



# A Literatures Based Study on Ancient Methodology of Cadaver Preservation According to *Acharya Sushruta*

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## ABSTRACT

The ancient culture that had developed embalming. In the ancient India culture few evidence is present in *Hindu's mythological* and *Ayurvedic Samhitas* and *Grantha*. In the Ramayana chapter *Ayodhya Kanda* evidence of Body preservation is mentioned about 5000 BC ago and in the *Ayurvedic Classics* in *Shushruta Samhita* of the body preservation is described and as earlier as first give the concept of preservation of cadaver and selection of cadaver. The Need for Preservation was for Long before early practitioners of medicine in India began dissecting cadavers to study the human body. The *Ancient Egyptians* also believed that preservation of the mummy empowered the soul after death, which would return to the preserved cadaver. The Ancient Egyptians (3200 BC) believed that preservation of the mummy empowered the soul after death. In the 19th and early 20th centuries arsenic was frequently used as an embalming fluid but has since been supplanted by other more effective and less toxic chemicals.

**Keywords:** Cadaver Preservation, embalming, Ayurveda etc.

## INTRODUCTION

The process of preservation of Cadaver in which the dead body treated with or without chemically preserved, protected for a long time which can studied the macroscopic to microscopic level.<sup>1</sup> The process of chemically treating a dead human body, or parts of it, to protect it from the forces of decomposition.

In Ancient India (Bharat) few evidence is mentioned in *Mythological* and *Ayurvedic Samhitas* and *Grantha* first evidence of Body preservation is mentioned in the *Ramayna* in the chapter *Ayodhya Kanda* 5000 BC ago<sup>1</sup>. When

King *Dashratha* died, *Maharishi Vashistha* advised his Prime Minister *Aaryasumanta* and gave suggestion to keep the dead body of King *Dashratha* into the wooden boat filled with medicated oil till prince Bharat came back to *Ayodhya*. In the Ayurvedic treatise's insight, accuracy and detail of the evidence of body preservation is described in *Shushruta Samhita*.<sup>2</sup> *Shushruta* has described the concept of preservation of cadaver and method of selection of the dead body. He described in detail the selection criteria for body which is to be preserved and detailed method of its preservation. Second Ancient embalming methods consisted of removal of the brains and viscera and the fillings of body cavities with a mixture of balsamic herbs and other substances. The ancient Egyptians are also known for their embalming techniques.

Contemporary embalming methods advanced remarkably during the height of the British Empire and the American Civil War, as a result of sentimental issues involving foreign officials, business- and service-men dying far away from home, and the need for their remains to be returned home for local burial.<sup>3</sup> In the 19th and early 20th centuries arsenic was frequently used as an embalming fluid but has since been supplanted by other more effective and less toxic chemicals. There were questions about the possibility of arsenic from embalmed bodies later contaminating ground water supplies. There were also legal concerns. Dr. Thomas Holmes received a commission from the Army Medical Corps to embalm the cadavers of dead Union officers to return to their families.<sup>4</sup> The essential motive behind embalming at this time was prevention of spread of diseases. Former American President *Abraham Lincoln*'s burial was made possible because of embalming techniques making the subject known to society at large. 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.

## MATERIALS AND METHODES

The material related to Cadaver preservation collected from various authentic articles, websites, literatures etc.

### TYPES OF PRESERVATION:

- 1) ***Jal-nijaamana koth (Purification)Vidhi***: Preservation of cadaver by hydration in the river in a running stream where the current is not very strong and where there would be no interference from public. The body should be steeped and allowed to decomposed for seven days.<sup>5</sup>
- 2) **Natural preservation**: Preservation of cadaver by dehydration with hot sand.
- 3) **Mummification**: A more enduring preservation of the dead body, and involves the drying-out of the cadaver.<sup>6</sup>

**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.

As per *Ancient* science of embalming different methods of cadaver preservation were mentioned in *ayurvedic* and contemporary sciences. In ayurveda *Acharya Sushruta* has described as<sup>7</sup>

First off, all the origin of embalming technique in ancient India. They were known for their embalming techniques and use to understand all external and internal parts of body and also the organs should thus be minutely examined and observed methods mentioned in the *Sushruta Samhita*.

The embalming process involves Three parts:

1. *Purva Karma*
2. *Pradhan Karma*
3. *Paschata Karma*

1. ***Purva Karma (Pre-Procedure)***: Here includes the selection of body which is to be preserved and not to be preserved. As per *Shushruta* it is detailed as:

With all limbs intact with their natural positions  
Where death was not due to poisoning  
Where the illness was not due to long duration  
Not a very aged person

2. ***Pradhan Karma is the main procedure which includes:***

They adopt the ancient embalming methods consisted of *removal of the intestine and faeces* placed the body in a stout case, covered with a mattress of fibers of *Kusha*, flex of similar material. The Iron case should be kept immersed in a running stream where the current is not very strong and where there would be no interference from public. The body should be steeped and allowed to decomposed for seven days.

3. ***Paschata Karma which is the post procedure:***

When every part is loose, it should be taken out and beginning from the skin, every organ should be examined and scrubbed off with a brush of Bamboo bark or *Kusha* and other similar material. All external and internal parts of body and also the organs should thus be minutely examined and observed method. The treatise's insight, accuracy and detail of the anatomical & surgical descriptions are most impressive. In the book's 184 chapters, 1,120 conditions are listed, including types of bones, Joints, Muscles, Tendons, Veins, Arteries and their classification, Garbha sharer (Embryology), Marma sharir (Vital Parts of the body) in the *Sharir Sthana*.

As per modern science the various methods of cadaver preservation were mentioned.<sup>8</sup> Which are:

**1.Artificial Embalming** took place inside a sacred tent called *ibu* ‘. The body would have first been washed with Palm (Tree) 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 Ever shed 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.

## 2.Notable Egyptian mummies:

- Tutankhamun & Ramesses II Ginger is the oldest mummy in the world which is in British Museum of London,
- MUMAB – Mummy of University of Maryland at Baltimore. In 1994, Bob Brier, a professor of Egyptology at Long Island University and Ronn Wade, an anatomy specialist at the University of Maryland Medical Center, attempted to replicate the embalming and mummy-making process of the ancient Egyptians— using only ancient. Egyptian-era tools and Herodotus's (Greek historian, who lived in the 5th century BC and travelled to Egypt around 454 BC) description.

The striving efforts of Dr. Bob Brier gave birth to MUMAB ‘, the first human being to receive a royal Egyptian mummification. MUMAB could serve as benchmark for mummy studies. One of the MUMABS feet was kept unwrapped so that every couple of years a tissue sample could be taken to assure that all was well and there was

still no decomposition. MUMAB stayed in University of Maryland School of Medicine for sixteen years, then shifted to —San Diego Museum of Man —a Modern Day Mummy exhibition.

**3.Embalming:** —a cadaver is treated to ward off decay by injection of embalming chemicals into the blood vessels.

### MODERN EMBALMING TECHNIQUES<sup>9</sup>

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. The embalming process involves four parts:

**1.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.

**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.

**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.

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

**2. Chemicals used:** 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.<sup>10</sup>

### 3.Types:

#### a. Specialist embalming:

Badly decomposing bodies, trauma cases, frozen or drowned bodies, and those to be transported over long distances also require special treatment.

Embalming autopsy cases differs from standard embalming because the nature of the post-mortem examination disrupts the circulatory system, due to the removal of the viscera. In these cases, a six-point injection is made

through the two iliac or femoral arteries, subclavian or axillary vessels, and common carotids, with the viscera treated separately with cavity fluid or a special embalming powder in a viscera bag.

In many morgues in the United States and New Zealand, these necessary vessels are carefully preserved during the autopsy.

**b. For Anatomy purpose:**

The first priority is for long term preservation. Embalming fluids contain concentrated formaldehyde 40%, (known as formalin) as preservative, phenol as fungicide, glycerin for softness & plasticity. Anatomical embalming is performed into a closed circulatory system.

**c. High pressure embalming:**

The fluid is injected into an artery under high pressure with an embalming machine and allowed to swell and saturate the tissues. The fluid is left in the system for a number of hours then the fluid allowed to drain out, although many anatomical embalmers do not use any drainage technique.

**d. Gravity-feed embalming:**

In this method the container with the embalming fluid is elevated above the body level and fluid is slowly introduced over long time. The drainage of fluid is not done. The distension caused reduces gradually, leaving a fairly normal appearance. There is no separate cavity treatment of the internal organs. Mixing of Formaldehyde with blood causes grey discoloration also known as "formaldehyde grey" or "embalmer's grey" which gives anatomically embalmed cadavers a typically uniform grey discoloration.

**e. Practical light embalming:**

This technique is used in surgical fresh tissue dissection laboratory. Lightly embalmed cadavers can be kept in a cooler for up to 6 weeks, with negligible loss of tissue quality, colour & Odour free condition.

**f. Thiel embalming technique:**

With Thiel embalming cadavers exhibit a greater degree of flexibility and colour retention compared to that of traditional formalin-fixed cadavers, this makes it a valuable method for microvascular surgical training.

**g. Notable embalming:**

Charles XII, (1682-1718) is one of several Swedish kings to have been embalmed. Pope John XXIII: (1881-1963) body is on display in an altar on the main floor of the Basilica of Saint Peter

#### **h. Medgar Evers:**

Murdered civil rights activist was so well embalmed that an autopsy could be performed decades after his death and helped in the conviction of his killer. Abraham Lincoln: Embalmed after his assassination in 1865. Vladimir Lenin: Most famous embalmed body of the 20th century Diana, Princess of Wales - embalmed shortly after her death in France in August 1997

#### **4. Plastination:**

Preservation of specimens by a method of forced impregnation with curable polymers. An 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 It not only preserves a cadaver but also keeps it lifelike.

The cadaver is first fixed in formalin by formal embalming procedure dissected to display the desired topographic features. The dissected specimens are then dehydrated by freeze substitution in acetone at  $-25^{\circ}\text{C}$ , 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, odorless and give a true to life appearance. 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.

#### **THE NEED FOR STUDY OF PRESERVATION:**

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

##### **1.Acquiring the Practical Knowledge of Anatomy (medicine & Surgery)**

*Acharya Sushruta* has described as:

A surgeon who desires to obtain through knowledge of body must dissect a dead body and see each and every structure and organ in it.<sup>11</sup>

Whatever is actually seen and observed during dissection and also theoretically learnt from text books on anatomy, should supplement each other. Both methods tend to the growth of true knowledge. Knowledge acquired from the

study of Shastras (Literature) can make a man perfect only if sided by personal observations, whether the subject of study be anatomy or any other. The art of Medicine should be practices after solving personal difficulties, both in theory and practice

## **2.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.

## **3.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.

## **4.Knowledge:**

Since ages people have been intrigued by the mysteries of the human body. Development of methods of preservation and chemicals, allowed human bodies to remain well without purification 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.

## **5.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. From a series of studies carried out on visitors to-Body Worlds, exhibition in New York, the following results were obtained 59% of the visitors had decided to pay more attention to their health in the future (including 10% which had, upon seeing tar-coated lungs, sworn never to smoke again) 36% of those who had previously not participated in organ donation program declared they would do so.

## **6.Comfort:**

Some ancient civilizations preserved their dead not because they believed in the Afterlife, but they refused to part with family members. The fact that many of the earliest mummies were of children and babies, suggest that it was the mothers who first practiced mummification in an attempt to keep their young ones with them.

## DISCUSSION

There is a wealth of material in historical books that reveals information regarding the preservation and dissection of a dead corpse. Susruta talks about scientific preservation and dissection methods. According to *Susruta*, the best way to keep a dead person alive is to immerse it in slow-moving river water. *Susruta* suggested preserving a dead body that had all bodily parts in order to learn about the entire body. There may be changes in the internal or exterior parts of the body if death happens as a result of chronic illnesses.

*Sushruta* also advises against preserving the body of someone who died as a result of ingesting poison since the poison may induce tissue deterioration. As a result, a body that has died naturally should be preserved. *Sushruta* states that after 7 days of preservation, the deceased corpse is dissected with the use of *kusha*, *khasha*, and bark. In addition, *Sushruta* advises against dissecting with a sharp edge device. With the use of bark and *kushakhasha* in dissection, he claims, one may gain detailed knowledge.

### **There are three methods of preserving a dead corpse according to contemporary science.**

1. A salt solution with a high concentration of sodium chloride.
2. A solution of formaldehyde

These cadaver courses were used to improve surgeons' techniques without putting patients at danger. These are the procedures that are best for specimens. Furthermore, the risk of infection and the high expense of utilizing cadavers are issues that must be addressed. This approach yielded cadavers with supple joints and great tissue quality, as well as a sufficient antibacterial action. It stops putrefying organisms from getting in.

## CONCLUSION:

All of the previous studies have been done on those parameters which determine the trend or history of cadaver preservation in the ancient time were practicing in the ancient India before the 5000BC. *Acharya Shushruta* described the body preservation and give the concept of dissection first also. The Indian sagas perform dissection for the purpose of gain the knowledge about human body's external and internal structures by observation method by own senses. Egyptians are also known for their embalming techniques but their intention was only how to preserve the body for a very long time. Gender variations in the body preservation techniques adopted at that time after comparing the findings of the present study with the previous data available, the observation is different while others are varying due to the formulas used for these calculations. Morphological study on body preservation is useful for Anatomists, anthropologists, experts in Forensic medicine, and surgeons. The purpose of this work is to contribute to the scientific literature, providing anatomical data on the similarities and variations. The ancient method of body preservation correlates with modern technique so this information may be helpful for our society.

*Conflict of Interest – Nil*

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