

## The Current Practices of Storage and Maintenance of Cadavers and Dissected Parts in Medical Colleges of Udaipur, India

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### Abstract

**Background:** This study delves into the practical approach taken by the stakeholders for maintenance and storage of cadavers.

**Aims:** This study aims at getting into the depth of the various methods employed by the anatomists of Udaipur, to study the various techniques being used to embalm the dead bodies and to keep the cadavers and dissected parts safe from decomposition and to find out methods of tackling untoward incidences of decomposition, or fungal/ parasitic infestation.

**Settings and Design:** A descriptive, cross-sectional questionnaire-based study

**Methods and Material:** Study was carried on the medical colleges of Udaipur, Rajasthan, India. A detailed questionnaire of fifty-eight items was prepared to investigate about the management of the cadavers and shared via google forms and received answers were then analysed.

**Statistical analysis used:** Microsoft excel was used for statistical analysis.

**Results:** The chemicals used by the participants are formaldehyde, alcohol, glycerine, phenol and thymol. 5 litres of 15% concentration of formaldehyde, 5 litres of alcohol, 2 litres of glycerine (amount may vary), thymol crystals and remaining amount of water is added to make a solution of 15 to 20 litres for one cadaver using the carotid or femoral artery with gravity method. Storage tanks are regularly inspected and dealt with accordingly. The procurement of dead bodies is done strictly as per the Anatomy Act of the state.

**Conclusions:** By and large all the medical colleges of the region of Udaipur, Rajasthan, India employ similar techniques of procuring, embalming, storing, maintaining, utilizing and disposing the cadavers.

**Keywords:** Embalming, Cadaver, Formaldehyde

**Keymessages:** This study gives an insight to the practical approach towards maintenance of cadavers and dissected parts by the stakeholders. It focusses on the actual practices and efforts made in maintaining the cadavers in good condition.

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## Introduction

Embalment is defined as the ‘treatment (of a dead body) – with special chemicals – so as to protect from decay [1]. It has been observed that anatomists have their own indigenous method, apart from the standard ones, for preserving cadavers. This study aims at getting into the depth of these various methods employed by the anatomists of Udaipur, Rajasthan (India) and to find out methods of tackling decomposition, or fungal/ parasitic infestation. Medico-legal considerations involved in authorizing the institute for acquisition of dead bodies has also been enquired. Meagre availability of literature on the daily and routine management of cadavers makes this study invaluable.

## Objectives

1. To study the various techniques currently being used by anatomists of Udaipur for embalming dead bodies.
2. To study the various techniques currently being used by the anatomists of Udaipur for maintaining the cadavers and dissected parts.
3. To study the various methods currently being used in tackling any problem of decomposition, fungal/ parasitic infestation or other situations.
4. To study the medico-legal considerations involved in authorizing the institute for acquisition of dead bodies.

## Materials and Methods

The current study is a questionnaire based descriptive cross-sectional survey study.

After obtaining institutional ethical clearance (Ref: GU/HREC/EC/2020/1812, Date: 23<sup>rd</sup> June 2020), this study was conducted on the five medical colleges of Udaipur, Rajasthan region, in November 2021, to determine the current routines of embalming and maintenance of cadavers. Study size: one

medical college declined to participate; therefore, the study was carried out by cooperation of four medical colleges. A detailed questionnaire of fifty-eight items was prepared to investigate about the management of the cadavers. The questionnaire was shared with only one reliable and responsible senior faculty of the department of Anatomy of each medical college via Google Forms.

The questionnaire consisted of nine sections with the first being of the demographic details of the Medical College and faculty, 2<sup>nd</sup> to 8<sup>th</sup> sections enquired about the embalming process, daily maintenance of cadavers, maintenance of storage tanks, utilization of dissected soft and hard parts, dry preservation of viscera, burial ground, legal formalities and documentation for acquisition of dead bodies. The last section was left for any additional information that may be relevant according to the participants.

The responses received via the Google forms were then analysed both quantitatively as well as qualitatively to arrive at the results. Statistical analysis was done in Microsoft excel.

## Results

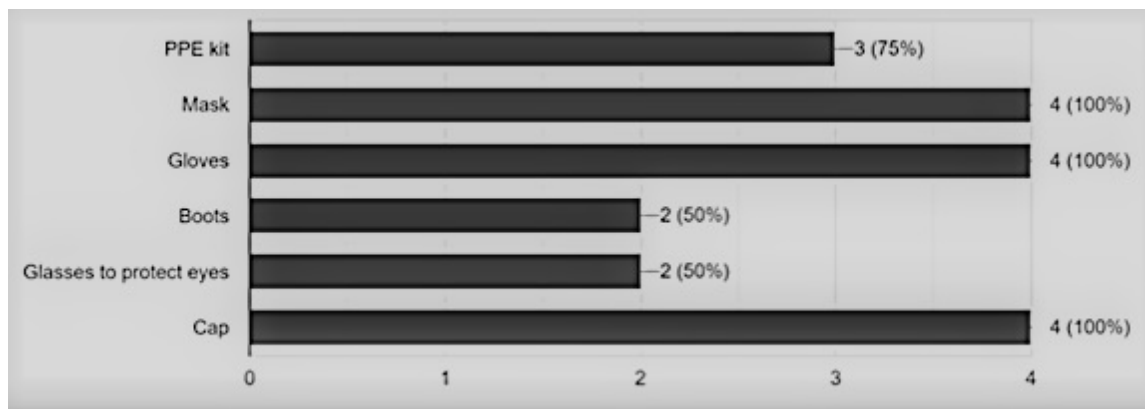
Four out of the five medical colleges of Udaipur complied with the filling up of google form in order to help in investigating the current routine of storing and maintaining the cadaver. These four colleges are from four different universities of Rajasthan and the faculty who responded were either Associate Professor or Professor and Head of Department of Anatomy of the respective colleges.

## Questionnaire for embalming process

The personnel doing embalming of dead bodies are sweeper/ dissection hall attendant, all faculty of Anatomy and resident doctors in

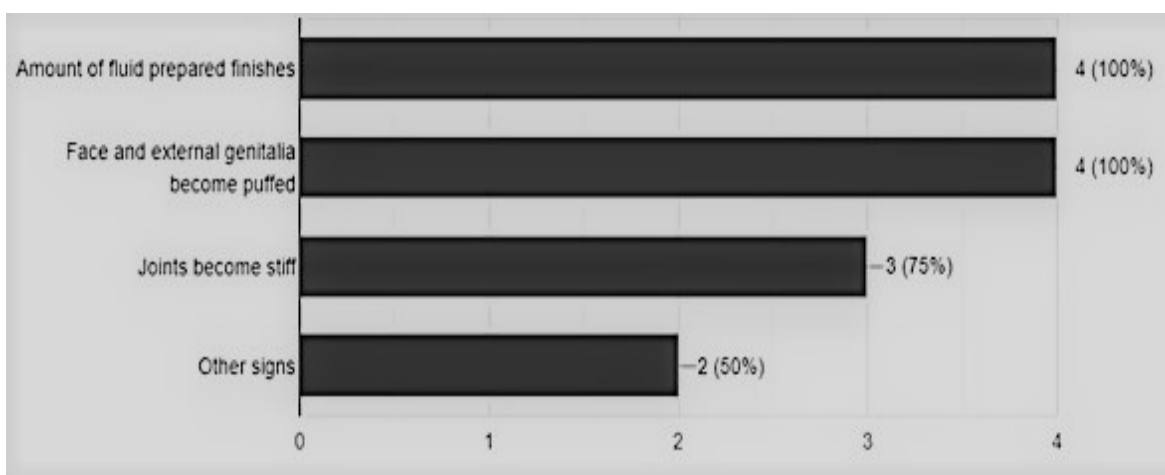
all the four participating colleges, under the supervision of the Head of Department or faculty in charge of embalming process, which is of the designation of either Professor or Associate Professor. Chemicals used by 100% participants are formaldehyde and methanol. Glycerine is used by 75%, Thymol crystals by 75%, and phenol (carbolic acid) by 50% participants. 100% participants use femoral artery for injection of embalming

solution and 75% also use the common carotid artery. Gravity method (by a raised bucket) is utilized for injecting embalming solution by all the participant institutes. 25% participants add 200ml turpentine oil in the embalming solution. Precautions taken by the embalming personnel are mask, gloves, cap, personal protective equipment, boots and eye glasses (Fig. 1).



**Figure 1: Precautions taken by the embalming personnel by the 4 institutes (number of institutes shown in %)**

A total amount of 15-20 L embalming solution is used per dead body by 75% and 20-25 L by 25% participants. Once the superior part of the body (above the level of canula while using femoral artery for injection) is embalmed, 75% participants reverse the direction of canula to inject fluid in the lower part of the extremity being used for embalming while 25% do not do so. The signs for determining the end point of injecting embalming solution are consumption of all the fluid, face and external genitalia become puffed, the joints also become stiff at the end of embalming (Fig. 2).



**Figure 2: Signs for determining end point of injecting embalming solution (number of institutes shown in %)**

Other signs indicative of completion of successful embalming observed by 50% participants are that there is oozing of fluid through the oral and nasal cavities, 50% observe that the abdomen becomes tense and the anterior abdominal wall rises, 25% observe that the superficial veins become prominent and the limb muscles become firm and there is loss of elasticity of the skin. The time taken for the whole process is 3 to 4 hours in 50%, 2 to 4 hours in 25% and 12-16 hours in 25% of participant colleges. Difficulties encountered by 25% are blocked artery and by 50% is lack of manpower. Once the injection of fluid is complete, the cadaver is kept outside the storage tank for about one week in 75% participating colleges and for 1 or 2 days in 25%. If the embalming process fails for any reason, then the body is buried in 50% participant colleges, disposed in human waste or incinerated in 25%. The same formula of preservative solution is used even if the cadaver has to be stored for more than two years.

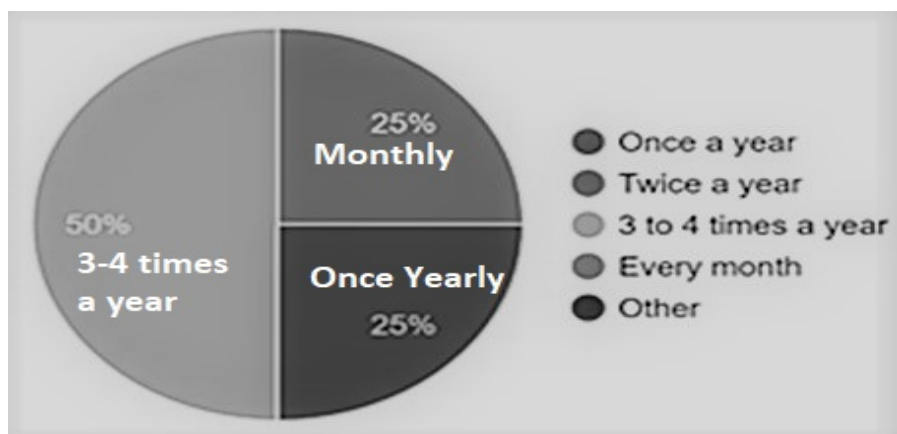
#### Questionnaire for daily maintenance of currently used cadavers

All the participants store currently used/dissected cadavers in separate tank with preservative solution on weekends. The cadavers being dissected on dissecting table are covered by wet sheet soaked in preservative solution by 100% participants at

the end of dissection each day. 25% participants also use wet sheet soaked in plain water or cotton soaked in plain water, if required. 75% also use separate tank with preservative solution to keep away the dissected part / cadaver, depending on the part dissected. This daily maintenance is done by the dissection hall attendant. The waste of dissected cadaver is collected and taken by the biomedical waste department periodically by 100% participants and 25% also bury the waste, if required.

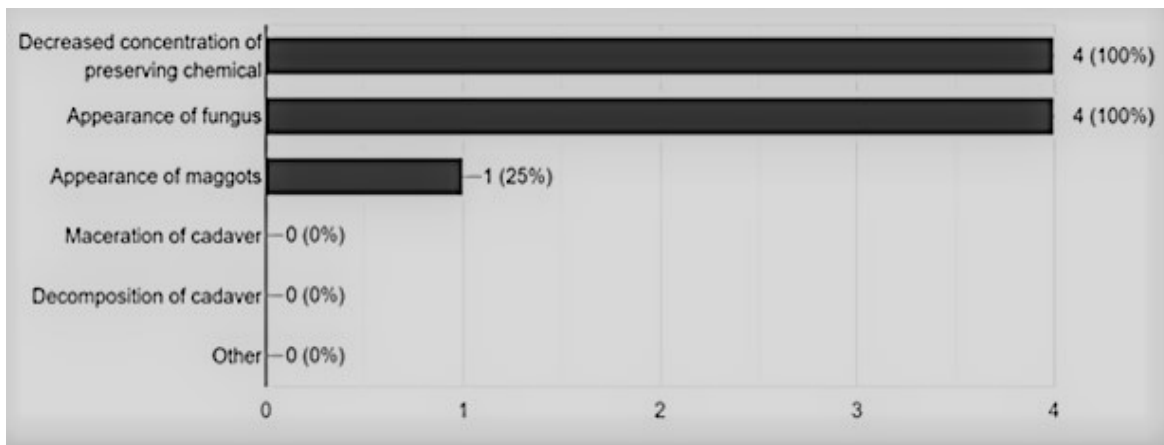
#### Questionnaire on maintenance of storage tanks of cadavers

Frequency of inspection of storage tanks varies from 25% inspecting them weekly to 75% monthly. Inspection is the responsibility of faculty in-charge in 50% participants, head of department in 25% and dissection hall attendant in 25% colleges. The concentration of formaldehyde in tanks is maintained at about 10% by 50% participants, 10-15% by 25% participants and 15% by 25% participants. The concentration of formaldehyde is determined subjectively by smell by 50% participants and by formalin fumes by 25%. 25% determine the concentration by appearance of fungus and condition of cadavers apart from the smell of formalin. Frequency of pouring additional preservative chemical in storage tank in a year varies from monthly to once a year (Fig. 3).



**Figure 3: Frequency of pouring additional preservative chemical in storage tank in a year (number of institutes shown in %)**

Frequency of cleaning storage tanks and changing their preservative solution varies from six monthly (25%) to once a year (50%) and once in two years (25%). The usual complications encountered during routine inspection of tanks are: decrease in the concentration of formalin, appearance of fungus and appearance of maggots on the wooden lid of storage tank (Fig. 4).



**Figure 4: Complications encountered during periodical inspection of storage tanks (number of institutes shown in %)**

Other complication observed by 25% participants is that of hardening of tissues. The situation of decreased concentration of preservative is dealt with by addition of more formaldehyde solution as per subjective requirement and capacity of tank by 100% participants. 50% of the participants deal with fungus by proper cleaning and application of turpentine oil to the affected part. The amount of turpentine mentioned by 25% participants is 200 to 300 ml to a tank of 700 to 800 litre capacity. 25% of those adding turpentine also add formalin to the solution. 50% participants deal with fungus by adding thymol crystals after cleaning away the fungus. Maggots are treated with xylene plus formaldehyde solution by 25% participants and turpentine oil by 25%. The remaining 50% have not reported appearance of maggots. In the event of decomposition of any cadaver in the tank, it is buried by 75% participants. 25% have not reported any decomposition.

#### **Questionnaire on utilization of dissected soft and hard parts**

75% of the participants utilize the dissected soft parts in preparing specimens for museum, 75% use it for teaching and 50% keep them

for practical examinations. 100% participants store the dissected parts in formalin solution, either in tank or separate containers. 25% participants also add turpentine oil in the solution. 75% of the participants harvest bones from the dissected cadaver for the purpose of teaching. 25% of the participants clean away the soft tissue attached to bone and then boil it in Potassium permanganate solution to clean it entirely. 25% of the participants scrape off the soft tissue and then put it in Hydrogen Peroxide for 1 or 2 hours to up to 1 day to make the bone white. 25% clean soft tissue from the bone and then boil it in water and finally varnish it in the end.

#### **Questionnaire regarding dry storage of viscera**

50% of the participants employ methods to store viscera without putting them in any preservative liquid. 25% do plastination by melamine and then dehydrate it in a series of xylene and alcohol solutions. 25% participants also use beeswax after the dehydration process without using melamine prior to it. The organs preserved by these methods are joints, muscles of hand, quadrangular spaces, heart, liver, spleen,

duodenum, ileum and brain. The size of the organ shrinks but the gross features are preserved and there is no requirement of preservative fluid once the process is complete.

### **Questionnaire for burial ground**

75% of the participants have burial ground in their colleges. Dissected waste parts, whole body if decomposed or decomposed parts of cadaver are buried in the burial ground. 25% bury the parts to a depth of 6 to 10 feet, 25% at 4 feet and 25% bury at 5 to 7 feet depth. Bones are harvested from the buried cadaver or parts by 50% of participants. The exhumation for harvesting bones is done at an average of 1 to 2 years after burial. Decomposition of buried parts is sped by addition of 10 to 15 kg of common salt in the burial ground on and around the cadaver. The buried cadavers and soft parts are kept safe from roaming animals by all participants with burial ground by a boundary wall. 50% participants also keep heavy stones on the ground where the cadaver is buried.

### **Questionnaire regarding legalities and documentation for procurement of dead bodies**

100% of the participants receive donated bodies for the purpose of teaching. 75% of the participants receive cadavers from other medical colleges also. All the participants obtained government permission to procure dead bodies for teaching purposes under the Anatomy Act 25% of the participants procure unclaimed dead bodies from an ashram with prior permission of collector and jurist. 25% participants also informed about permission letter from the police and concerned authority. The donated bodies are procured after proper documentation. An undertaking form is taken from the relatives of the dead, death certificate from the hospital, or if the dead has already filled a body donation form prior to death then that document is retrieved. Police verification may be done if required. Receipt

of donated body is handed over to the relatives of the dead.

### **Suggestions from participants**

Suggestions were received for incorporating questionnaire about how softness of the parts can be maintained, how discolouration can be prevented, maintenance of museum specimens and details of how the work is supervised.

### **Discussion**

The topic of current research is of great value to the stakeholders of medical education as cadaver is the first teacher of a medical student. With rigorous government rules and laws regarding procurement and handling of human dead body, it becomes crucial to maintain the available resources in good condition. Details of maintaining cadavers in good condition is a curiosity of almost all the personnel concerned. There is usually a lack of confidence which is difficult to confess. It is almost a sacred topic for an anatomist and there are bound to be hitches and glitches in cadaver procurement and their maintenance so that justice can be done to the great sacrifice made by the donor. Learning from the experience of others can be of immense benefit. This study is not focussing on the ideal situation of what should be but on what is. Therefore, it is more of a practical approach and eliminates the hesitation and encourages the stakeholders in being more open about speaking out their problems on this taboo topic and finding solutions. Thus, eventually, by putting all honest efforts in taking good care of the cadaver, we justify the sacrifice of the dead.

The embalming fluids used by the participants of this study are the standard ones used to make the cadaver infection free, ensure preservation of the body and to prevent putrefaction and contamination with maggots [1]. The chemicals used by the participants are formaldehyde, alcohol, glycerine, phenol and thymol. 5 L of 15% concentration of

formaldehyde, 5 L of alcohol, 2 L of glycerine (amount may vary), thymol crystals and remaining amount of water is added to make a solution of 15 to 20 L for embalming one cadaver. This is injected into the arteries namely- the common carotid artery, axillary, brachial, femoral, ulnar, radial and tibial arteries [2]. The ones used by the participants of this study are the common carotid artery and the femoral artery.

The developing countries like Nigeria use the gravity-fed method of infusing preservative solution in the dead body [3]. Likewise, the participants of the current study also use the gravity-fed method in which the prepared solution is filled in a container (bucket) with a tube connected to its base, the distal end of which is connected to a canula that is connected to the wide bore needle inserted into the artery. The container (usually a bucket) is hung at a height so that the solution enters the arteries by gravity. The range of time taken for completion of embalment by the participants of this study is 2 to 16 hours and the signs observed are swelling of face and external genitalia, stiffening of joints, oozing of fluid from oral and nasal cavities, bloating of abdomen and its wall becoming tense, prominence of superficial veins, discolouration of skin and loss of elasticity of skin. It is to be noted that this embalmed body is kept outside the tank for a time ranging from 2 days to a week by the participants of this study. Then it is kept in the storage tank with preservative solution of the same components and concentration as used for embalming.

The cadavers being dissected are usually left on the dissecting tables on weekdays and covered by wet cloth or cotton soaked in preservative solution or water, as required, to prevent drying and decomposition. Dismembered limbs and removed viscera may be kept in separate containers with preservative solution daily. If the limbs have not been removed then the cadaver is kept in

separate tanks with preservative solution on weekends.

Maintenance of storage tanks is a crucial thing for proper preservation of cadavers, as such regular inspections ranging from weekly to monthly are undertaken to detect any development of fungus, maggots, decomposition of cadaver, malodour and low concentration of preservative solution. If detected then cleaning is undertaken and chemicals like turpentine oil, thymol crystals, extra formaldehyde solution are added on as and when needed basis.

In case a cadaver cannot be salvaged from any of these complications, it is buried to a depth ranging from 4 to 10 feet under the ground and 10 to 15 kg of common salt may be sprinkled on the cadaver to facilitate fast decomposition. It may be exhumed after 1 to 2 years to harvest bones for teaching purposes. These bones are first cleaned and then efforts are made to make it white and shiny by various methods mentioned earlier.

The soft tissues, viscera and limbs are also stored as museum specimens with the same preservative fluid. Some tissues are preserved without the standard preservative fluid after treating them in various ways like plastination by melamine, or by putting through a series of xylene and alcohol (as done for processing the histology slides) and also soaking in beeswax. The size of the organ shrinks but the external features are preserved in such specimens.

The legalities taken into consideration by all the participant authorized teaching institutions are strictly according to the Anatomy Act which instructs who can possess a dead body for the purpose of teaching, who can examine the dead body, how it can be utilized by the authorized persons [4].

#### **Limitations of the current study**

There is hesitation in participating in such a delicate topic and secrecy assurance has to be given to the participants.

## Conclusion

By and large all the medical colleges of the region of Udaipur, Rajasthan, India employ similar techniques of procuring, embalming, storing, maintaining, utilizing and disposing the cadavers. The sacrifice of the dead is valued and all efforts are made to make maximum and best use of the cadavers.

## Acknowledgement

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