed by Sushruta, India's greatest surgeon of the pre-medieval period [1,2].

Sushruta's time has long been a controversial subject due to a lack of direct evidence [3]. The original copy of *Sushruta Samhita*, the monumental treatise on surgery written by Sushruta, is not traceable. However, a version of this textbook was discovered in 1890 in Kuchar, Chinese Turkestan, and was named after the man to whom it was sold, Hamilton Bower. The Bower manuscript is currently housed in the Bodlean Library in Oxford [4]. Hoernle edited and critically evaluated it and placed its origin around fifth century BC. As Sushruta's name was found in this document, it is presumed that he must have existed in the fifth century BC or earlier [3]. Sushruta is the most celebrated physician and surgeon in India. Many of his contributions to medicine and surgery preceded similar discoveries in the western world [5]. Sushruta practiced medicine nearly 150 years before Hippocrates [6].

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The steps of the operation definitely indicate that it was done for removal of the opacity of cataractous lens though there was some confusing interpretation of the findings encountered while doing the surgery. Several reasons, such as translation of the original work by a non-medical Sanskrit scholar, difficulty in interpreting Vedic Sanskrit and the understanding of cataract at that time might lead to this confusion. Recently there has been some debate whether we should consider the operation done by Sushruta to be extracapsular cataract extraction or couching [7,8]. But in ancient times, cataractous lenses were dislocated into the vitreous cavity rather than removed in the strict sense. Sushruta unknowingly might have done some partial extracapsular lens extraction in cases with mature or hypermature cataract while attempting displacement of opaque lens from the pupillary area (couching).

Nevertheless, it is really amazing to note that in the later part of the 'Vedic Age' (3000 to 1000 BC), a surgeon dared to enter the eye with a lancet to remove the lens opacity. Couching became a very popular procedure for removal of blindness due to cataract. The analogy of Buddha removing the screen of ignorance using a probe of wisdom to the surgeon who removes cataract with a metallic probe is often found in Buddhist literature. Even a symbolic cataract operation was imitated at the time of initiation of monks at that time [9].

It was quite natural that people at that period of time tried some non-surgical measures to cure cataract before the development of the surgical remedy. In one such approach, a fully

developed dead cobra was put into a jar of milk along with four scorpions, and was kept aside to degenerate and decay in the milk for about a period of 21 days. After that the milk was churned into butter. This butter was fed to a cockerel. The faecal matter of this cockerel was applied to the eye with the hope of curing the eye of cataract [2].

Ancient knowledge

The Vedas, the oldest sacred books of the Hindu religion are considered to be the first record of the ancient knowledge and civilisation of India, but also of the whole world. There are four Vedas, which were compiled in Sanskrit language between 3000 to1000 BC. Most of the early Vedic medicine was compiled in one of the four Vedas, known as *Atharvaveda*. Superstition and magic is seen in Atharvaveda and the cures suggested are both magic spells and plant remedies [10]. The ancient Indian system of medicine and surgery is commonly known as Ayurveda (science of life). This was given the status of 'Upa Veda' (supplementary subject of Veda) or fifth Veda in the next stage of growth. Among the available literatures three 'Samhitas' (compendiums) – *Sushruta, Charaka* and *Astanga Hridaya* are currently the chief source of knowledge of Ayurveda [11]. In fact, the first rational approach to medical science is seen in the composition of Sushruta and Charaka Samhita in the pre-Buddhist period [10].

The oldest treatise dealing with surgery is the *Sushruta Samhita*. Sushruta was possibly born in the seventh century BC. He practiced and taught the art of surgery at the University of Benares in the ancient city of the same name, located on the bank of the river Ganges that flows through the northern part of India [3,12]. The followers of Sushruta were called Saushrutas. The new student was expected to study for at least six years. Before starting his training he had to take a solemn oath, which can be compared to that of Hippocrates [12]. Sushruta had superb observational power and a sharp analytical mind. *Sushruta Samhita* established him as the 'Father of Indian Surgery' or rather 'Father of surgery in the world' [3,11,13,14]. The *Sushruta Samhita* was a textbook of surgery in those days and was studied by the students of medicine more than 2000 years ago. The text of the *Samhita* was quite long, running to 1700 pages in its English translation [13]. As a textbook, it is unrivalled in respect of composite teaching on the subject, as it included information about all allied branches of medical learning required by a surgeon [11]. The original *Sushruta Samhita* was revised by Nagarjuna in the second century AD. Nagarjuna was a great Buddhist teacher. The *Samhita* was again re-edited by Chakrapani in the 11th century [6]. The Samhita contains 184 chapters and description of 1120 illnesses, 700 medicinal plants, a detailed study of anatomy, 64 preparations from mineral sources and 57 preparations from animal sources. Sushruta devoted 18 chapters to describing 76 eye diseases, of which 51 required surgical treatment. *Sushruta Samhita* was written in the aphorism form and the techniques described in it are eminently in line with the technical abilities of the times [11,14].

Figure 1: The Sushruta Samhita or Sahottara-Tantra (A Treatise on Ayurvedic Medicine). Source: Los Angeles County Museum of Art.

Sushruta was one of the first in the world to study the human anatomy with the aid of a preserved dead body. He was the first person who established the technique of preservation of dead bodies [1,15]. Sushruta had devised various experimental models for trying surgical procedures for the students before trying their hands on actual patients [16].

Sushruta described surgery under eight heads – excision (Chedya), scarification (Lekhya), puncturing (Vedhya), exploration (Esya), extraction (Ahrya), evacuation (Vsraya) and suturing (Sivya) [1]. He described over 120 surgical instruments and 300 surgical procedures in his *Samhita* [11]. He was the first surgeon to systemise surgery by dividing it into separate fields. He is known as the originator of plastic surgery, cataract operation, laparotomy and vesical lithotomy [3]. He was aware of angina and the ill effects of obesity. He also knew about diabetes and was aware of the benefits of physical exercise in controlling this disease. Tipton [17] rightly observed that Sushruta's concepts pertaining to the health benefits of exercise were "remarkably modern." He is credited with performing cosmetic surgery and especially rhinoplasty using forehead skin to reconstruct noses which were usually amputated as a punishment for crimes in his era [1,6]. This rhinoplasty operation eventually changed the course of plastic surgery in Europe.

Indian ophthalmic tradition started much earlier than Sushruta's time. Indeed, India had a long tradition of ophthalmic study and practice starting from the legendary King Nimi of Videha (located in what is now the eastern Terai-Madhesh region of Nepal and the northern Indian state of Bihar). This great king was considered to be the founder of the science of ophthalmology in India. It was Nimi who first gave instructions for operation on a cataract. The knowledge of ophthalmology, as well as other aspects of medical science, was passed through king Nimi to Sushruta and Nagarjuna of second to fourth century AD, Vagbhaa of sixth century AD and so on up to pre-modern times [9].

The procedure of the cataract

surgery described in *Sushruta Samhita* might have been transmitted to the west by Greek travellers from India and the Middle East [18]. This procedure was also introduced into China from India via the silk route during the late West Han Dynasty (206 BC – 9 AD). In China, it was combined with the Chinese concept of acupuncture [19]. The first reference to cataract and couching as its treatment in the west is found in 29 BC. It was adapted all over the world till the French ophthalmologist Jaques Daviel did the first successful extracapsular cataract extraction in April 1747 [18]. Though the technique of cataract surgery changed rapidly, the ancient procedure was carried out by wandering vaidyas, hakims or barbers up to the 20th century [9], however, this procedure is not always effective and at times may turn out to be dangerous.

Ancient Indians understood the anatomy of the eye only as much as can be perceived from the exterior. They did not have any idea about the retina or optic nerve. This indicates that their knowledge about the eye was not based on practical dissection of the organ. They had some idea about the lenses inside the eye for quite some time, but the correct idea about its location came only by the 12th century AD [9].

Ancient Indian philosophers contributed substantially to the development of ideas of visual mechanism. The contribution of an outer source of light and cognitive power was known all along but there was confusion as to the seat of perception. The brain as a physical entity was not recognised, again due to the taboo of dissecting a cadaver [9].

Sushruta Samhita described surgeries for conditions like cataract, pterygium, trichiasis and entropion. Diseases like glaucoma were treated by relieving ocular pressure by inserting a needle or using leeches [9].

The 'golden' and 'dark' ages

The 'golden age' of Indian medicine was between 800 BC and 600 AD. Learned men from China, Tibet, Afghanistan, Greece, Rome, Egypt and Persia came to the Indian Ayurvedic Schools to learn about this system of medicine. Ayurvedic texts were translated into Arabic by physicians like Avicenna (Ibu Sina) and Razi Sempion. Both of them quoted Indian Ayurvedic texts and established the Islamic medicine 'Unani System'. This Indian Ayurvedic System also became popular in Europe and helped to form the foundation of the European tradition of medicine [6].

Though ancient India made mindboggling advances in medical science, this was unknown in the West until recent times. The main reason is that old Indian texts were written in Sanskrit and only a few Sanskrit scholar-physicians are available to translate the material into western languages. Also, interestingly, the knowledge of Ayurveda was guarded as a family secret by people of the priestly class who practised it in ancient times [3].

The period between 500 AD and 1500 AD is called the 'dark age of medicine' all over the world [6]. The caste system which had crept into the Indian society and the taboo of dissecting dead bodies hampered the expansion of the knowledge of medical science in India. However, during this period, Arabs advanced a lot in comparison to other civilisations. Graeco-Roman medical literature was translated into Arabic. They founded medical schools and hospitals in Baghdad, Damascus, Cairo and other Muslim capitals. The 'golden age' of Arabic medicine was between 800 and 1300 AD [6].

The domination of Indian medicine gradually declined with the spread of Islam during the middle ages. With the arrival of Muslims in India, Hindu medicine lost its importance due to the lack of state help and support by the rulers. The Muslim rulers introduced the Unani system of medicine and by the 13th century, the Unani system was firmly established in places like Delhi, Aligarh, Lucknow and Hyderabad. This continued until the eighteenth century when, with the arrival of the British in the 18th century, the Ayurvedic system was revived again along with the Western system of medicine [6].

The modern era

By the late 19th and 20th centuries, almost every civilised area on the globe saw a new trend in art, politics, science and culture. The modern era of science is closely associated with technological progress, which has lead to many discoveries and changes in our understanding of many diseases. The advent of the modern science of ophthalmology is essentially a Western phenomenon [9].

In the early 19th century, the British Government of India could not entrust the healthcare of their own people into the hands of Ayurvedic physicians and Unanis. They had to bring medical men from their own country. The British surgeons trained a few Indians in the elementary principles of diagnosis and the treatment of disease and appointed them as 'native doctors'. Seeing the dedication of these people, the Medical Board of the British Surgeons thought of providing a more systematic education. With a Government Order dated 21 June 1822, the first medical school in British India was established. The school opened in October 1824 at Calcutta Sanskrit College. The period of training was for three years. In 1833 Lord William Bentinck, the then Governor of India, took initiative in establishing a medical college for Indians [6].

However, long before the establishment of Calcutta Medical College in 1835, the East India Company had a small eye infirmary in Halliday Street, Calcutta. In 1880, this eye infirmary was shifted to Medical College Hospital. A separate eye infirmary was opened in 1928. During the Second World War, the eye infirmary gained prominence by receiving and treating the eye casualties from the Burma front [6].

By the 19th century, there was considerable improvement in various fields of medicine, including ophthalmology, and the healthcare system in India. After the 'British Raj', a significant milestone in the development of ophthalmology in India was the growth of the department of ophthalmology at the All India Institute of Medical Sciences, New-Delhi to the Dr RP Centre for Ophthalmic Sciences in 1967. The institute grew between 1967 to 1986 to a 300 bed eye hospital with 12 operation theatres, 25 full-time faculty, with basic sciences and community ophthalmology wings and providing training to 72 junior residents and 25 senior residents – one of the largest residency training programmes in the world [20]. During this period some sophisticated eye institutes were also built in the southern part of India.

Now, every state of India has several medical colleges with well-equipped eye departments, and many of the states have ophthalmic institutes of international standard in both the government and private sectors. It seems there is a bright future for Indian ophthalmology. The younger generation should be able to regain the

lost glory of Indian ophthalmology, as there is no dearth of talent or patients.

Lastly, while researching this article, I was amazed to notice that many of the ancient kings and spiritual leaders of India were the great physicians / surgeons of that period of time. Even the teacher of Sushruta was a king. But why did the kings themselves became physicians? Was it because the common people looked towards them for every problem in life? Or did they consider the act of treating the sick and giving life to the dying to be of great virtue?

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Declaration of Competing Interests
None declared.