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Human Body Preservation: Expanding Life After Death

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Abstract :

Anatomy is the branch of medicine where study of structures of human body is done at the level of first year of academic course of every medical profession. Dissection or cadaveric anatomy is the only efficient tool to gain the knowledge of human body structures. A medical student who never stepped in the cadaveric laboratory of his institute during his first year can neither be a good physician or surgeon in his medical career. So dissection plays a very important role in learning anatomy completely.

Dissection is a long lasting procedure which is carried out in every medical teaching institute in their first year academic course as a practical study of Anatomy. The duration of this dissection is 1 to 1.5 years. So the dead body should be preserved till this period for better study. This procedure of preservation of human dead body is called as Embalming. It is the process of preserving a dead body with purpose of postponing decomposition for as long as possible.¹

Key Words : Dissection, embalming, formalin, preservation

Need Of Preservation :

Long before early practitioners of medicine began dissecting cadavers to study the human body, people have been preserving dead bodies and/or body parts. Some of the reasons are as follows.

A)Religion and beliefs:

Ancient cultures believed of a bodily continuation of life after death (the ancient Egyptians).Some other cultures treated their dead as deities, fed and clothed them, and at times brought their problems to them. While many primitive tribes, especially the Jivaro Indians, shrink heads as an act of war. It was common belief that possession of a shrunken head would bring good fortune to the warrior.²

B)Sanitation:

Embalming was also practiced in Egypt to solve the problem of burying their dead in a valley that was frequently flooded, and to avoid unsanitary conditions caused by cadavers mixing with drinking water spreading infections. It will avoid soil, water & air pollution.

C)Knowledge:

Since ages people have been intrigued by the mysteries of the human body & eager to know the inside of human body.

Development of methods of preservation and chemicals, allowed human bodies to remain well without putrefaction for the purpose of study by physicians. Thus extending the 'lives' of dead ones became possible.

Plastination, the latest technique of preservation developed by Prof. Von Hagens allows maintenance of human body in its natural form & color.

D)Public awareness:

Viewing of preserved human body specimens conveys health awareness messages far more effectively than many diagrams & illustrations. e.g. A blackened lung would deter a person from smoking & a cirrhotic liver would deter a person from alcohol.³

History Of Body Preservation :

The Chinchorro culture in the Atacama desert of present day Chile and Peru are among the earliest cultures known to have performed artificial mummification as early as 5000-6000 BC .The Ancient Egyptians believed that preservation of the mummy empowered the soul after death, which would return to the preserved cadaver. The ancient culture that had developed embalming to the greatest extent was that of Egypt⁴. Other cultures known to have used embalming techniques in antiquity include those of the Ethiopians, Guanches, Peruvians, Jivaro Indians, Aztecs, Toltecs, Mayans, Tibetan and southern Nigerian tribes.

The first lady anatomist —Alessandra Giliani|| of Persiceto, in Italy was the first one to inject the vascular system for long term body preservation in 14th century. In 1867, the German chemist August Wilhelm von Hofmann discovered formaldehyde, whose preservative properties were soon discovered and which became the foundation for modern methods of embalming, replacing previous methods based on alcohol and the use of arsenical salts.

Modern embalming is most often performed to ensure a better preservation of the deceased till arrival of their near & dear ones. Embalming is also now a legal requirement for international repatriation of human remains.⁵

Ancient Body Preservation In India :

Sushruta, the father of Indian surgery is well known to discover & develop many surgical techniques almost four to five thousand years ago. He was the first surgeon who performed dissection of human body & studied each & every part of the body.⁶

In Sushrutasamhita, references of the body preservation & dissection with the help of resources available at that time are found. After getting the ideal dead body for dissection, Sushruta suggests to remove intestines of the dead body so as to remove bacteria in the intestines which are responsible for the putrefication of the dead body. Then that dead body is enveloped with leaves & bark of different plants & it is enclosed in a large cage made of strong sticks of trees. This cage is then kept in the flowing water of the river in lonely place where there will be no harm to the body by animals like dogs, cats, etc. After

7 days, the body is taken out from the water & dissection is done removing the skin other inner structures one by one with the help of sharp grass.⁷

At that time neither chemicals or preservatives nor the advanced instruments were available for preservation & dissection of the dead body. So Sushruta tried natural way of preservation & used available resources for dissection.

Types Of Human Body Preservation :

- 1) Natural preservation: Preservation of cadaver by dehydration with hot sand.
- 2) Mummification: A more enduring preservation of the dead body, and involves the drying-out of the cadaver.

Natural -The dehydrating effects of being buried in hot sand led to really effective mummification. Winds could uncover the mummified bodies which then allowed scavengers to damage or destroy it. Occasional flash flooding was another enemy which could not only carry the body away but also could introduce moisture and bacteria.⁸

Artificial -Embalming took place inside a sacred tent called ‘_ibu’. The body would have first been washed with palm wine and then rinsed with water. Next the brain would have been removed; with help long hooks inserted through nostrils and into the skull, as Egyptians did not see the brain as a vital organ.

Once the brain was removed, palm wine and resin were poured through the nostrils to rinse and purify the hollow skull. This would have removed any remaining blood and brain matter. The natural disinfecting properties of the wine and resin would have helped kill bacteria, further hampering decomposition. More resin would be added later. Once the brain was removed, the embalmers would remove the internal organs by a small incision on the left side of the body.

The ancient Egyptians believed that dead would use their organs in the next life and thus a great effort was made to preserve them.

Natron, a naturally occurring mixture of sodium chloride (salt) , sodium bicarbonate (baking soda) and sodium carbonate decahydrate (ash soda), is vital to mummification. It is the key to dehydrating the body fast enough to prevent decomposition. Natron helps break down fats into oil and then absorbs these and other liquids from the body.

70 days was the standard period for mummification. The body would have then been washed with palm wine and anointed with resin and pleasant-smelling oils. The body was now ready to be wrapped in linen, with resin applied to the bandaging to act as a glue and sealant.

The exact ingredients of the preserving materials have long been a mystery. In the early 2000s, Richard Evershed at the University of Bristol in Britain took samples from 13 mummies and analyzed them using gas chromatography and mass spectrometry and found out that most embalming concoctions were a mixture of fats, resins, perfumes and waxes.

Sources such as tomb paintings, mortuary tools themselves, gave the fairly good idea of how the mummification was performed.⁹

Notable Egyptian mummies:

- 1) Tutankhamun & Ramesses II
- 2) Ginger, the oldest mummy in the world in British Museum, London.
- 3) MUMAB – Mummy of University of Maryland at Baltimore In 1994,

Embalming & Its Types :

The process of preservation of human body with the help of chemicals to delay its decomposition for study of Anatomy is called as Embalming. A cadaver is treated to ward off decay by injection of embalming chemicals into the blood vessels.

Embalming the word for the old English phrase to apply balm is derived from Latin with em-encapsulate and balming or balsam - any aromatic resins produced by certain trees of the mint family, in most modern cultures, is the art and science of temporarily preserving human remains to forestall decomposition and make it suitable for display.¹⁰

1.Ancient embalming

Ancient embalming methods consisted of removal of the brains and viscera and the fillings of bodily cavities with a mixture of balsamic herbs and other substances. The ancient Egyptians are known for their embalming techniques.

2.Modern embalming techniques

Modern embalming techniques are not the result of a single innovator, but rather the accumulation of many decades, even centuries, of research, trial and error. The method which is practiced today is as follows.

A.Arterial embalming: It involves the injection of embalming chemicals into the blood vessels, usually via the common carotid artery. Blood and interstitial fluids are displaced by this solution.

B.Hypodermic embalming: A supplemental method which refers to the injection of embalming chemicals into tissue with a hypodermic needle and syringe, generally used as needed on a case by case basis to treat areas where arterial fluid has not been successfully distributed.

C.Surface embalming: Another supplemental method, to preserve and restore areas directly on the skin's surface and other superficial areas as well as areas of damage.

D.Cavity embalming: This refers to the replacement of internal fluids inside body cavities with embalming chemicals via the use of an aspirator and trocar.¹¹

Commonly Used Embalming Agents :

Embalming chemicals are a variety of preservatives, sanitizers, disinfectants and additives. A mixture of these chemicals is known as embalming fluid. Typical embalming fluid contains a mixture of formaldehyde, glutaraldehyde, ethanol, and wetting agents and other solvents. The formaldehyde content generally ranges from 5 to 35 percent and the ethanol content may range from 9 to 56 percent.

Different types of the chemicals are the components of embalming fluid. These are:

1.Preservatives: These are the chemicals which inactivate saprophytic bacteria rendering it unsuitable media upon which such bacteria thrive. This arrests decomposition by altering enzymes and lysins of the body. These are a mixture of formaldehyde, glutaraldehyde and phenol. Formalin refers specifically to 37% aqueous formaldehyde.

2.Germicides (disinfectants): Chemicals used to kill microorganisms e.g. quaternary ammonium compounds (Roccal, Zephiran Chloride) and glutaraldehyde.

3.Modifying agents: These include buffers, humectants and inorganic salts. These agents influence the chemical reactions produced by preservative solution and function in embalming fluids to control the action of main preservative agents.

4.Buffers: They help to maintain acid base balance (pH) e.g. Borax, Sodium phosphate, Citrates and Sodium salt of EDTA (Ethylene diamine tetra acetic acid)

5.Inorganic salts: They play an important role in determining the osmotic qualities of embalming solution.

6.Humectants: they are used to hydrate the tissues e.g. Glycerol (Glycerine), Sorbitol, Glycol (Ethylene and Propylene glycol) and Lanolin.

7.Anticoagulants: They retard the natural postmortem tendency of blood to become more viscous e.g. sodium citrate, sodium oxalate and sodium salt of EDTA (Chelate).

8.Surfactants: These are the chemicals that reduce the molecular cohesion of a liquid so that it may flow through smaller apertures e.g. Sulfonates (alkyl sulfonates or alkyl aryl sulfonates and sodium Lauryl sulfate).

9.Dyes (coloring agents): they impart a definite color to the embalming solution e.g. Eosin, Ponceau Red, Erythrosine and Amaranth.

10. Perfuming agents/Masking agents/ Deodorants: they reduce the harshness or raw odour of the solution e.g. Benzaldehyde, Oil of cloves, Oil of Sassafras, Methyl Salicylate.

11.Vehicles (Diluents): liquids that serve as a solvent for the numerous ingredients that are incorporated into embalming fluids e.g. water, alcohols (methyl alcohol, glycerol). These chemicals are combined in various concentration to produce:

- a) Vascular (arterial fluids) for injection into the arterial system during vascular embalming.
- b) Cavity fluids (these are injected into the cavities of the body.
- c) Supplementary fluids.
- d) Jaundice fluids (special vascular fluid with special bleaching and coloring qualities of use on body with jaundice).¹²

Important Embalminngs :

Late British royal Diana princess of Wales was embalmed on the orders of British authorities to prevent tests which could have confirmed whether or not she was carrying her lover Dodifayed's child.

Soon after January 21, 1924, the day that Lenin died, the Soviet government received more than 10,000 telegrams from all over Russia, which asked the government to preserve his body somehow for future generations. On the morning of January 23, Professor Alexei Ivanovich Abrikosov, a prominent Russian pathologist and anatomist done the embalming.

When Abraham Lincoln's body was embalmed, the embalmer preserved it for the long term. At the turn of the century it was disinterred for forensic study, revealing a perfectly preserved corpse.¹³

Recent Advances In Body Preservation :

Preservation of specimens by a method of forced impregnation with curable polymers is called as plastination. It not only preserves a cadaver but also keeps it life like.

A unique method of permanent preservation in which anatomical specimens are completely impregnated with reactive polymers, silicone, rubber, epoxy or polyester resin was developed in 1977 by Dr. Gunther Von Hagens, Institute of Anatomy, and University of Heidelberg, Germany. In 1993 he established the Institute for Plastination in Heidelberg.

The cadaver is first fixed in formalin by formalin embalming procedure dissected to display the desired topographic features. The dissected specimens are then dehydrated by freeze substitution in acetone at -25°C, which eliminates water and fat from the body tissues. The cadaver is then submerged in fluid plastic that fills in all the cavities and is then hardened gradually under heat and ultraviolet light. The specimens may take 4-12 weeks to complete the process of plastination. Thus treated cadavers can be sliced into cross-sections. Variations of the technique are used for hollow viscera, sponge structures and brain. Plastinated specimens are clean, dry, durable, odourless and give a true to life appearance.¹⁴

Human plastinated specimens are today's milestone in medical education. They have become an ideal teaching tool not only in anatomy but also in pathology, obstetrics, radiology and surgery. Though plastination has its advantages, considering the advances in medical science embalming has its own place.

Plastination allows students to have hands on experience in this field without exposure to chemicals such as formalin. Plastination of soft tissues, organs, bones and teeth has proved valuable in preserving delicate, friable and calcined specimens. The dry, odourless and biological inert specimens are durable and resistant to damage caused by frequent handling. Patterned injury may change due to shrinkage, but remain easily recognizable. Plastinated whole jaws are easily identifiable from Ante mortem records. Radiograph density is unchanged and putrid and charred specimens become manageable. In Medico-Legal cases, these specimens may be used for accurate identification and preservation of important material. Body preservation method current to the 21st century is cryopreservation.

Cryopreservation is a process where cells or whole tissues are preserved by cooling to low sub-zero temperatures, such as (typically) 77 K or -196 °C (the boiling point of liquid nitrogen). At these low temperatures, any biological activity, including the biochemical reactions that would lead to cell death, is effectively stopped. However, when vitrification solutions are not used, the cells being preserved are often damaged due to freezing during the approach to low temperatures or warming to room temperature.¹⁵

Conclusion :

Embalming or human body preservation is a very essential procedure so as to keep the bodies in their natural form & to extend their decomposition. Now a days, with the advancing technology & day to day research, newer techniques & chemicals are discovered for better preservation of the dead bodies. New techniques & chemicals are much effective than the traditional ones and are being adopted by all medical institutes. These techniques should be taught to the all medical professionals related to this faculty in various conferences & training programmes.

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