

# EMBALMING OF HUMAN CADAVERS FROM EGYPTIAN ERA TO THE MOST MODERN TECHNIQUES - A REVIEW ON PRESERVATION OF HUMAN CADAVERS

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## ABSTRACT

Embalming is a means of artificially preserving the dead human body by use of chemicals for its preservation. It prevents the growth of microorganisms which are responsible for the decomposition and putrefaction. Embalming originated in Egypt around 3200 BC and continued on until AD 650. William Hunter is credited with being the first to report fully on arterial and cavity embalming. He used various chemicals like oil of turpentine, oil of lavender, camphor, oils of rosemary and chamomile. Soft embalming is a newer technique in which cadavers have no structural distortion on dissection and the tissues remain soft and flexible and hence dissection becomes easier. The movement of muscles of the limbs are also very good as well as excellent colour retention is present. This article deals with the various methods of preservation of human cadavers, which allows the use of cadavers over longer period of time, which prove to be very useful in teaching gross anatomy to the undergraduates as well as learning surgical skills.

**KEYWORDS:** Embalming, Cadavers, Preservation, Soft embalming, Surgical skills, Plastination.

## INTRODUCTION

Embalming, which is one of humankind's longest practiced arts, is a means of artificially preserving the dead human body [1]. The human body is preserved by use of chemicals, preventing the growth of microorganisms which are the main causes of organic decomposition and putrefaction [2]. The term Embalming is derived from the Latin word- *em* meaning of which is to encapsulate and *balming* is the application of any aromatic resin, which is produced by certain trees of the mint family. The three major goals of embalming are thus, preservation, sanitization and presentation (or restoration of a dead body) [2]. There are natural processes of embalming as well as artificial means. The natural ones include freezing techniques by using dry cold or dry heat and the artificial methods includes use of zinc sulphate mixed with sawdust powder, cavity injections and arterial injections [3,4].

This article deals with the various methods of preservation of human cadavers, which allows use of cadavers for a longer duration. These cadavers prove to be very useful in teaching gross anatomy to the undergraduates as well as learning surgical skills. Thus, this review may be an addition to the previous literatures for providing a variety of various methods which may be used for preservation of cadavers and thus a better outcome can be achieved [5].

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## Review of Literature:

### 1. The Egyptian Embalming Method: (3200 BC- 650 AD)

Embalming originated in Egypt around 3200 BC and continued on until AD 650. After the death, the brain was removed and the skull was packed with resin. Then the internal organs were removed through an abdominal incision. The organs were removed, washed and mixed with resins and spices. Then they were either returned to the body or were placed in separate burial vases called canopic jars. The body was immersed in sodium salt solution for 20-70 days. After that the body was cleansed, and allowed to dehydrate in the sun. Finally the body was wrapped using about 1200 yards of 3 1/4 inch bandage. Gum or glue held the cloth together and helped in fitting it around the body [6,7].

### 2. Period Of Anatomists: (AD 650- 1861)

The principal geographic area was Europe. During this period, various embalming techniques were developed for preservation of dead for the purpose of dissection and teaching of gross anatomy. In the earlier period, preservation of cadavers was done by drying through exposure to natural heat of sun. Later use of controlled heat in oven was employed.

As early as 1326, Alessandra Giliani of Italy injected blood vessels with coloured solutions which hardened.

Leonardo da Vinci was probably the first to inject chemicals or wax into the specimens that he dissected and sketched, but Dr. Frederick Ruysch is known as the father of embalming. He injected a prepared preservative chemical solution of turpentine, oil of lavender coloured with vermilion into the blood vessels. However, William Hunter is credited with being the first to report fully on arterial and cavity embalming. He used various chemicals like oil of turpentine, oil of lavender, camphor, oils of rosemary and chamomile [8].

### 3. Modern Period Of Embalming: (1861-Present day)

Dr Thomas Holmes is the Father of modern embalming. He used Arsenic, mercury, turpentine and various forms of alcohol. He reportedly embalmed over 4000 soldiers and officers during the American Civil War. In 1867, the science of embalming took a step forward when the preservative chemical formaldehyde was discovered by August Wilhelm von Hofmann. It was more effective and economical preservative. Laskowski (1886) introduced phenol to the embalming techniques in the middle of 19th century. He did embalming using a mixture of glycerine and phenol [6].

### 4. Concept Of Soft Embalming

The faculty of anatomy, medical students as well as dissection hall attendants have prolonged exposure to the harmful vapors of formaldehyde, which have toxic effects on body [10,11]. Bari Logan in 1985 developed the technique of soft embalming in Cambridge. He reduced the concentration of Formalin from 10% to 3% and replaced it with Methanol. It gives greater flexibility and good fixation to the specimen. There are lesser harmful fumes too [12,13].

- **Thiel's Soft embalming solution:** Prof W. Thiel developed a new soft embalming solution in 1992 at Graz Institute of Anatomy, Austria. He used various chemicals like Potassium nitrate, Boric acid, Ammonium nitrate, and Water [14]. The advantage of his method was that the cadavers had no foul odor. The movement of body parts was very smooth and parts were very flexible [15,16]. The color was excellently preserved. The joints were freely movable and the peritoneal cavity was so inflatable so that it could be used for teaching and learning laparoscopic procedures [17,18].
- **Coleman and Kogan saturated salt solution:** Coleman and Kogan in 1998 simply modified the embalming mixture prepared by Logan by replacement of alcohol with isopropyl alcohol and addition of sodium chloride in a good

quantity. There was no desiccation and excellent colour preservation was present. The common salt is very cheap and easily available too. The only disadvantage was the deposition of salt at some places. [19,20].

- **Larsen solution (2007):** Larsen in 2007 prepared an embalming solution by using Sodium chloride, Chloral hydrate, Sodium sulphate, Sodium Bicarbonate, Solution of 10% formalin and Distilled water. The embalmed specimen was very flexible and thus very good dissection could be performed on it. But, colour was not retained, skin desquamation occurred as well as loss of tissue texture was there [6,21].
- **Modified Laskowsky solution (2007):** It comprised of glycerine, ethanol, phenol and boric acid. The advantage was good colour retention, no odour present and in vivo like flexibility was there. But, there was loss of tissue texture as well as skin desquamation [21,22].
- **Al-Hayani Shellac mixture:** Al-Hayani in 2011 made use of natural polymer of the lac insect, Laccifer lacca. There was no distortion of anatomical structures on dissection. The soft parts were very flexible which made the dissection easy. But, there was slight brownish discoloration of skin present [23].
- **Goyri-o-neill embalming solution (2013):** Goyri-O-Neill made an embalming fluid by mixing diethyl glycol and monoethylene glycol. It was good but the preservation was for short period of time. The muscles were very well preserved with good flexibility of joints too. The skin preservation was also good with no desquamation but, mucosa of buccal cavity could not be preserved and showed signs of putrefaction [24].
- **Natekar and DeSouza Glutaraldehyde solution (2014).** Natekar and DeSouza in 2014 have reported a soft embalming solution. The solution is composed of glutaraldehyde, water, methyl alcohol, glycerine, cetrimide, eosin and eucalyptus oil. Glutaraldehyde is activated by adding the entire contents of the activated vial which is attached to the glutaraldehyde container. It was also observed that although skin did not show much change in colour imparting a natural look, the arteries appeared reddish in colour. The arterial fluid was red in colour and could be differentiated from cavity fluid. The superficial fascia appeared reddish over the face whereas the muscles appeared red in colour [25].

### Plastination

Plastination is a process which was first developed by Gunther von Hagens in 1977 and is used for preservation of bodies or body parts. The steps of plastination are fixation, dehydration, forced impregnation in a vacuum, and hardening. The first step includes the replacement of water and lipids by polymers like silicone. In the next step of dehydration the part is placed in a tub of acetone, which withdraws all the water from the cells. For forced impregnation, placement in a bath of liquid polymer is done [26]. A vacuum is created, which makes acetone to boil and finally vaporizes. The cells are filled with liquid plastic, which is further hardened. The plastinates are resistant to the growth of micro-organisms [27,28]. The disadvantage is that, it causes undesirable changes in like shrinkage, spots on the organ surface etc in the specimen [29,30,31].

## CONCLUSION

### Need for better preservation

Human cadavers have always been a superb tool for the medical students for teaching and learning gross anatomy. And for this, a good technique of embalming is needed for better preservation of the cadaver. However, in most of the conventional methods many harmful chemicals are used, which are toxic to the entire faculty, medical students as well as staff of Anatomy department. Hence, by the use of new embalming solutions, the process of preserving cadavers may become comparatively less toxic.

### Learning of surgical skills

Surgical techniques are constantly advancing now-a-days, which requires a thorough training and practice for achieving mastery. Due to medicolegal cases too, trainees find it difficult to learn invasive procedures on living patients. Thus, cadavers which are embalmed using soft embalming techniques are much suitable for such new learners to boost up their confidence before performing those procedures on living patients.

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