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

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SUMMARY

Based on skeleton examination, cave-paintings and mummies the study of prehistoric medicine tells that the surgical experience 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. 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 familiar with a lot of surgical procedures and had pioneered plastic surgery. 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 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 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 after him, according to many writings, medicine and surgery became a science, medical schools were formed all 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.

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

Glossary

* B.C.E. (Before the Common Era) is used instead of B.C. (Before Christ); C.E. (Common Era) is used instead of A.D. (Anno Domini)

** Surgery (cheirourgike in Greek) (chirurgiae in Latin) – meaning "hand work"

*** Small possession of tools, or instruments

****Ayus – duration of life, long life (Sanskrit); Vedas – science of life, knowledge (the most sacred books of ancient Indian civilization); Ayurveda – knowledge of life is called "medicine of the God" for its divine origin

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 diseases and 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 presenting as author's critical compilation 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 literate 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 thorns). Prehistoric people used medicinal herbs and animal fat for healing wounds, and animal skin for 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 so that the bone could heal properly (2, 3).

Trephination 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. Trepanned 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 diseases. It was practiced by a special group of priests or "medicine man", more or less experienced, using primitive instruments like knives 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 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 using any kind of anesthesia during these surgical procedures, not even among Central American tribes who did know the effects of coca 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 exhumed bodies from prehistoric graves (8). It is still questionable whether circumcision procedure originated from Egypt some 15,000 years ago and was spread 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 circumcised (9).

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 pincers of certain ant species were used, the ant being held above the wound until it bit, then its head was removed allowing the pincers to hold close the wound ("ant suture") (10). Ancient Indian surgeons also used ants to close intestinal wounds.

Medical knowledge, as it was so, increased gradually into oral databases that were transferred 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 them are about medical issues (the first translation by R. C. Thompson was published in 1923) (11). The newest translation was published by Scurlock JA, an assyriologist and cuneiformist, and Anderson BR, a physician and medical historian, in 2005 offering advances in interpretation of the text (12).

All the records were organized in separate subsections about disorders, surgery, gynecology and pediatrics. There were two types of professional practitioners in ancient Mesopotamia. The first type was "ashipu" who made a diagnosis of the disease. Type "asu" was a healer, a specialist in herbal remedies that treated wounds in three fundamental techniques: washing, bandaging and making plasters (13).

Four surviving clay tablets describe specific surgical procedures like: a procedure in which the doctor cuts into the chest of the patient in order to drain pus from the pleura, the next mentions the knife scraping the skull of the patients, or the use of some plants to stop the bleeding. The final surgical tablet mentions the instruction for a surgical wound care. This tablet recommends the application of a dressing consisting mainly of the sesame oil, which acted as an anti-bacterial agent (11, 14).

Medicine in Mesopotamia was a well-recognized profession and a lot of information about Mesopotamian physicians is written on a large block of polished diorite known as a Law Code of Hammurabi, dated c. 2000 to 1700 B.C.E. (preserved in Code of Hammurabi stele in Louvre, Paris). Eleven paragraphs, among 282, refer to the practices of physicians. Basically, it is a collection of legal decisions that pertained to liability of physicians who performed surgery or "use a knife". These laws state that the doctor was responsible for surgical errors and failures depending on the status of his patient: if a surgeon operated and saved the life of a person of high status, the doctor was well paid in silver. If the surgeon operated and saved the life of a slave, he received a small compensation for his service. However, if a person of high status died as a result of surgery, the surgeon risked having his hand cut off. While if a slave died from receiving surgical treatment, the surgeon only had to pay to replace the slave (according to Charles Edwards, London, paragraphs 215-224) (13, 15).

The primary center of health was the home, and 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 rivers for Mesopotamians believed that the rivers had the power to carry away evil substances and force the healing.

Temples 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 *** were stored and distributed to the health consultants. The excavations of such temples show signs that patients were housed 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).

INDIAN MEDICINE 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 800 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 (The Collection of Sushruta) in 500 B.C.E. Descriptions and instructions were given of how to perform a tonsillectomy, caesarean section, amputation, rhinoplasty, otoplasty and repair of anal fistulae. 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 operation", or the patient inhaled the fumes of burning Indian hemp – cannabis as an anesthetic), and simple surgery like incision, puncture, drainage, wound suturing. In general surgery, some very difficult operations were performed like opening of the intestine and removal of any blockage (ileus), rinsed with milk, lubricated with butter and finally closed by the ant head method – and some operations were successful.

Ancient Indian surgeons were very skilled because their training for incision was important and they used melons, gourds, and animal bladder 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, flax, bark fiber. Bengal ants were used because their stiff jaws held together the wound edges. Bowstrings, presumable made of sheep gut, possibly, were the first absorbable suture threads.

Ancient surgeons practicing Ayurvedic medicine also had an extensive knowledge of poisons, internal diseases and vegetable drugs and were specialists in treating snakebites. Ancient Indian medicine played a great role in Asia and Buddhist monks spread Ayurvedic teaching to Indo-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 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 Ankh-Mahor at Saqquara around 2250 B.C.E. shows doctors performing a circumcision (Figure1)(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. Adolescents in ritual circumcision, Tomb of Ankhamor, Saqquara – Egypt

Ancient Egyptian medicine refers to the practices of healing commoners, this medicine was highly advanced for the time, and included simple surgery, settings 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. Prostheses, which show 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 Ipwy at Deir el-Medina (Tomb 217 20th Dynasty) displays a variety of occupational injuries and their treatment – dropped mallet 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 47 B.C.E. and 389 A.D. and only a small fraction of medical papyri 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.

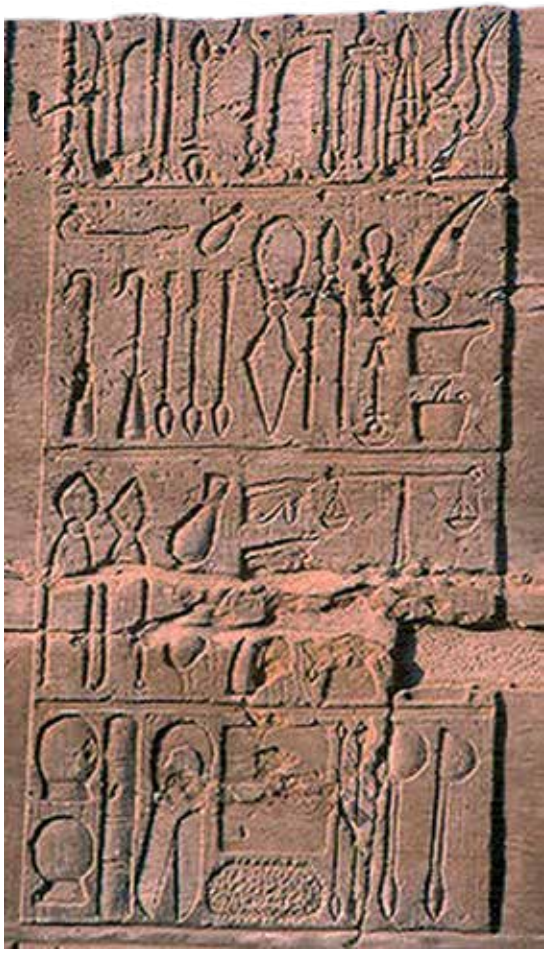

Figure 2. Ancient medical instruments in inscription on the Temple of Kom Ombo, Egypt, Ptolemaic period

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 contented three viewpoints: I can treat this condition, I can contend 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 simply bandaging by splints and casts (27). For "puss-filled tumors" (abscesses), 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 vessels. Removal of the spears 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 Meren-Ptah (19th 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 (34, 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 strangulated hernia). The Papyrus Ebers 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 volvulus: "if he does not evacuate for a twist in the bowel and it 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, cautery 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) (29).

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 acetic 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 hopped to protect against infectious disease. Tannic acid derived from acacia nuts commonly helped heal burns.

Here is an example of one injury (translated version from ES Papyrus): "Treat wound with mixture of grease (snake or other kind) and honey (prevents bacteria from growing in an open wound and thus decreases the risk of an infection), and lint (cover up the wound) every day until it recovers". The meat was used as a clotting agent in the bleeding wound and fresh meet was used in some wound treatments.

There are the instructions to close wounds using tapes and adhesives. Sometimes they recommend suturing the wound with acacia thorns used as needles, primitive needles or needles with eye made of sharp bone, piece of pointy cane or metal and pieces of flex as suturing material like plants, fibres, hair, tendon and wood threads. Use of silver wire for wound clamping was practiced much later; it describes also the after managements of sutured wounds: "hast it stitched, you should lay fresh meat upon his wound the first day. You should not bind it. You should treat it afterward with grease, honey and lint everyday, until he recovers" (31). They routinely used suturing in the preparation of mummies for burial (the oldest suture of the world was found on a mummy's abdomen applied in 1100 B.C.E. practiced always on the left side) and it was also used in medical practice of the time on living patients (27, 37).

Though the Egyptians were effective healers they did not have knowledge of cellular biology and germ theory but used some natural antiseptic and antibiotics like honey, mouldy bread or willow bark to dress wounds to prevent the infection (38,39). Bacterial infection was regarded as a normal consequence of the open wound and the classic signs of superficial infection are described in ES Papyrus: pain, swelling, redness and heat. If those signs appeared around of the stitches, as foreign objects within the skin, they had to be removed.

Surgical supply was very useful and practical. A famous relief on the wall of the temple at Kom Ombo Temple shows about 40 different medical instruments (Figure 3). These include speculums to open the vagina and rectum for internal examinations, containers for holding solid and liquid medicines, forceps, dental tools, suction cups, hooks for special spreading open incisions and wounds, and curettes for scraping away infected tissue. Surgical tool also included knives, drills, saws, hooks, scalpels, retractors forceps and pinchers, scales, spoons and a vase with burning incense (25, 27, 40, 41).

Figure 3. Edwin Smith's Papyrus: Plates VI and VII (displayed at the Rare Book Room in New York Academy of Medicine)

The knives used had stone blades. Flint or obsidian has 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 up 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).

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

The most famous physician is Imhotep, 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, 43). Some archaeologists 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 surgery). The earliest women physicians were Peseshet (2613-2494 B.C.E. stela in the tomb of Akhethotep) and Merit Ptah (2700 B.C.E. picture on the tomb in the necropolis near the step pyramid of Saqquara), they had graduated as midwives in the medical school in Sais (46).

Women in ancient Egypt were able to study and practice medicine and were much respected. They particularly studied obstetrics, and were known to have been instructors at Egyptian medical training schools. Doctors-surgeons were literate and often scribes and the priests at the same time. They acted as physicians for different parts of the body (like specialization) as they believed that different gods governed different sectors of the human body. According to Herodotus, there was a high degree of specialization among physicians (22).

Doctors in ancient Egypt usually went through years of training at temple schools.

Sometimes the sons following the profession of their fathers, they were instructed from childhood by their fathers or relatives. Medical Schools "Houses of Life" were institutions settled in Sais, Bubastis Abydos, Edfu, Tell El-Amarna as centers for teaching medicine, Some centers with special interest in medicine (1) were established by the 1st Dynasty. By the time of the 19th Dynasty, their employees enjoyed such benefits as medical insurance, pension, sick leave and worked eight hours per day. In 332 B.C.E., Alexander the Great established a medical school in Alexandria and it had a profound influence on Egyptian medicine during the Ptolemaic, Roman and Coptic periods (22, 27). At Deir El-Medina there was a system of free medical aid (1).

Egyptian physicians had an excellent reputation and sovereigns from foreign lands frequently appealed to pharaohs to send them their doctors. It was common that scholars from ancient Greece and other parts of Mediterranean studied medicine in Ancient Egypt, the most notable of these traveling scholars were Herodotus, Hermes and Pliny whose medical records contributed from ancient to modern medicine.

ANCIENT GREEK SURGERY

In terms of political governance, ancient Greece was not a single country but consisted of numerous independent city-states like Athens, Sparta Thebes, etc. that shared a similar culture and religious beliefs. Medical practice was mostly influenced by Egyptian medicine and also reflected the society's relationship to nature and religious beliefs.

The earliest description of ancient Greek medical practice derives from the two epic poems attributed to Homer (47), the Iliad and the Odyssey, dated around the 8th century B.C.E., presenting last parts of Aegean war against Troy. Surprisingly enough, among the poem lines there are descriptions of nearly 150 different battle wounds: injuries made by arrows and spears are with excellent anatomic description (Iliad XIII. 640-653) (48), 31 lethal head injuries (48,49, 50, 51). The procedures of healing and care giving are also recorded. Medical care among Greek warriors was organized by professionals. One of the art healing masters was Machaon, the son of the legendary Asclepius. He was very skilled in taking up the arrows and healing the wounds (48). The solders were educated to help themselves and also to help each other (Figure 4). They cleaned the wounds with wine (Iliad XI. 638) (48), and bandaged them with certain herbs. In military surgery, many scientific rules were applied and it comprised systematic observation. Surgical procedures were always accompanied by prayers and magic (52).

Figure 4. A cup by Sosias: Achilles bandaging the injured arm of Patroclus (vase displayed in Antikenmuseum, Staathliche Museen Preußisher Kulturbesitz, Berlin

Ancient Greeks used scientific observation and logic to conclude what caused diseases and what they could do. In the Hellenistic period (300's B.C.E. and afterward), Greek doctors worked out a logical system for understanding disease. Their writings on this subject have been collected in the Hippocrates Writings (written by him or his followers), named after

the first and most famous of these doctors, Hippocrates. His idea that a doctor can learn to understand and treat diseases by using careful observation and logical thinking is very important to modern medicine and is present in recent methodology (53, 54).

Much later published as "De Medico" are Hippocrates' records on military wounds, diagnostics and therapy. They contain descriptions of fractures, joints luxation and reposition. There are also very clear descriptions of organization of operation theatres, instruments, assistance, and many operations like trepanation, hernia, hemorrhoids, empyema of the pleura, amputation of the extremities etc. Ancient Greek surgeons applied cautery in hemostasis, bending and casting (52). Suturing was applied only on superficial flesh wounds. The common suture materials were: fibers made from various, particularly strong animal tendon, fascia trips and gold wire for bone sutures.

According to Christopher Freville the first documented chest surgeries were conducted by Hippocrates and his findings are still relevant today (55).

The surgeon Antillus (3rd century B.C.E.) performed a bone and joint resection, tracheotomies and the first operation on traumatic aneurysms, using chordae material (an animal gut string) (37). The first record of tracheostomy being carried out by a physician is given by Galen, who credits Asclepiades of Bythinia (124 B.C.E.) with the operation (56, 57).

For medical practice, no professional qualifications were required, and doctor's reputation was essential property for his success: a doctor had to have in mind interests of patients and his own reputation, and was expected to inspire confidence and trust. The so-called Hippocratic Oath (attributed to Hippocrates but may have been written after his death) represents the guiding ethical concept of ancient Greek medical profession (58, 59).

Due to conquering of Egypt by Alexander the Great close relations between Greece and Egypt in medicine and surgery maintained during the rules of Ptolemy dynasties in Alexandria, a great city founded by Alexander the Great. There the most important medical center of that era was organized serving as a center for Greek medical education (60). Many of the doctors educated there continued to disseminate their knowledge elsewhere in the Mediterranean. Pliny the Elder recounts that in 219 B.C.E. the Spartan doctor Archagathos was working as a surgeon in Rome (61).

In ancient Greece, temples dedicated to healer god Asclepios, and his daughters Panacea and Hygeia were called asclepeias, and they functioned as centers for medical advice, healing and prognosis (62). According to records from the Aesclepieon of Epidaurus, 350 B.C.E. soporific substances, such as opium, were used in some surgical procedures as opening the abdominal abscess, or the removal of traumatic foreign materials to diminish the pain (63).

After the Roman invasion in 48 B.C.E. Alexandria gradually declined. Its famous Royal Library of Alexandria (founded in the 3rd century B.C.E.) had housed all the learning of the ancient world, around 700,000 volumes from Assyria, Greece, Persia, Egypt, India, etc. but was destroyed in a great fire during the Roman rule over Egypt**.** Medicine and surgery were practiced by Greeks and other scholars but in a Roman cultural environment (2). Soon, Greek medicine and surgery were assimilated by the Romans. Its influence on present-day medicine is evidenced by the predominance of Greek terminology.

SURGERY IN ANCIENT ROME

There was an obvious close proximity of Greece and Rome. The Romans came into contact with the Greeks in about 500 B.C.E. By 146 B.C.E., 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 medicine and Roman doctors accepted a lot of Greek medicine. In fact, most of the doctors who were practicing in the Roman Empire were Greek. Works of Hippocrates served as the basis for training of numerous Roman doctors. Doctors in the ancient Rome would have received formal training, and would often serve as surgeons in the Roman Empire's army (64). There were no licensing boards and no formal requirements for entrance to the profession. Anyone could call himself a doctor. Medical training consisted of apprentice work. Men had been trained as doctors by another doctor. Roman doctors did not fare so well and their social standing was quite low.

Deriving knowledge from the medical treatises and methods of the Greeks, the Etruscans, the Egyptians, the Persians and other conquered peoples, the Romans came up with one of the best and most sophisticated medical and surgical systems of the ancient world. Ancient Roman surgery was a combination of physical techniques using various tools and holistic medicine using rituals and religious belief system. Magical treatment was commonly applied. Healing was sought after from religious temples.

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 tasks were performed by appropriate specialists. An Ancient Roman doctor's tool kit included forceps, scalpels, catheters, 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 henbane seeds (scopolamine).

The Romans did not understand the infection process but they did use many of the techniques that diminished or kill germ cells, like boiling their tools before use and would not reuse the same tool on a patient before reboiling it. Wounds were washed with acetum, which is a very good antiseptic.

The Romans were unaware of bacteria but placed an emphasis on public health, personal hygiene being considered the imperative of public health. Roman war doctors learned how to prevent many battlefield epidemics and organize surgery rooms. They invented permanent hospitals with specialized rooms for different tasks.

Many implements were used in ancient Roman surgery – some dating to 460 B.C., the period when Hippocrates wrote The Oath.

Aulus Cornelius Celsus (25 B.C.E. to 50 C.E.) (37) was one of the main medical writers of the Roman era. He was the first to produce a detailed description of ligatures used for hemostasis. He knew both continuous and simple sutures.

The needle and a fitting needle holder were part of the surgeon's standard equipment. Material used for adapting the wound edges were linen and wool threads, silk and human hair and metal clips.

The ancient Romans operated on people's eye. They also pioneered cataract surgery.

Ancient surgical practice and science in Europe declined with the fall of the Roman Empire. Temples in Egypt were abandoned and covered with sand and the ideas about anatomy and technique of surgery were kept alive only by the Arab doctors for centuries (65) but almost disappeared in the Middle ages with the destruction of Arabian culture in Spain. Dark ages for surgery in Europe lasted until the 18th century when restoration in the whole medicine began.

Conflict of interest

We declare no conflicts of interest.

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