JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue
JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)
An International Scholarly Open Access, Peer-reviewed, Refereed Journal

EVOLUTION OF DEAD BODY PRESERVATION: FROM ANCIENT AYURVEDIC PRACTICES TO MODERN TECHNIQUES

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ABSTRACT:

Introduction:

Dead body preservation is essential for maintaining cadaveric integrity for anatomical education, medico-legal, cultural, and research purposes. *Ayurveda* describes traditional methods of preserving the dead body, particularly in relation to *Mṛtaśarīra* examination and *Śarīra Vicaya*. These methods reflect an early understanding of environmental factors influencing decomposition. Modern medicine employs systematic preservation through refrigeration, embalming, and chemical fixation.

Materials and Methods:

A conceptual review was conducted using classical *Ayurvedic* literature concerning *Mṛtaśarīra* and *Śarīra Vicaya*, and these descriptions were compared with modern cadaver preservation techniques. Traditional practices involving body selection, wrapping, immersion, and controlled environmental exposure were reviewed alongside refrigeration, embalming, and formalin-based preservation.

Results:

Ayurvedic descriptions indicate that the body was maintained under controlled environmental conditions to allow gradual decomposition and facilitate anatomical examination. Preservation primarily depended on environmental control and appropriate handling rather than chemical preservatives. Modern methods use refrigeration and chemical embalming agents, particularly formaldehyde-based solutions, to inhibit microbial growth, delay autolysis and putrefaction, and preserve tissues for longer periods. Both approaches aim to delay decomposition and facilitate subsequent examination, although their mechanisms and duration differ.

Discussion:

The *Ayurvedic* approach represents an early systematic method of cadaver preservation and anatomical learning. Modern embalming provides more predictable and prolonged preservation through chemical fixation and temperature control. Their comparison demonstrates the evolution from traditional observational practices to scientifically standardized techniques.

Conclusion:

Ayurvedic dead body preservation provides valuable historical insight into the development of anatomical education and preservation practices. Comparative study of classical *Ayurvedic* concepts and modern preservation science may further illuminate the historical evolution of cadaver preservation.

Keywords: *Ayurveda*, *Mṛtaśarīra*, *Śarīra Vicaya*, Dead body preservation, Cadaver preservation, Embalming, Formalin, Anatomy**.**

INTRODUCTION:

Dead body preservation is an essential component of anatomical education, medical research, forensic practice, and surgical training. Preservation of a cadaver aims to delay decomposition and maintain the structural integrity of tissues for systematic examination. The study of human anatomy through dissection provides direct knowledge of the relationships between organs, tissues, vessels, nerves, and other anatomical structures. In this context, the ancient *Ayurvedic* tradition demonstrates a remarkable emphasis on practical anatomical knowledge, particularly through the teachings of *Acharya Sushruta*. [1,2]

Sushruta Samhita, one of the foundational texts of *Ayurveda*, gives considerable importance to direct observation and dissection of the human body. *Acharya Sushruta* stated that a person who desires thorough knowledge of anatomy should prepare a dead body and examine its different parts by direct observation, in addition to studying the descriptions given in the classical texts. [1] In *Sharira Sthana*, *Acharya Sushruta* described a systematic method for preparing a cadaver for anatomical examination. A suitable body was selected, with intact body parts and without death due to poisoning or prolonged disease. The intestinal contents were removed, and the body was wrapped with materials such as *Munja*, *Kusha*, *Shana* and bark, placed inside a protective cage, and immersed in a slowly flowing water body in a secluded place. After approximately seven days, the body was removed and the tissues were gradually examined by gentle scraping with a brush-like instrument. [1,3] This method is often described in modern *Ayurvedic* literature as a hydrobiological approach to cadaver preservation and preparation for dissection. [3]

The underlying objective of this ancient technique was to facilitate gradual decomposition and enable the anatomical structures to be studied layer by layer. Although it differs fundamentally from modern chemical embalming, the method reflects an early practical understanding of environmental factors influencing decomposition. [3,4] The emphasis on direct anatomical observation also demonstrates the importance given to practical learning in ancient surgical education.

In modern medicine, cadaver preservation has evolved considerably with advances in anatomy, microbiology, chemistry, refrigeration, and embalming technology. Embalming involves the introduction of preservative and fixative solutions into the vascular system and body cavities to delay autolysis, inhibit microbial decomposition, reduce tissue deterioration, and maintain the body for educational or other purposes. Formaldehyde-based solutions have historically been among the most widely used preservatives, while alternative techniques such as soft-preservation methods, refrigeration, and plastination have also been developed. [5,6] Modern preservation techniques are selected according to the intended duration of preservation, tissue characteristics required, safety considerations, and educational or research objectives.

A comparative study of *Ayurvedic* and modern approaches therefore provides an important perspective on the historical evolution of cadaver preservation. While *Acharya Sushruta* employed natural environmental processes for anatomical preparation, modern medicine uses scientifically standardized chemical, physical, and technological methods. Understanding both approaches highlights the continuity of anatomical learning while demonstrating the progression from traditional observational techniques to contemporary preservation science.

AIM AND OBJECTIVES:

1. To study the scientific method of preservation of dead body mentioned by *Acharya Sushruta*.
2. To study about the various traditional along with new advance techniques for the preservation.

MATERIALS AND METHODS:

The present study was conducted as a conceptual and comparative review of dead body preservation methods described in *Ayurveda* and modern medical science.

The materials included classical *Ayurvedic* texts, particularly *Sushruta Samhita – Sharira Sthana*, along with relevant contemporary anatomy and cadaver-preservation literature. Modern methods considered included refrigeration, embalming, chemical fixation, and plastination.

REVIEW OF LITERATURE:

Dead Body Preservation in *Ayurveda*:

The concept of preservation of the dead body for anatomical study is described prominently by *Acharya Sushruta* in *Sushruta Samhita*, *Sharira Sthana*, Chapter 5.[7] *Sushruta* emphasized that theoretical knowledge of anatomy should be supplemented by direct examination of the human body through cadaveric dissection. This indicates the importance of practical anatomy in ancient *Ayurvedic* surgical education.

According to *Acharya Sushruta*, a suitable cadaver should possess all body parts, should not have died from poisoning or a prolonged disease, and should not be excessively old. The intestinal contents were first removed. The body was then covered with materials such as *Munja*, *Kusha*, *Shana*/flax and bark, placed inside a cage, and immersed in a slowly flowing water body in a secluded and relatively dark place. It was allowed to undergo decomposition for approximately seven nights.

After the prescribed period, the body was removed and examined by gradually scraping the tissues layer by layer using a brush-like instrument (*Kurcha*) prepared from materials such as *Ushira*, hair, bamboo and coarse grass. This enabled the student to observe the external and internal structures systematically through direct perception.

Acharya Sushruta's preservation technique and highlighted its importance in facilitating cadaveric dissection and anatomical education. More recently, Adhikary et al. described this traditional procedure as a hydrobiological approach (*Jala-nimajjana Paddhati*) and discussed its scientific interpretation and historical significance.

Thus, the *Ayurvedic* method represents a systematic cadaver-preparation technique based on controlled decomposition, rather than modern chemical embalming. It demonstrates the importance given to direct anatomical observation in ancient *Ayurvedic* education and provides an important historical perspective on the development of cadaver preservation and dissection.

Dead Body Preservation in Modern Concept:

Embalbing:

Embalming is the process of treating a dead body with preservative chemicals to delay decomposition and maintain the structural integrity of tissues. In anatomical embalming, preservative fluids are introduced primarily through the vascular system and may also be introduced into body cavities and tissues when necessary.

The fundamental principle of embalming is to reduce autolysis and microbial decomposition while fixing and preserving tissues. Fixatives cross-link proteins, thereby stabilizing cellular and extracellular structures. Preservative components also help reduce microbial proliferation and delay putrefaction. [8,10]

Development of formaldehyde preservation:

The introduction of formaldehyde as a preservative in the late nineteenth century represented a major advancement in cadaver preservation. Formaldehyde became widely used because of its effective tissue-fixing properties and its ability to provide relatively prolonged preservation. [8]

Formaldehyde reacts with proteins and produces cross-linking, which stabilizes tissues and reduces their susceptibility to enzymatic degradation. Formalin-based embalming consequently became a standard method in many anatomy departments.

However, conventional formalin embalming may produce considerable tissue rigidity, changes in colour and texture, and a strong chemical odour. In addition, occupational exposure to formaldehyde is an important health consideration, leading to increased interest in alternative and reduced-formaldehyde embalming methods. [8,10]

Procedure of embalming:

The exact embalming procedure varies between institutions and according to the intended purpose of preservation. Generally, it involves several stages:

Preparation of the body:

Before embalming, the body is examined, identified and prepared according to institutional protocols. The external surfaces are cleaned, and appropriate precautions are taken to reduce exposure to potentially infectious material.

Arterial embalming:

In conventional anatomical embalming, a preservative solution is introduced into a major artery through a cannula. The solution is distributed through the vascular system, replacing or mixing with blood and reaching tissues through the vascular network.

The arterial solution commonly contains a combination of fixatives, preservatives, disinfectants, humectants, buffers and other additives, depending on the formulation. Formaldehyde or formalin has traditionally been an important component. [8]

Cavity treatment:

Body cavities may require additional treatment because arterial perfusion may not adequately preserve all internal organs. Cavity preservation involves removal or treatment of residual fluids and introduction of appropriate preservative solutions.

Surface and local preservation:

Areas inadequately reached by vascular perfusion may require local application or injection of preservative solutions. Proper positioning and storage after embalming contribute to uniform preservation.

Plastination:

Plastination is a modern anatomical preservation technique in which water and lipids present in biological tissues are replaced by curable polymers. The resulting specimens are dry, durable, relatively odourless and resistant to decomposition. The technique was developed by Gunther von Hagens and colleagues and was introduced as a major advancement in long-term anatomical specimen preservation. [9,12]

Von Hagens, Tiedemann and Kriz described plastination as a technique involving fixation, dehydration, forced impregnation under vacuum and hardening. The characteristics of the final specimen depend largely on the polymer used. [12]

Principle of plastination

The basic principle of plastination is the replacement of tissue fluids and lipids with polymers.

In conventional biological tissue, water and lipids contribute significantly to decomposition. During plastination, these components are progressively removed and replaced with a polymer that is subsequently hardened.

The major stages are:

Fixation
Dehydration
Defatting
Forced impregnation
Positioning
Curing or hardening [12,13]

The completed specimen retains much of its original three-dimensional form while becoming substantially more resistant to decomposition.

Fixation in plastination

The first stage is fixation. The specimen is treated with an appropriate fixative to stabilize tissues and prevent decomposition.

Fixation also facilitates subsequent handling during dehydration and preparation. Although formaldehyde may be used during the initial fixation stage, the final plastinated specimen contains polymer rather than the large quantity of preservative fluid associated with conventional wet specimens. [12]

Dehydration

After fixation, water is removed from the tissues. Acetone is commonly used as a dehydration agent.

Dehydration is essential because the water present in tissues must be removed before polymer impregnation. The acetone also helps in subsequent removal of tissue lipids.

Defatting

Following dehydration, remaining lipids are removed to improve polymer penetration and the quality of the final specimen.

Adequate dehydration and defatting are essential because residual water or fat can interfere with polymer impregnation and affect the long-term quality of the plastinated specimen. [12,13]

Forced impregnation

Forced impregnation is considered the central stage of plastination. During this process, the biological tissue is immersed in liquid polymer under controlled vacuum conditions.

As the vacuum is gradually increased, volatile substances such as acetone are removed from the tissue. The polymer progressively enters the spaces previously occupied by the tissue fluid.

This process replaces the volatile components of the specimen with polymer. [12]

Positioning

After polymer impregnation, the specimen is carefully positioned according to its intended educational purpose.

Muscles, nerves, vessels and organs can be arranged to demonstrate important anatomical relationships. The positioning stage is particularly important in whole-body plastination and anatomical teaching specimens.

Curing

The final stage is curing or hardening. The impregnated polymer is converted into a stable solid material using an appropriate curing method.

After curing, the specimen becomes dry, durable and relatively resistant to environmental deterioration. [12]

Types of plastination

a) Silicone plastination

Silicone polymers are commonly used for whole-body specimens, organs and dissected anatomical structures.

Silicone plastination can produce specimens that retain a degree of flexibility and resilience. It is especially useful for demonstrating three-dimensional anatomy.

b) Epoxy plastination

Epoxy resins are particularly useful for producing thin, transparent anatomical sections. These preparations can demonstrate fine anatomical relationships and sectional anatomy.

c) Polyester plastination

Polyester-based polymers are useful for certain brain and central nervous system preparations and for producing relatively firm anatomical specimens. [12,13]

DISCUSSION:

Dead body preservation has been an important component of anatomical education from ancient times to the present. In *Ayurveda*, *Acharya Sushruta* described a systematic method for preparing a cadaver for anatomical examination in *Sharira Sthana*. The body was selected according to specific criteria, prepared and wrapped with natural materials, placed in a protective enclosure, and immersed in slowly flowing water for approximately seven days. After adequate decomposition, the body was examined gradually by scraping the tissues layer by layer. This indicates that *Acharya Sushruta* utilized controlled decomposition as a means of facilitating anatomical dissection, rather than preservation in the modern sense of completely preventing decomposition.

In the modern concept, cadaver preservation primarily aims to delay autolysis and putrefaction and maintain tissue integrity for anatomical education, research, and surgical training. Conventional embalming commonly uses formaldehyde-based fixatives introduced through the vascular system and body cavities. Although effective, formaldehyde may cause tissue rigidity, colour changes, unpleasant odour, and

occupational exposure concerns. Therefore, newer techniques such as low-formaldehyde and soft embalming methods have been developed to improve tissue flexibility and provide more lifelike cadaveric specimens.

Plastination represents another important advancement in modern preservation. It involves fixation, dehydration, defatting, forced impregnation with polymers, positioning, and curing. The resulting specimens are dry, durable, relatively odourless, and suitable for long-term anatomical teaching. However, plastination requires specialized equipment, expertise, and resources and may not reproduce the flexibility of soft-embalmed or fresh tissues.

A comparison of both concepts reveals that *Ayurvedic* cadaver preparation and modern preservation differ considerably in their mechanisms and objectives. Nevertheless, both demonstrate the fundamental importance of direct anatomical observation and preservation/preparation of the body for systematic study. The *Ayurvedic* method represents an early empirical approach to cadaver preparation, whereas modern techniques apply principles of chemistry, microbiology, refrigeration, and polymer science. Studying these approaches together provides valuable insight into the historical evolution of anatomical education and cadaver preservation.

CONCLUSION:

Dead body preservation represents an important link between traditional anatomical knowledge and modern medical science. The *Ayurvedic* method described by *Acharya Sushruta* demonstrates an early systematic approach to cadaver preparation through controlled decomposition and gradual anatomical examination. In contrast, modern methods such as embalming and plastination use chemical fixation and polymer-based preservation to provide prolonged and standardized preservation. Although the principles and techniques differ, both approaches share the common objective of facilitating anatomical study and education. The *Ayurvedic* method holds significant historical and scientific value and provides an important perspective on the evolution of cadaver preservation techniques. Integration of traditional knowledge with modern scientific understanding may encourage further research into safe, effective, and educationally valuable methods of human body preservation.

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