Surgery Before Common Era (B.C.E.*)

Dudanka Dobanović, Ljiljana Mitrovavnić, Andelka Slavković, Milanka Tatić, Sanja Skedeljžić Mitković, Svetlana Škorić-Jokić, Marija Pecanac

SUMMARY

Based on skeleton examination, carving-paintings and mummies the study of prehistoric medicine tells that the surgical expertise was associated with skull trepanning, male circumcision, culture and warfare wound healing. In prehistoric tribes, medicine was a mixture of magic, herbal remedy, and superstition beliefs practiced by witch doctors. The practice of surgery was first recorded in clay tablets discovered in ancient rests of Mesopotamia, translation of which has nowadays been published in Diagnoses in Assyrian and Babylonian Medicine. Some simple surgical procedures were performed like puncture and drainage, scraping and wound treatment. The liability of physicians who performed surgery was noted in a collection of legal decisions made by Hammurabi about the principles of justice between doctors and patients. Other ancient cultures had also had surgical knowledge including India, China and countries in the Middle East. The part of ancient Indian ayurvedic system of medicine devoted to surgery Sushruta Samhita is a systematized experience of ancient surgical practice, recorded by Sushruta in 500 B.C.E. Ancient Indian surgeons were highly skilled and with a lot of surgical procedures and had pioneered several surgical instruments. In the ancient Egyptian Empire medicine and surgery developed mostly in temples: priests were also doctors or surgeons, well specialized and educated. The Edwin Smith Papyri, the world’s oldest surviving surgical text, was written in the 17th century B.C.E., probably based on material from a thousand years earlier. This papyrus is actually a textbook on trauma surgery, and describes anatomical observation and examination, diagnosis, treatment, and prognosis of numerous injuries in detail. Excavated mummies reveal some of the surgical procedures performed in the ancient Egypt: excision of the tumors, puncture and drainage pus abscesses, dentistry, amputation and even skull trepanation, always followed by magic and spiritual procedures. Various types of instruments were invented, in the beginning made of stone and bronze, later of iron. Under the Egyptian influence, surgery was developed in ancient Greece and in Roman Empire. Prosperity of surgery was mostly due to practice in treating numerous battlefield injuries. Records from the pre-Hippocrates period are poor, but afterwards, according to many writings, medicine and surgery became a science, and surgical instruments were formed in the Mediterranean, and surgeons were well-trained professionals. Ancient surgery closed a chapter when Roman Empire declined, standing-by up to the 18th century when restoration of the whole medicine began.

Key words: General Surgery; History of Medicine; History, Ancient

Surgery B.C.E.*

Surgery** is a medical specialty that uses manual and instrumental techniques on a patient to investigate or treat a pathological condition such as disease or injury, to improve body function or appearance as a contraindication to disease, to heal and go on to any help and dress and bandages the wounds. Setting broken limbs was also practiced in primitive medicine. The injured area with fractured bones was covered using river mud or clay materials, which then set hard so that the bone could heal properly (2, 3). Trephination was practiced in every part of the world when prehistoric people lived and is believed to be the oldest known surgery, since the earliest evidence were from the Stone Age. Trephinated human skull fossils of all ages date as far back as 10,000 years, the Neolithic era in Europe, Russia, the Canary Islands, North Africa, Peru and Bolivia. The reasons for trepanning are not known, but it might have been performed as a procedure for releasing evil spirit in people who suffered epilepsy, terrible headaches, or mental disorders. It was practiced by a special group of priests or “medicine man”, more or less experienced, using primitive instruments like leaves of stone, obsidian, bronze, or bone (4). This procedure involves cutting or drilling an opening in the skull and closing up the wound. In some skulls there is no sign of healing, indicating that the death of the patients occurred during or after the operation; however, many show extensive healing of the bone edges, indicating the patients’ survival (5). Some of the trepanned skulls might be battle resulted casualties. There is no evidence of any kind of anesthesia during these surgical procedures, not even among central American tribes who did know the effects of cocoa leaves (6, 7). Circumcision was also practiced in the prehistoric days – some believe as early as in 4000 B.C.E. This was confirmed on extant bodies from prehistoric Egypt and elsewhere. Whether the prehistoric circumcision procedures originated from Egypt some 15,000 years ago, and was spread worldwide through the prehistoric migrations, or developed independently in different cultures. When Columbus arrived to the New World, he found that many of the natives were already circumcised. The primary closing up of wounds by using some insects in America and Africa is a well-known practice. It was also practiced in ancient tribal medicine: the priests of certain ant species were used, the ant being held above the wound until it bit, then from its head was removed allowing the pins to hold close the wound (“ant sutures”) (8). Ancient Indian surgeons also used ants to close intestinal wounds. Medical knowledge, as it was so, increased gradually into oral databases that were transformed through hundreds of generations until literacy.

THE DOWN OF CIVILIZATION

began with Sumerians in Mesopotamia c.3500 B.C.E., when the system of writing developed and society was no longer prehistoric. A lot of information about life and science are available from cuneiform clay tablets that have survived from the library of king Asshurbanipal (the originals are in the British Museum, London). Some of these are about medical subjects, but after him, according to many writings, medicine and surgery became a science, and surgical instruments were formed over the Mediterranean, and surgeons were well-trained professionals. Ancient surgery closed a chapter when Roman Empire declined, standing-by up to the 18th century when restoration of the whole medicine began.

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**SUMMARY**
Based on skeleton examination, carving-paintings and mummies the study of prehistoric medicine tells that the surgical experience was dated with skull trepanning, male circumcision and warfare wound healing. In prehistoric tribes, medicine was a mixture of magic, herbal remedy, and superstitious beliefs practiced by witch doctors. The practice of surgery was first recorded in clay tablets discovered in ancient rests of Mesopotamia, translation of which has nowadays been published in Diagnoses in Assyrian and Babylonian Medicine. Some simple surgical procedures were performed like puncture and drainage, scraping and wound treatment. The liability of physicians who performed surgery was noted in a collection of legal decisions made by Hammurabi about the principles of relationship between doctors and patients. Ancient cultures had also had surgical knowledge including India, China and countries in the Middle East. The part of ancient Indian ayurvedic system of medicine devoted to surgery Sushruta Samhita is a systematized experience of ancient surgical practice, recorded by Sushruta in 600 B.C.E. Ancient Indian surgeons were mostly skilled with a lot of surgical procedures and had pioneered the concept. In the ancient Egyptian Empire medicine and surgery developed mostly in temples: priests were also doctors or surgeons, well specialized and educated. The Edwin Smith Papyrus, the world’s oldest surviving surgical text, was written in the 17th century B.C.E., probably based on materials from a thousand years earlier. This papyrus is actually a textbook on trauma surgery, and describes anatomical observation and examination, diagnosis, treatment, and prognosis of numerous injuries in detail. Excavated mummies reveal some of the surgical procedures performed in the ancient Egypt: excision of the tumors, puncture and drainage pus abscesses, dentistry, amputation and even skull trepanation, always followed by magic and spiritual procedures. Various types of instruments were innovated, in the beginning made of stone and bronze, later of iron. Under the Egyptian influence, surgery was developed in ancient Greece and in Roman Empire. Prosperity of surgery was mostly due to practice in treating numerous battlefield injuries. Records from the pre-Hippocrates period are poor, but available, according to many writings, medicine and surgery became a science. Various kinds of surgical instruments were formed over the Mediterranean, and surgeons were well-trained professionals. Ancient surgery closed a chapter when Roman Empire declined, standing-by up to the 18th century when restoration of the whole medicine began.

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**Surgery B.C.E.** Surgery**” is a medical specialty that uses manual and instrumental techniques on a patient to investigate or treat a pathological condition such as disease or injury, to improve body function or appearance as a consequence of illness, trauma or congenital anomalies. This short overview of the development of surgery points out the major milestones in the several millennia long history of medicine and surgery before the common era as presenting author’s critical conclusion from the sources listed in references. “It is our duty and hard task to preserve the heritage of medicine and keep, for the next generation, this treasure from the past” (1).

At the very beginning of prehistoric medicine, treatments of the sick or injured were very simple, and reflected in essence the relationship of prehistoric people to nature. They were hunters and lived in small tribes, constantly on a move in search for better life conditions and food. The prehistoric period ended with the development of tribes, societies, which, in different parts of the world, happened in different times (2). The study of prehistoric medicine is mainly dependent on sources such as skeletons, artifacts, and cave paintings or inscriptions. Also, the studies of people who at present live in tribal societies, like East African tribes, Aborigines in Australia, or native Americans can help understand the idea and practice of prehistoric medicine (burning of parts of a body to remove, tying of blood vessels with tendon and closing of wounds with acacia gum) (3). Prehistoric people used medicinal herbs and animal parts for healing, and animal vessels in dressing and bandaging the wounds. Setting broken limbs was also practiced in primitive medicine. The injured area with fractured bones was covered using river mud or clay materials, which then set hard on the bone to heal properly (2. 3). Trepanation was practiced in every part of the world where prehistoric people lived and is believed to be the oldest known surgery, since the earliest evidenced were from the Stone Age. Trepaped human skull fossils of all ages as far back as 10,000 years, the Neolithic era in Europe, Russia, the Canary Islands, North Africa, Peru and Bolivia. The reasons for trepanning are not known, but it might have been performed as a procedure for releasing evil spirit in people who suffered epilepsy, ter- rible headaches, or mental disorders. It was practiced by a special group of priests or “medicine man”, more or less experienced, using primitive instruments like leaves of stone, obsidian, bronze, or bone (4).

This procedure involves cutting or drilling an opening in the skull and closing up the wound. In some skulls there is no sign of healing, indicating that the death of the patients occurred during or shortly after the opera- tion; however, many show extensive healing of the bone edges, indicating the patients’ survival (5). Some of the trepanned skulls might be battle related casualties. There is no evidence of trial compensation for his service. However, if a person of high status died as a result of surgery, the surgeon risked having his head cut off. While it was a death due to receiving surgical treatment, the surgeon only had to pay to replace the slave (according to Charles Edwards, London, paragraphs 215-224) (13, 15). Before the primary center of the surgical art, the majority of health care was provided at the patient’s own house with the family acting as care-givers. Other important sites for religious healing were nearby villages for Mesopotamians believed that the rivers had the power to carry away evil substances and force the healing. The samples belonging to gods and goddesses of healing were places used for health care: practicing, petition, therapy and thanksgiving. The Temple Gula, dedicated to the significant goddess of healing and her sacred dog, was a center where information and paraphernalia (5) were stored and distributed to the health consultants. The excavations of such temples show signs that patients were hosted at the temple while they were treated. The temples contained libraries and held many useful medical texts as a source for education and transmission of surgical knowledge and skill (16).

**THE DOWN OF CIVILIZATION**

began with Sumerians in Mesopotamia c.3500 B.C.E., when the system of writing developed and society was no longer prehistoric. A lot of information about life and society are available from cuneiform clay tablets that have survived from the library of king Assurbanipal (the originals are in British Museum, London). Some of the records are about medical procedures. The newest translation was published by R. C. Thompson was published in 1923) (11). The latest translation was published by Scrubark, JA, an assyriologist and curator and, Americanist, AR, a physician and medical historian, in 2005. The translation was published by Scrubark, JA, an assyriologist and curator, and Americanist, AR, a physician and medical historian, in 2005. The oldest known text was from Egypt some 15,000 years ago and was widespread throughout the world in prehistoric migrations, or developed independently in different cultures. When Columbus arrived to the New World, he found that many of the natives were already accustomed to the practice of surgery. The primitive closing up of wounds by using some insects in America and Africa is a well-known practice. It was also practiced in ancient tribal medicine: the priests of certain ant species were used, the ant being held above the wound until it bit, then its head was removed allowing the pin to hold close the wound (“ant tattoo”) (10). Ancient Indian surgeons also used ants to close intestinal wounds. Medical knowledge, as it was so, increased gradually into oral databases that were transformed through hundreds of generations until literacy.

**INDIAN MEDINE AND SURGERY**

The heritage of Mesopotamian civilization was evident in ancient India, where the Vedic**** system of medicine promoted health as harmony among body, mind and spirit. The period of Vedic medicine lasted from approximately 3000 B.C.E. until about 1500 B.C.E. Ayurvedic medicine has eight branches, surgery being one of them. The earliest recorded knowledge about Ayurvedic medicine is from the 2nd millennium B.C.E. A great reservoir of information was written in a surgical text by Sushruta, a Hindu surgeon and founder of plastic surgery (in Sushruta-Samhita). This text contains over 1000 surgical descriptions and instructions was described how of a perform a trep- anation, caesarean section, amputation, rhinoplasty, stomopasty and repair of anu fistula. Reconstruction of the nose was common because the punishment for adults was often a nose cut off. There is a description of 14 types of immobilization, many types of anesthesia (“wine should be used before the operation to produce insensibility to the pain of the opera- tion”, or the patient inhale the fumes of burning Indian hemp – cannabis as an anesthetic), and simple surgery like incision, puncture, drainage, and wound suturing. In general surgery, very few surgeons did not perform open incision of the internal and removal of any blockage (ileus), rinsed with milk, lubricated with butter and finally closed by the at head method – and so operations were successful. Ancient Indian surgeons were very skilled because their training for indi- vidual was important and they used meaks, gurus, and animal balder to practice. Instruments were described in detail in Sushruta surgical text. They used triangular, round-bodied, curved, or straight needles, and sutures made of hemp, hair, silk, bark fiber. Bengal ants were used because their stings are held together the wound edges. Suturing, presumably made of sheep gut, possibly, were the first absorbable suture threads. **REFERENCES**

Antique surgeons practicing Ayurvedic medicine also had an extensive knowledge of poisons, internal diseases and vegetable drugs and were specialties in treating snakebites. Ancient Indian medicine played a great role in Asia and Buddhist monks spread Ayurvedic teaching to China, Indonesia, Tibet, Central Asia, and as far as Japan (17-19). Almost at the same time, a great civilization developed on the banks of the river Nile.

ANCIENT EGYPTIAN SURGERY

More than twenty-five centuries B.C.E., ancient Egypt was a highly organized society in which medical practice was developed and recorded. Early Egyptian medicine was a mixture of religious (magic) and medical (scientific) procedures. The duties of Egyptian physicians included creating medications, providing magic spells and prayers to provide healing, mending broken bones, dentistry, embalming, surgery, especially on their wounded, and autopsy (20). According to the wall inscription from the Old Kingdom (2635-2155 B.C.E.) anatomy was very well understood and dissection of human body was a common procedure. The amputation or deep surgery were avoided for the rules that the body must not be disintegrated, for the whole body is necessary for the afterlife. Circumcision was an exception to this rule, the Egyptians, like other ancient peoples recognized the importance of circumcision. The world's first known picture of a surgical operation, carved on the wall of a tomb of Ahm-Ankhet at Saqqara around 2250 B.C.E. shows doctors performing a circumcision (Figure 1)(21). According to Herodotus, Egyptians were the first to circumcise children and it was practiced for reasons of hygiene (22). The ancient Jews may have learned the surgical technique of circumcision from Egyptian civilization and circumcision is the only surgical procedure mentioned in the Old Testament (23).

Figure 1. Circumcision in a relief, Temple of Ankhef, Saqqara - Egypt

Ancient Egyptian medicine refers to the practices of healing commoners, this medicine was highly advanced for the time, and included simple surgery, setting of bones and an extensive set of pharmacopoeia (24). They usually performed surgical procedures such as lancing boils, drained abscesses, and stitching up battle wounds. Trepanation was practiced occasionally using a mallet and chisel. Limb amputations and some kind of prosthetics were also performed as observed in the mummies (25). At any rate, people at least occasionally survived surgery. Bodies of amputees from as the Old and the Middle Kingdoms have been found which display signs of healing. Piriformis, which shows signs of wear have also been discovered. Egyptian surgeons were excellent in management of injuries. Trauma was present in many forms: warfare, bites of dangerous animals, accidents in mining, quarrying and erection of large buildings. A wall painting in the tomb of Djehutka (2197 B.C. Dynasty) displays a variety of occupational injuries and their treatment – 직접단 malt on the foot, removing foreign body from the eye, reducing a dislocated shoulder (26). There are many medical papyri providing detailed descriptions of surgical procedures and other topics related to medicine. Many papyrus scrolls have been lost by the ravages of time, and disastrous fires in the Library of Alexandria in 173 B.C.E. and 388 A.D. and only a small fraction of medical paper is available.

The Edwin Smith (ES) Papyrus is the world's oldest surviving surgical treatise that was written in Egyptian hieratic script around the 17th century B.C.E., probably based on material from a thousand years earlier (27-28). The papyrus is an ancient textbook on trauma surgery, a document arranged in 22 pages and 48 examined cases of trauma (Figure 2). The papyrus opens with eight paragraphs concerning head wounds, followed by nineteen paragraphs on treatment of wounds of the face.

Figure 2. Ancient medical instruments in inscription on the Temple of Kom Ombo, Egypt, Ptolemaic period

This treatise contained description of anatomy, the examination, diagnosis, treatment, and prognosis (i.e. a protocol of management). Numerous injuries were presented in detail beginning from head, face, jaw and neck, arms and torso, spine, after which it cuts off stopping before consideration of the lower part of the body (29). Each of 48 cases is presented in four clearly differentiated parts: the title of each case details the nature of trauma. The examination starts with “if you examine a man having...” followed by objective examination process. The diagnosis and prognosis contains three viewpoints: I can treat this condition, I can content with this condition, and I can do nothing for this condition (27, 29). Scrolls include a vast experience in fractures that can be acquired at a site where accidents were numerous, as during the building of the pyramids; how to set a fracture, reduction of a dislocation, and healing by splints and casts (27). For “puss-filled tumors” (abcesses), it recommends cauterization, in which very hot copper instruments were to be used, not only to cut away the damaged tissue but also to seal all blood vesicles. Removal of the spars and arrows were sometimes accomplished with great skill. It is believed that this trauma textbook was the result of military battles (29).

In the Edwin Smith Papyrus an inguinal hernia is well described. The mummy of Menen-Pah (19 Dynasty) shows a sign of an open wound resulting from surgical interference (30). Reading the ES Papyrus records we have to conclude that Egyptian medicine was rational, used scientific practice constructed through observation and examination despite everyday use of magic and prayers (31, 32). ES Papyrus today is the property of the Academy of Medicine in New York and displayed at Rare Book Room. The entire translation of scrolls is available online (33).

The medical papyrus purchased by Georg Ebers, well known as Ebers Papyrus, today is a property of University Library of Leipzig. The contents are arranged in seven parts, the last one being about the surgical disease (24, 35). In this treatise, an inguinal hernia was described as a tumor above the genitalia, which appears on coughing, and could be restored by heat application (one of the methods to reduce a strangled hernia). The Ebers Papyrus informs us of practices relating to the removal cysts and tumors and offers a variety of methods to achieve this. It also mentions treatment of boils: “if the do not evacuate for a twist in the bowel and if phlegm does not find a way out, it shall rot in the belly.” They used direct pressure on cuts to stop bleeding, also used tourniquet, cauterization and styptic plant substances. Egyptians used antiseptics to aid the healing process (willow leaves and bark which are known to decrease the likelihood of infection) (25).

In the Ebers Papyrus there is a recipe for treatment of bleeding resulting from circumcision (36). In these documents, the anesthetic action of carbon dioxide resulting from the acute effect of vinegar was used to relieve the pain in children during the circumcision procedure. Ancient Egyptian surgeons often cleaned and treated open wound with honey. Freshly peeled garlic wrapped in muslin was topped to protect against infectious disease. Tannic acid derived from acacia roots commonly helped heal burns.

Figure 3. Edwin Smith’s Papyrus, Plates VI and VII (displayed at the Rare Book Room in New York Academy of Medicine)
Ancient Egyptian surgeons often cleaned and treated open wounds with cautery and styptic plant substances. Egyptians used antiseptics to aid the healing process (willow leaves and bark which are known to decrease bleeding) and tannic acid derived from acacia nuts combined with incense (25, 27, 40, 41). Incisions were then covered with a dressing made of honey and a medicinal ointment, which slow wound healing by providing moisture and nonspecific antiseptic properties. 

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- [ES Papyrus](http://www.onk.ns.ac.rs/Archive Vol 20, No. 1–2, July 2012)
The knives used had stone blades. Flint or obsidian had edges sharper than modern surgical steel. When metal instruments were used, the act of cauterizing accompanied it. In some procedures, the blade was heated until it glowed red, and then used to make incisions. It cut well as it sealed the wound and stopped the blood vessels limiting the bleeding.

Copper had been used for making instruments until 700 B.C.E. when the iron period started. Copper needles were used for clothing and for suturing the abdomen in mummification process (1, 42).

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Ancient Egyptians were allowed to use opium and poppy, cannabis and mandrake known from the New Kingdom. Poppies were used to relieve insomnia, headaches, and as an anesthetic. Opium was used for diminishing pain and hyoscymus as a sedative drugs. Stone of Memphis mixed with water resulted in formation of carbon dioxide and it might have resulted in analgesia in theolis. They also used wine in embalming, as diuretic and preservative. The fire drill was employed in surgery for cauterization (1).

The most famous physician is Hippocrates, a powerful figure in ancient Egypt, who lived around 2725 B.C.E. in Egypt and is credited with being the founder of medicine (31, 45). Some anthropologists speculate him of being the author of medical treatise, the so-called Edwin Smith papyrus (44).

Two thousand years after his death, his status was raised to that of a deity and he became the god of medicine and healing (45).

The earliest known physician was Hesy-Ra in 27th century B.C.E. (stone inscriptions indicate that Hesy-Ra performed an early form of oral sur- gery). The earliest written Physicians were przecel (2013-334 B.C.E.) in the tomb of Ankhstef, Menpt Ahmose (2700 B.C.E. picture on the tomb in the necropolis near the step pyramid of Saqqara), they had graduated as midwives in the medical school in Saq (46).

Women in ancient Egypt were able to study and practice medicine and were much respected. They particularly studied obstetrics, and were graduated as midwives in the medical school in Saq (46).

The most famous physician is Imhotep, a powerful figure in ancient Egypt (32). His writings on this subject have been collected in the Hippocrates Writings (written by him or his followers), named after him (46).

According to records from the Aesclepieon of Epidaurus, 350 B.C.E. a cup by Sosias: Achilles bandaging the injured arm of Patroclus (vase dated,

In terms of political governance, ancient Greece was not a single country but consisted of numerous independent city-states like Athens, Sparta, Thebes, etc. These city-states were not united under a single authority, and their political systems varied greatly. The social standing of doctors in ancient Greece and Egypt in medicine and surgery maintained during the rules of Ptolemy dynasties in Alexandria (33). Many of the techniques that diminished or kill germ cells, like boiling water were practiced by Greeks and other scholars but in a Roman cultural system. Some parts of Greece had become a province of the Roman Empire and by 27 B.C.E. the Romans were in control of the land around Mediterranean. Much of Roman medicine was Greek (57). Works of Hippocrates served as the basis for training of numerous Roman doctors. Doctors in ancient Rome would have received formal training, and would often serve as surgeons in the Roman Emperor’s army (64).

In ancient Rome, all surgeons knew how to use tourniquets or clamps to stop blood flow. They practiced amputation to prevent deadly gangrene or as a consequence of war. All surgical tools were performed by appropriate specialists. Ancient Roman doctor’s tool kit included forceps, scalpels, cutters, and even arrow-extractors. Ancient Roman surgeons had a wide range of painkillers and sedatives to help in surgery, including extracts of opium poppies (morphine) and of honeybees (ococaine).

The Romans did not understand the infection process but they did use many of the techniques that diminished or kill germ cells, like boiling water, and many other techniques to diminish the pain (65). The Romans understood the infection process but they did use many of the techniques that diminished or kill germ cells, like boiling water, and many other techniques to diminish the pain (65). The Romans were unable of bacteria but placed an emphasis on public health, personal hygiene being considered the important of public health. Roman war doctors learned how to prevent manybattlefield epidemics and organize surgery rooms. They invented permanent hospitals with specialized rooms for different tasks. Many employment were invented in ancient Roman surgery – some dating to 469 B.C.E., the period when Hippocrates wrote The Oath.

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Conflict of interest

We declare no conflicts of interest.

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