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EMBALMING: FROM ANCIENT TIMES TO MODERN MEDICINE

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Actuality: Since the beginning of time, people have been embalming their bodies, trying to create new methods of preserving dead bodies. Over the years this procedure has been improving and developing as well as actively gaining popularity and attracting scientists and researchers for further investigation.

Purpose of the study: The aim of this research was to study the history and peculiarities of embalming from ancient times to the present day.

Materials and methods: Theoretical review and analysis of scientific, historical and journalistic literature.

Results and discussion: Embalming is a method intended to prevent

decomposition of corpses or individual organs, which is used to preserve human bodies after death, decontaminate cadavers and make anatomical exhibits.

Embalming the body is done by injecting embalming solutions. The idea of this method is to saturate the tissue of the corpse with certain substances that kill germs and prevent postmortem destruction of the tissue.

Embalming had been practiced since times immemorial, but it gained its popularity during the Civil War years (1861-1865).

History of embalming bodies Embalming has been used since the ancient times when people tried to "freeze time" and immortalize the dead using art, sculptures etc. Ancient people believed that by preserving the body of the deceased in "our world", they took care of their relatives and gave their soul an opportunity of a peaceful and prosperous life in the other world. Over time, the meaning and understanding of such a method as embalming moved away from ideas of afterlife tranquility and still began to be used as a hygienically necessary practice.

Learning the history of embalmment, we will begin with the culture of Chinchorro, that is not really known nowadays. Contrary to popular but mistaken belief, this method of preserving dead bodies is not an invention of ancient Egyptians. Egyptian priests were among the first to learn about mummification, but the real pioneers of ritual preservation were the Chinchorros of South America, who lived on the territory of modern Peru and Chile during 9 000-4 000 years BC. Their mummies are about 7 000 years old, and the earliest one discovered in Egypt is 5 000 years old.

The Chinchorros had many methods of mummification, but the process of preparing the bodies did not change much over the millennia. The first step was to remove the skin, then use stone scrapers to separate soft tissues, muscles and organs from the bones. The bones were dried by hot ashes or coals. The body was then rebuilt (the skeleton was reinforced with branches, stuffed with grass, animal hair, earth and sand) and, finally, after attaching the limbs, it was covered with white ash or clay.

However, with the experience of Chinchorro they managed to improve this method. Instead of dismembering the body to remove internal organs and dry it out,

they made special incisions in the lower and upper parts of the body and stuffed it with plant material to give it a human look, sewed the skin with red seaweed and covered the face with a clay mask. The mummy was dyed in red ochre or completely covered with a mixture of clay, sand and fish oil.

The most perfect embalming technique in the ancient world was undoubtedly used by Egyptians. They used this method to ensure immortality in the afterlife (they believed that the soul could reunite with the body and face the judgment of the god Anubis only if the body was "reborn" by the priests). Special attention was paid to the heart of the deceased, as it was considered to be the "key" to the afterlife. Egyptians embalming was primitive enough: they took out all internal organs of the body and filled the cavities with linen cloths impregnated with different spices.

However, a millennium later, the Egyptian embalmers were able to improve their skills by transforming the simple technique of mummification into a complex and multi-stage procedure. This process began with the extraction of the brain, using sharp hook-shaped sticks that were inserted into the nostrils and thus "cleaned out" the cranium. An incision was made on the left side of the body with flint knives, and all of the viscera, except the kidneys and heart, were taken out. The remaining organs were washed with palm oil and immersed in special vessels filled with palm wine. The dead body itself was washed with wine, spices and filled with incenses, soaked in solutions of sodium salts and swaddled, after which it was covered with various materials depending on the status of the deceased. Although palm oil and wine were used extensively, to make the procedure cheaper, saltpeter, cedar oil, tinctures of Alexandrian leaf and cassia were used for embalming.

Talking about the Middle Ages and Renaissance, the embalming of bodies was rarely used. In Europe embalming began to gain a place in medical science at the end of the 15th century for conserving the bodies of higher ranks for transportation from battlefields, for anatomical museums, etc. However, the first embalmed body was found near Osorno in Spain, when the 5 000-year-old cinnabar had been applied to the corpse.

Although the practice of embalming was known by Europeans through contact

with the Egyptians, the procedure was ignored for a long time. The first mention in historical sources dates back only to the 5th century AD. During the Middle Ages and Renaissance, a small amount of embalming was done by specialists, who used a sophisticated Egyptian method. For example, for the purpose of returning from France to England, in the 12th century the body of King Henry I was embalmed and disemboweled, and cavities were filled with medicinal herbs.

Also, there is a fascinating fact that bodies of Louis XIII, King of France, and Alexander I, Tsar of Russia, were embalmed, because French doctors used special mixture called murrhaceum, which consisted of table salt, alum, myrrh, aloe, vinegar and other suitable substances.

The great interest in anatomy and surgery during the Renaissance stimulated doing experiments with other methods of embalming. Leonardo da Vinci, who dissected more than 50 corpses for study, developed the method of venous injection to preserve them, which foreshadowed modern embalming procedures. On the other hand, Leonardo da Vinci was the one who studied and developed methods of preserving corpses. He emphasized the use of a mixture of turpentine, camphor, lavender oil, cinnabar, rosin, sodium nitrate and potassium nitrate, and the injection of liquid wax into internal organs. But a later generation of anatomists favored alternative compositions, for example Peter van Forest (15th century) used cold water to flush the body internally after the process of organ removal and a mixture of aqua vitae (aqueous solution of ethyl alcohol) with vinegar, aloe, table salt and colostrum. Then it was filled with a powder of ground fragrant herbs and spices, cotton rags soaked in the remedies that were listed above, and covered in wax or resin. A 17th century Florentine doctor is reported to have turned a corpse into a stone by injecting a solution of potassium silicate into the tissue and then immersing the body in a solution of weak acid.

A significant anatomist during the Renaissance period was Friedrich Ruysch, who developed liquor balsamicum (the solution of coagulated pig's blood and mercury oxide). In 1835 Italian physician Trancini introduced a new method of embalming without opening cavities by injecting a solution of arsenic and cinnabar

into large vessels. Moreover, in 1845 zinc chloride was widely used for embalming without dissection and removal of internal organs. In Russia this method was used very soon, as professor Gruber and Lesgaft embalmed the bodies of Emperor Alexander II and Empress Maria Alexandrovna.

Besides, the interest in embalming increased during the American Civil War, when the victims included not only ordinary people and soldiers, but also prominent political figures.

From the middle of the 18th century up to nowadays, different chemical solutions have been injected into the blood system for embalming, which help to preserve the process of decomposition and prevent rotting.

William Hunter, a Scottish surgeon, who worked in a morgue, was the first to use such a method. In view of the fact that he was approached by a man, who was unable to abandon his deceased lover and asked him to perform an embalming procedure. This way he drew up a detailed method of preserving the body, which became the basis for subsequent research. This experiment proved so successful that the woman's body was placed in a glass coffin and placed in front of the clinic to attract visitors.

Up to the 20th century, the arsenic was used as the main embalming fluid, but it was soon replaced by formaldehyde. Significant for medicine was the case of embalming the body of the prominent surgeon and anatomist N. I. Pirogov conducted by D. I. Vyvodtsev, who created and implemented his latest method: embalming the body by injecting of thymol solution into the carotid and femoral arteries and using salicylic acid without opening cranial, abdominal and thoracic cavities. Before embalming, the veins were opened to allow all the blood to come out.

In modern practice, embalming takes place 12 hours after the death of a person and is made by injectional method. However, depending on the circumstances, this period is extended to several days or even weeks.

Firstly, bodies are prepared for embalming in a thanatology department. There external defects are removed, the skin is treated with disinfectants and hair is washed with a bactericidal shampoo. The pathologist chooses the type of embalming and

composition of the solution depending on some points: the general condition of the body, whether an autopsy has been performed or not, how much embalming action is needed and other anatomical features. The solution is administered through the femoral, carotid or brachial artery. But an important fact is that this method is available only in the case, when the autopsy wasn't performed. If the body was opened, then the cavity method is used. All of the cavities are filled with solution and then sutured. There is also a method called combined method, when the limbs are filled with solution through the vessels and the body and internal organs are processed in the cavity method.

But still the injectional and cavital are the most commonly used methods, because the most reliable embalming process is performed through the artery.

For that purpose, the solution may contain the following substances: formalin; mercuric acid; rectified ethyl alcohol; potassium sulphate; zinc chloride; glycerin; water. Nevertheless, the best embalming agent is a solution of formalin with sulema. To neutralize the specific and very unpleasant smell, that occurs due to the decomposition process in tissues, are added some good-smelling balsams, for instance - scented essential oils such as bergamot, lavender, oregano and others.

The most modern methods of embalming are plastination and polymeric embalming. At the end of the last century Günther von Hagens came up with a technology to fill organs with polymers, calling his method plastination. But due to the excessively high cost, anatomists began looking for a replacement. Then Professor I. V. Gaivoronsky created a simpler and cheaper method of embalming, similar to the technology of his German colleague. He decided to use Russian medical silicone. The human organ was placed in a hermetic container and the acetone-containing solvent was pumped through the container to extract all the fat and water from the tissues. The organ was immersed in the silicone and depressurized at a low temperature. The solvent filled the tissue and started to boil in it. After this process cells were cleared by the steam and the silicone entered them. Once the polymer was cured, it was heated and kept in the thermostat for a certain period of time.

This method is still widely used today.

Significance for modern medicine

Besides the obvious usefulness of embalming for hygienic, aesthetic purposes, this method is also widely used for scientific activities in the field of modern medicine. Embalming has made possible to study the structure of the body both inside and outside, as well as tissues and organs (thanks to modern methods of making and fixing anatomical preparations). This allows students to learn theoretical material fundamentally and gather practical skills and necessary abilities for their future practice in medicine.

Conclusions: Studying the specifics of embalming techniques during millennia, from ancient times up to now, we can trace progress clearly. Undoubtedly, that now it is not possible to study historical methods of embalming properly and gradually, but it is achievable to gain general knowledge and understand the process itself, which is essential for medical practitioners and medical students.