

The history of embalming in the era of anatomists of the XV-XVIII centuries

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Introduction

Throughout the time, from the cessation of the activities of Egyptian embalmers to the early Middle Ages, embalming was carried out in Europe only if someone from royalty or church leaders, nobles, wealthy merchants and landowners passed away. Anatomists and doctors of the Middle Ages brought almost nothing new to the method of embalming. Embalming, not surprisingly, was in fact the same as in Egypt, as described by Herodotus and other embalmers, except that it took much less time to complete [1,2]. After processing, the bodies of the dead were placed in family crypts. However, this method of burial has not received widespread distribution. This procedure was not designed for the average European, being too expensive for him.

Embalming in Europe experienced several periods of decline and a new revival. It was quite popular among the Crusaders, who wished during the era of the Crusades that their bodies, in case of death, were brought home from the Middle East and buried there. However, the almighty church in those years looked at such an embalming procedure with hostility and, in the end, directly branded it (forbidden under pain of excommunication by the bull of Pope Boniface VIII " Desepulturis ") [1,2,3].

A new return of embalming to Europe took place only in the Renaissance and was initially used by naturalists for the long-term preservation of rare specimens of living organisms. Particular attention was paid to it by Leonardo Da Vinci, who developed methods for injecting embalming solutions directly into the veins - these methods, by the way, formed the basis of modern embalming technologies, which will be discussed later [1,2].

The great artist, pioneer of medical research and brilliant inventor Leonardo da Vinci (1452-1519) achieved significant success in the development of embalming. Anatomy classes cover his entire life - the first anatomical manuscript dates back to 1484, and the last to 1515. Probably, it was in Florence that Leonardo first visited the anatomical theater. The main practical guide for anatomy in the Middle Ages was the scientific work of Mondino de Lucci (1275–1325) (Mondino dei Lucci) " Anathomia ". His dissection method was used by many generations of anatomists and artists, as well as by Leonardo da Vinci. Leonardo da Vinci performed his anatomical dissections at the Santa Maria Nova hospital, founded in 1255. Yes Vinci performed autopsies on over 30 cadavers to produce hundreds of accurate anatomical illustrations. At the hospitals, other Florentine artists were also engaged in anatomy, for example, Michelangelo - at the hospital of the Holy Spirit. Yes Vinci introduced new methods of anatomical research, including washing organs with running water, injecting wax into the ventricles of the brain and blood vessels, cutting bones and organs. When embalming, he conducted experiments with various solutions: turpentine, lavender oil, rosin, camphor , potassium and sodium nitrates. To preserve the bodies, the scientist also practiced subcutaneous injection of liquid wax [2,7]. Da Vinci's work laid the foundation for a number of scientific medical studies.

Universities in Europe in the XIV-XV centuries received the right to conduct anatomical classes in special classrooms - anatomical theaters - with permission to open a dead body, study its structure, and demonstrate the preparation technique. There is a special literature on embalming, conservation and storage of anatomical preparations. At the royal houses, the positions of court anatomists are established, performing public autopsies, making preparations for museums and cabinets of curiosities.

In the 15th century, Peter van took care of the preservation of the remains. Forest , also called Petrus Forestus (Alkmaar , 1521 - Alkmaar , 1597)[11,12], who was one of the most prominent physicians of the Dutch Republic. He did an extensive autopsy report in the states of Holland. His account in German is included as an appendix to Peter Offenbach's treatise on surgery, which appeared in 1505. Forestus carefully describes the embalming process and the materials used on five occasions between 1410 and 1548, two of which he carried out personally. So, in 1410 the body of Pope Alexander V of Bologna in Italy was embalmed, in 1511 in Holland - the body of Lady Joanna of Burgundy, in 1537 - the body of Bishop Magoluetos (Bologna, Italy), in 1582 - the body of Countess Houtkerken from The Hague in Holland, and in 1584 - the body of Princess Aurasius of Holland [1,3,4]. After the assassination of Prince William of Orange on 10 July 1584, Forestus performed an autopsy and embalming, along with his Delft colleague. His method of embalming was somewhat different from all previously known procedures. The bodies of the deceased were completely rid of the internal organs and thoroughly washed. The remains were treated with an aqueous mixture based on ethyl alcohol, the so-called " aqua vitae ". Vinegar, wormwood, aloe, colonyte , and table salt were added to the solution. Powdered incense, herbs, spices, as well as rags soaked in preservative compounds were placed in the prepared body. At the end, the deceased was wrapped with cuts of cloth, pre-impregnated with resins and wax. Petrus died Forestus March 10, 1597. He was over 75 years old. His remains were buried in the Great Church or Church of St Lawrence in Alkmaar on March 13, 1597. The last line on his tombstone reads: " Hippocrates batavus si fit ille fuit " ("If there ever was a Dutch Hippocrates, he was this man").

Over time, it became more and more obvious that for the development of medical science it was necessary to develop some kind of system for the preservation of corpses, even if temporary, for a more thorough and careful study of the structure of the human body. Early attempts in this regard

followed the method of drying the body parts, since moisture has been and remains the enemy of the preservation of corpses. First, the corpses were dried in the sun. Later, the controlled heat of furnaces was used [1,7].

Records of attempts to preserve corpses since the 15th century contain references to the infusion of various solutions into the circulatory system [2,5].

Jacobus Berengarus (1470-1550) used a douche and poured warm water into his veins. Batolomeo Eustachio (1520-1574) used warm ink. Reginière de Graaff (1641-1673) invented the syringe and infused mercury. Jan Swammerdam (1637-1680) introduced a waxy material that later became hard, which subsequently formed the basis for the manufacture of corrosion preparations. Early infusion instruments were crude, ill-conceived, and usually consisted of two parts - a container for the injected material and a cannula of various shapes. Sometimes straws, bird feathers, metal or glass tubes were used as a needle [8].

In the first half of the 16th century, new methods of embalming appeared and a number of interesting, detailed works in this area [6,7,8,10].

Not only "learned men", but even pharmacists and healers offered their own methods of embalming.

For example, let's take the embalming method proposed by Ambroise Pare. After opening the corpse, the insides were taken out, deep cuts were made on the soft parts of the body, washed and covered with powder, which included aloe, sodium chloride, alum. The cavities of the body were filled with a complex aromatic powder, the whole body was saturated with strong terpine and essential oils. After that, the corpse was wrapped in canvas and placed in a lead coffin, at the bottom of which aromatic herbs were laid. The corpse of Ambroise treated in this way Pare kept in his office for 25 years and did not notice signs of decay [3,4].

Bils (1624-1671), a Flemish anatomist permanently residing in Leiden, gained great fame, in which embalming was carried out without opening cavities. 60 pounds of crushed oak bark, 50 pounds of Roman alum, the same amount of pepper and 100 pounds of table salt were poured into a lead box, then 1,500 pounds of alcohol and 800 pounds of vinegar were poured in [2,3,4,5]. After soaking in this liquid for two months, the corpse was immersed for another two months in alcohol, with the addition of aromatic substances. Then the corpse was dried in a drying oven, smeared with balm and placed in a coffin.

It must be emphasized that with all the variety of preservation methods, the injection of vessels in the 17th century was not yet put into practice [3,5,6]. Only immersion of the body in liquid or its introduction into tissues and cavities was used.

In Italy in the 17th century, the Santorelli method (1629) was used, which consisted of the following manipulations: removal of the entrails and bleeding, salting, rubbing the body with wax, cedar oil and gum, wrapping with wax-impregnated paper [2,3,6,7].

A scientifically based method of embalming was proposed by the Dutch doctor Blankardus (October 24, 1650, [Middelburg](#) - February 23, 1704, Amsterdam), whose anatomy textbooks were used by the first doctors in Russia [4]. Two methods of embalming have been published - wet and dry. With the wet method, the body, after removing the brain and viscera, was immersed either in a strong solution of sea salt and alum, or in turpentine, or in alcohol. With the dry method, blood was released from the blood vessels and wax was injected instead, after which the corpse was left in the fresh air and covered with varnish [8].

There was another embalming solution during the Renaissance. Created by Frederick Ruysch (correct: Frederic Reuss, netherl _ *Frederick Ruysch*, 1638 - 1731) - the famous Dutch anatomist . in the world fame received his way save anatomical drugs and embalm corpses through So called liquor balsamicus, and currently unknown time way fill thin circulatory vessels hardening liquid [5,6]. Ruysch founded the first after museum Worma and Bartholin in Denmark anatomical museum. Ruysch was brought to worldwide fame by the anatomical collection he collected, which has no equal in the world. In accordance with the technology developed by the researcher, the body was treated with a serum based on coagulated pig blood and mercury oxide. It is worth noting that the scientist achieved significant results, he managed to achieve the preservation of the remains for a long time[8]. The famous collection of embalmed animals and body parts was bought by the Russian Tsar Peter I. Ruysch also informed Peter mine amazing way embalming corpses , which before wanted sell Are-skin per fifty 000 florins ; although way was reported king on a secret , but Peter handed over his Blumentrost , the latter to Schumacher , and this one - the label - to the medic Rieger who , having left Russia , published his in *Notitia _ rerum naturalium "* (article animal). located in museum academies Sciences in Petersburg (Kunstkamera) preparations prepared _ Ruysch , excellent survived before present time[9,10,11].

Part collections Ruysch sold Polish king Stanislav , who them donated Wittenberg university.

In the 18th century, the pharmacist Louis Penicher published a book in which he describes the different methods of embalming. The author considers the best method in which the organs are removed, the heart is embalmed in alcohol, the stomach is stuffed with aromatic powder. The body is wrapped in paper, oilcloth and placed in a box, the insides are placed in a lead barrel and covered with aromatic powder, which often included from 70 to 10 ingredients . But all this could not protect the corpse from decomposition for a long time [12].

With the onset of the 18th century, the art of embalming takes on a scientific basis. Szent-Petert in 1747 defended his dissertation on this topic. Major manuals on embalming appear (L.Penicher, I.Bush). Then Gringill 's essay was published and Xu's works came out.

In the era of Napoleon, in 1805, the French surgeon, life physician Dominique Larrey embalmed the corpses of Morlandi and Marshal Lon. Embalming was carried out according to Chasse with the use of sublimate and subsequent drying of the corpse. To embalm Lon , Larrey used 30 pounds of sublimate, but the results were not particularly good [2,6,12].

Inquisitive minds have long been looking for ways to inject embalming agent into a corpse without opening it.

John Gunther (1728-1793), an English anatomist and surgeon, was on the right track and suggested injecting the arteries into whole corpses with resinous aromatics or tinted turpentine. As an injection mass, a mixture of oils and turpentine dyed with cinnabar was used, and again - a mixture of turpentine, cinnabar, camphor and alcohol. After pouring, he took out the insides, sprinkled them with aromatic powder in the amount of 20 pounds and then filled the stomach with resins. At this time, the corpse had already partially embalmed itself [6,9,11,12]. The new method of embalming by vascular injection began to complement the method of immersing the whole corpse. This method has found many followers. In London, there is the mummy of the bride of Dr. Selm, which he himself embalmed in 1775 according to Gunther's method.

Dr. Hona in 1858 in the library of medical sciences describes a certain Buttard, who inserted iron rods into the armpit, eye sockets, ears and popliteal fossa, turned from different sides and thus made

long channels, where he then inserted latticed wooden tubes. The corpse was immersed in 45% alcohol saturated with sublimate and stored in this solution for two and a half months. Using this method, the author tried to inject the solution into the depths of the body without opening the cavities. Then the corpse was dried, the incisions were sutured. The face of the corpse shrunk, the nose and mouth were stuffed with rags, enameled eyes were inserted, the face was tinted and restored according to the previously removed mask [7].

With the development of scientific knowledge about the human body and its capabilities, scientists began to use the arterial system for embalming. The introduction of preservative liquids into conducting vessels made it possible to ensure the long-term preservation of the bodies. The first to put forward such an idea were the British W. Harvey and W. Hunter. It was they who became the forefathers of the technology of abdominal and arterial embalming. Embalming reached a new stage of development thanks to the discovery of formaldehyde. Before the German scientist August Wilhelm von Hoffmann (April 8, 1818 – May 5, 1892) invented this composition, arsenic was used mainly for the preservation of bodies. The new method showed much greater efficiency and became the basis of modern methods of processing the remains. Formaldehyde remains one of the best preservative liquids today: it not only prevents decay processes in tissues and organs, but also destroys pathogenic flora, providing a disinfectant effect [9,10].

In the first half of the 18th century, national Russian medicine began to develop in Russia. At first, foreigners, invited by Peter I to the Russian service, helped to develop it. Among them, it is necessary to note the Dutchman Nikolai Bidloo, who in 1706 opened the first school of Russian doctors and for many years helped the Russian people find their own path in medicine. Under him, the first anatomical theater was created and Russian anatomical technology was developed [9].

In the future, a number of the first Russian anatomists (Schepin, Protasov, Mukhin, and others) improved the process of embalming, but, unfortunately, no records of the methods they used have come down to us [9,10].

Throughout the 19th century, many different methods were proposed, based on sublimate embalming, which kept corpses from rotting.

Analyzing the era of anatomists of the 15th - 19th centuries, we can conclude that thanks to their work, a qualitative leap was made from primitive embalming techniques to more advanced ones, close to modern techniques for preserving cadaveric material. At the beginning of the XIX century, embalming, subjected to a comprehensive study of chemistry, physics and biology, gradually acquires a theoretical basis.

Thus, the development of anatomy as a science gave a serious impetus to the study of the issue of embalming. Knowledge of human anatomy is necessary for the professional training of doctors of any specialty. Human anatomy is a fundamental subject of medical education. It is she who is the first step that ensures the formation of clinical thinking. A doctor who does not know anatomy is helpless in practical actions, not convincing in judgments, and cannot fully analyze the examination data. Now is the age of innovative technologies. New technologies and opportunities, endolaparoscopic methods and robotic medicine are actively developing. From one era in medicine, we begin to move to another, but without a knowledge of anatomy it is impossible to become a surgeon or a doctor of any other specialty.

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