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A Critical Review on Ancient and Modern Methodology of Cadaver Preservation with Special Reference to Technique Mentioned by *Acharya Sushruta*

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Abstract: ***Medical courses are thought to have a unique defining feature that is learning Anatomy from a dissected cadaver. The study of the human body through cadaver dissection is very helpful in proliferation of medical knowledge possible. This way of studying human anatomy is present since ancient times, also mentioned by our Acharyas. According to Sushruta, dissecting a dead body is a crucial step towards becoming a renowned clinician and surgeon. Theoretical information acquired from the teacher and practically witnessed knowledge in the dissection complement one another. An effort is made by gathering all relevant literature on the Ayurveda science, modern history and modern medical science including information regarding preservation as well as on where and how the body is dissected.***

Keywords: ***Preservation, Embalming, Mrita-Sanrakshan***

I. INTRODUCTION

Before dissecting cadaver, dead body needs to be preserved as it cannot be kept for long time in its original form. Various references can be seen in various ancient and modern texts regarding this.

1) *The Vedic Period:* In the chapter of the Ramayana topic of body preservation was brought up. When King *Dashratha* passed away, *Maharishi Vashistha* gave his Prime Minister *Sumanta* advice to put the remains of the king in a wooden boat filled with medicinal oil until prince Bharat returned to Ayodhya.
2) *The Ancient Egyptians:* Also considered that the mummy's preservation gave the soul enough strength after death that it would return to the preserved corpse.
3) *19th and Early 20th Centuries:* Arsenic was once a common embalming fluid, but more effective and secure substances have since replaced it. Modern embalming techniques considerably advanced during the height of the British Empire and the American Civil War due to sentimental considerations surrounding foreign leaders, businesspeople, and troops dying far from home and the necessity for their remains to be sent home for local burial. Dr. Thomas Holmes was even chosen by the Army Medical Corps to embalm the bodies of Union commanders who had passed away so that their families could receive them.
4) *According to Ayurveda: Acharya Susruta* describes dead body preservation in

Sushruta Samita 5th chapter of Sharira Sthana.

तस्मात्समस्तगात्रमविषोपहतमदीर्घव्याधिपीडितमवर्षशतिकं निःसृष्टान्त्रपुरीषं पुरुषमावहन्त्यामापगायां निबद्धं पञ्जरस्थं मुञ्जवल्कलकुशशणादीनामन्यतमेनावेष्टिताङ्गमप्रकाशे देशे कोथयेत्, सम्यक्प्रकुथितं चोद्धृत्य, ततो देहं सप्तरात्रादुशीरबालवेणुबल्वजकूर्चानामन्यतमेन शनैः शनैरवघर्षयंस्त्वगादीन् सर्वानेव बाह्याभ्यन्तरानङ्गप्रत्यङ्गविशेषान् यथोक्तान् लक्षयेच्चक्षुषा ॥४९॥

➢ *Human body dissection – Selection of cadaver, preservation (Mrita-Sanrakshan Paddhati) and method of dissection*

According to Acharya Sushruta, who studied Anatomy by dissecting dead bodies, someone who has Anatomical knowledge will undoubtedly perform surgery successfully because they are aware of the body's vital organs, such as *Dhamani, Sira*s, Nadi and *Marma* points, which help them avoid harm during the surgical procedure. Sushruta stated that cadaver dissection was necessary for medical students to learn the subject of Anatomy practically, which is why he talked about the preservation strategy and dissection procedure.

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- *Samasta-Gatram*- According to Sushruta, a human corpse (cadaver) contains all of its parts in their original, undamaged states, neither more nor fewer in number is supposed to be taken for dissection.
- *Avisha-Upahatam*:- As poison affects different body parts, the body does not remain in its natural state.
- *Adeergha-vyadhi-peeditam*:- According to Sushruta, the individual whose body is being preserved should not have been died from chronic diseases because these conditions may have effect on various body parts, such as the skin in leprosy, the bones in the nose and other bones in syphilis, the penis in gonorrhoea, etc. Such type of body gives wrong information about the study of body parts. Since acute diseases do not cause any damage in the early stages, a dead body that had previously experienced long-term disease should be taken for dissection.
- *Avarsha-shatikam*:- Sushruta declines to accept both the bodies of youngsters and elderly people. Because as people age, many components of their bodies degrade, including the skin, teeth, bones, muscles, ligaments, and, in the case of older women, the uterus also shrinks. On other hand, in children their organs, bones and system are not fully developed as seen in adults. Like milk teeth, bones not formed well etc.
- *Avarshahatikam* which means not above the 100 years. But in present era average age level diminished so we can take body having age up to 60 to 65 years.
- *Nisrushta-antra-pureesham*: - As there are numerous bacteria in the colon and faeces, *Sushruta* advice, they should be expatriate out along with the faeces. The benefits of removing the faeces from gut is that body and intestine will not be bacterially destroyed.
- *Avagahnty-amaapgayam:* - To keep the body moist and soft and prevent foul odours it is told to put body consistently in contact with water, tie it securely and place it in a river with a slow-moving stream.
- *Nibadhham*: - As stated earlier, the meaning of the word "Nibandhham" is to tie body properly. So that the body won't sink, drown, or otherwise float away.
- *Panjarastham*: - *Sushruta* advised that dead bodies were enclosed in a cage to protect them from aquatic creatures.
- *Munja-valkal-kusha shanadinam- Anyatam-en- Aaveshtita Anga-pratyangam*:- Dead Body was wrapped either with *Munja*, *Valkala* (inner barks of trees), *Kusha* (Grass part of *TrinaPanchmoola*), *Shana* or any such material. The purpose of this wrapping was to shield the body from small aquatic creatures. Because it could be thought as the reason for the post-mortem damage, allowing microorganisms to colonise the body and trigger its decomposition. And the skin of the cadaver also softened for dissection.

The following are some specifics regarding these materials:

Plant name	Botanical name	Family	Properties	Specific content
Munja	Saccharum munja Roxb	Graminae	Source of natural fibre	-
Valkala	5 Plants are considered in *Valkala* – 1.*Nyagrodha* (Ficus bengalensisLinn.), 2.*Udumbara* (Ficus glomerataRoxb.), 3.*Ashvatha* (Ficus religiosa Linn.), 4.*Pareesha* (Thespesia populnea Soland.) and 5.*Plaksha*(Ficus lacor Buch.Ham.)	*Nyagrodha*, *Udumbara*, *Ashvatha*, *Plaksha* Moraceae family and *Pareesha* Malvaceae family	Antiseptic, Anti-inflammatory, Antioxidant, Antibacterial, Antimicrobial Wound purifying and Healing, and Astringent In *Ayurveda* these five are called *Panchavalkala* which is *Shothahar* (reduces swelling) and *Vranaropaka* (helps in wound healing)	All these 5 plants contain tannins

Kusha	Desmostachya bipinnata Stapf	Gramineae	Antibacterial effect against gram negative and gram positive organism, Astringent, Antiseptic and toning properties	Tannins
Shana	Crotalaria juncea Linn.	Leguminosae	Source of natural fibre, Astringent, Antimicrobial activity	

- *Aprakashdeshe Kothayet :-* Dead bodies should be kept in secret, dark areas where they can decompose. *Aprakashdeshe* (dark area) refers to a place where people rarely or never go. The other reason could be that no one can see or utilise the water of that gloomy region, preventing the spread of disease to others through water
- *Samyak Prakuthitam Ch Udhrutya Tato Deham Saptaratrat:* - When a dead body has been adequately putrefied for seven days, it should be removed and the wrapping should be taken off.
- *Ushir Bal Venu Valkala Kurchaanaam Anyatamen Shanai Shanai Avgharshyanstvagadin Sarvaneva Bahyaabhyantarangpratyang Visheshan Yathokran Lakshayechchkshusha):-* brushes made from *Usheera* (grass), *Bala* (hairs), *Venu* (bamboo), *Valkala* (inner bark of trees), *Kurcha* (grass part of *PanchTrinamoola*) or any other similar material were used for Scrubbing the dead body slowly and then the entire body, including all of its external (Bahya) and internal(Abhyantara) components, like the muscles, skin, and so on, should be keenly observed by the eyes (Pratyaksha). To observe the intricate details of the body's components and the various skin layers specified by Acharya Sushruta, a dead body is slowly scrubbed.

A. Modern Embalming Techniques

Medical students regularly use cadavers for Anatomical studies because they are a monument to body science. Before doing surgery on actual patients, surgical procedures are commonly tested on cadavers. Despite the fact that many schools now use robotics and surgical templates to train. Cadavers are still necessary for practical hands-on learning. Modern embalming methods are the culmination of decades, work done for centuries, studies, experimentation, and research rather than the work of a single pioneer.

The embalming process which are practised nowadays involves following various techniques:

1) *Arterial Embalming:* In most cases, the common carotid artery is used to inject embalming agents into the blood vessels. This solution removes blood and interstitial fluids replacing it with embalming fluids.
2) *Hypodermic Embalming:* One more technique which involve the use of a hypodermic needle to inject embalming agents into tissue.
3) *Surface Embalming:* To preserve and restore areas that are immediately on the skin's surface and other superficial areas, there is another additional technique.
4) *Cavity Embalming:* This refers to the process of using an aspirator and trocar to replace internal fluids in body cavities with embalming chemicals.

B. Chemicals use

Various preservatives, buffer agents, disinfectants, and additives are included in embalming chemicals. Embalming fluid is a combination of several chemicals.

Typical embalming fluid contains a mixture of formaldehyde, glutaraldehyde, ethanol, and wetting agents and other solvents.

C. Types

1) *Specialised Embalming:* Additional, particular care must be taken with decaying remains, trauma cases, frozen or drowned dead, and those that must be transported across great distances.as the nature of the post-mortem examination disturbs the circulatory system due to the removal of the viscera, embalming autopsy cases differs from conventional embalming.
2) *For Anatomy Purposes:* Long-term preservation is of the utmost importance. Concentrated formaldehyde (formalin), phenol, and glycerine are all ingredients included in embalming fluids. Anatomical embalming is carried out in a closed circulatory system.

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3) *High-pressure Embalming:* An embalming machine uses high pressure to inject the fluid into an artery, where it is then allowed to saturate and inflate the tissues. Although many Anatomical embalmers do not utilise any drainage techniques, the fluid is permitted to remain in the system for several hours before being allowed to drain away.
4) *Gravity-feed Embalming:* This technique involves raising the container containing the embalming fluid above the level of the body and gently adding fluid over an extended period of time. The fluid is not being drained. Gradually, the resulting distension disappears, leaving a somewhat typical appearance. The internal organs are not treated separately for cavities.
5) *Practical Light Embalming:* In the surgical fresh tissue dissection laboratory, this method is employed. Lightly embalmed bodies can be stored in a chiller for up to 6 weeks with minimal deterioration in tissue quality, colour, or odour.
6) *Thiel Embalming Technique:* When compared to conventional formalin-fixed cadavers, Thiel embalmed cadavers "show, a greater degree of flexibility and colour retention," making it a useful technique for microvascular surgical teaching.

D. Plastination

specimen preservation through forced impregnation using curable polymers. An innovative technique for long-term preservation that involves thoroughly impregnating anatomical specimens with reactive polymers like silicone, rubber, epoxy, or polyester resin. It keeps a cadaver realistic and preserves it as well. Patinated specimens are pristine, dry, long-lasting, odourless, and appear realistic. Plastinated human specimens are modern milestone in medical teaching.They are now the perfect teaching aid for anatomy, pathology, obstetrics, radiography, and surgery.

II. DISCUSSION

Various types Of Preservation methods are summarized-

1) *Jal-Nijaamanakoth (Purification)Vidhi:* by Sushruta, Preservation of the corpse through hydration in a river or stream that is flowing, where there is a moderate current and no influence from outside. The corpse needs to be immersed and left to decay for seven days.
2) *Natural Preservation:* Preservation of cadaver by dehydration with hot sand.
3) *Mummification:* In Ayurveda, Sushruta has a wealth of knowledge regarding Sharir Rachana, as evidenced by a number of facts. Sushruta goes into great detail on how to preserve and dissect a cadaver using Ayurveda principles. Since he believed that students aspiring to become surgeons should have a firm awareness of the human body's structure, there is also substantial evidence that the information of human Anatomy was discovered by both observation of the human body's surface and human dissection. Acharya Sushruta explained the procedures for scientific dissection and preservation. Sushruta recommended keeping a dead body with all of its bodily components in order to study the entire body.

The embalming process mentioned by Acharya can be classified according to following three steps:

a) *Purva Karma (Pre-Procedure):* It comprises the selection of body to be preserved. As per *Sushruta,* it is described as:

- all limbs should be intact
- cause of death should not due to poisoning
- illness was not of long duration
- person should not be of elder age

b) *Pradhan Karma:* Main procedure which includes: They use traditional embalming techniques that involve removing the intestine and faeces before placing the body in a sturdy casket and covering it with a mattress made of Kusha or a closely related material. The Iron casing ought to be maintained submerged in a flowing stream with a moderate current and no nearby people to cause disturbance. The corpse needs to be immersed and left to decompose for seven days.
c) Paschata Karma which is the post-procedure: Every part should be removed once it is loose, examined, and scrubbed with a brush made of bamboo bark, kusha, or any similar substance. This process should start with the skin.

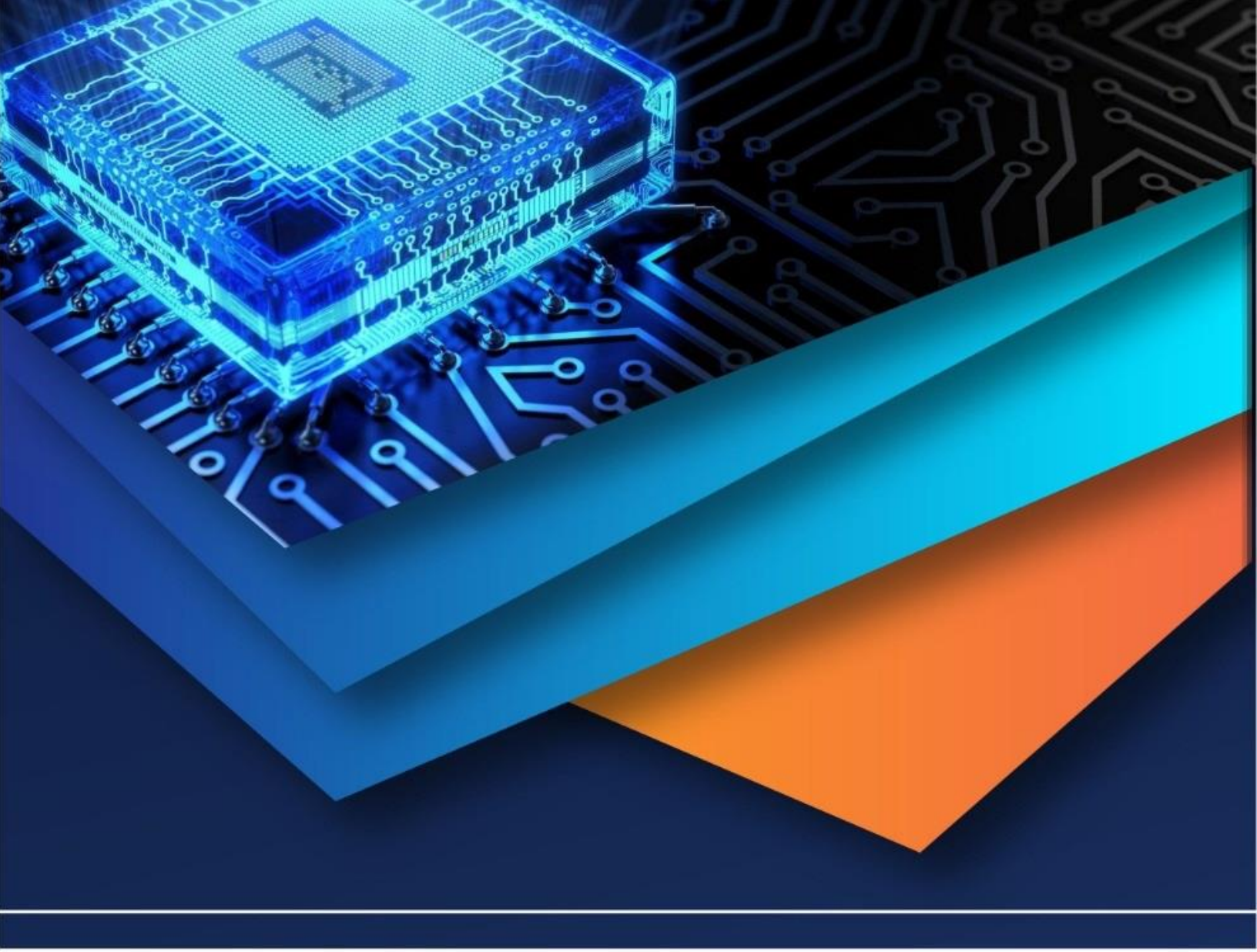
III. CONCLUSION

In the Ayurveda treatise's insight, accuracy and detail of the evidence of body preservation are described in *Sushruta Samhita*. *Sushruta* has described the concept of preservation of cadavers and the method of selection of the dead body. He described in detail the selection criteria for the body that is to be preserved and the detailed method of its preservation.

Egyptians are also known for their embalming techniques but their intention was only how to preserve the body for a very long time 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. Despite the benefits of plastination, embalming still has value in light of medical science's advancements. The ancient method of body preservation correlates with modern techniques so this information may be helpful for our society. According to contemporary science, the objective is to keep the body healthy for as long as possible while also clearly displaying each structure and organ.

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