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ORIGINAL ARTICLE

A New Embalming Fluid for Preserving Cadavers

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Abstract:

Background: Dissection laboratory is the only place where the three dimensional structure of the human body is reinforced by visual, auditory and tactile pathways. Cadavers are main teaching tools in Anatomy and are handled by the staff and students routinely. Very often the cadavers enbalmed by various chemicals are not effective in inhibiting growth of fungi, bacteria, maggots etc. To date limited studies have been carried out to overcome this problem hence this study was undertaken to find out safe and effective enbalming fluid. *Aims and Objectives:* The main object of the present study is to provide a composition of body-preservation fluid which is effective in preventing decomposition of cadavers, maintaining a desired life-like appearance of the body which is non hazardous for dissection and environmentally safe. It was observed that chemical composition of the embalming fluid was very effective in prevention of growth of bacteria, fungus and also decay and discoloration. *Results:* This study was carried out in the department of Anatomy, Goa Medical College Bambolim Goa (India) from the year 2006 to 2011. Total 100 cadavers were embalmed with the following composition of the embalming fluid. It was observed that the solution in tanks where intact bodies were preserved was clear without any fungus form a period of 5 years whereas the dissected cadavers were kept separately also containing 10 percent formalin showed minimal growth of fungus after 12 months and the solution was replaced after 12 months. *Conclusions:* In our present study the tank containing undissected cadavers has not shown any growth of fungus for a period of 5 years. Routine dissected parts showed fungal growth only after 12 months, whereupon the scum was removed and the tank solution replaced. The arterial fluid was red in colour and could be differentiated from cavity fluid. The cadavers were free from growth of fungus and maggots during their entire first MBBS course. Not only is this the most cost effective method of body preservation, it also has the added advantage of being environmentally safe for the staff and students, who would otherwise be exposed to harmful bacteria and fungi on a regular basis during routine dissection.

Key words: embalming; formalin; dissection; embalming fluids

Introduction:

Embalming the word for the old English phrase to apply balm is derived from Latin with emencapsulate and balming or balsam - any aromatic resins produced by certain trees of the mint family, in most modern cultures, is the art and science of temporarily preserving human remains to forestall decomposition and make it suitable for display. Cadavers remain a principal teaching tool for anatomists and medical educators teaching gross anatomy.

Dissection of cadavers has provided us a strong edifice so that we can express our surgical talents for independent learning and thinking, perform psychomotor skills and exchange our views. Dissection can thus play many roles in the educational process. For funeral embalming it is very essential to introduce some colouring agents so as to enliven the dull state of death, whereas for the anatomical dissection it is important to restore or enhance a normal ante mortem appearance of the body.

In India there are nearly 300 medical colleges in different states which show variations in their climatic conditions. The cadavers which are embalmed with various chemicals of different composition for preservation of human cadavers, for teaching and research purposes, are hazardous to health, due to growth of fungi, bacteria, maggots etc. To date only limited studies have been carried out to overcome these problems. An all India survey was conducted for the methods adopted in injection, precise quantity of the preservatives used, colouring agents and preservation of embalmed cadavers in the tanks for the dissection purpose [1]. Earlier studies have revealed that by using carbolic acid there was mild to moderate growth of fungus, whereas the use of 20gms of CuSo4 showed no growth of fungus after 4 months [2].

Studies have also revealed that copper sulphate prevents the growth of algae and fungi and also acts as an insecticide [3] Its presence in the tank solution minimizes the growth of fungus and if Surf is added in the tanks no growth of fungus is seen even after 16 weeks [4]. However the use of Surf did not act as a deterrent to fungal growth as the same was tried earlier. A possible reason could be the increased humidity and hot climatic conditions.

The main aim of our study has been to decrease the growth of fungus in a manner which is cost effective, safe and reduces the day to day care of the cadavers.

Material and Methods:

This study was carried out in the department of Anatomy, Goa Medical College Bambolim Goa (India) from the year 2006 to 2011. Total 100 cadavers were embalmed with the following composition of the embalming fluid.

Embalming Fluid Composition	
Formalin	4 litres
Water	4 litres
Methyl alcohol	1 litre
Glycerin	500 ml
Cetrimide	500 ml
Eosin	25 ml
Eucalyptus oil	25 ml

These embalmed cadavers were then stored in tanks having capacity of 500 litres containing 10 percent formalin diluted in water. All the tanks were fully covered with Sintex lids.

Method of injection: All the cadavers were embalmed with arterial embalming by gravitation method which is simplest, safest with gravity bottle placed at 3-4 feet above the height of embalming table which provides a pressure of 0.6kg/sq.cm. The maximum local temperature ranged between 19 and 36 degrees Centigrade and the humidity between 30 and 100%.

Observations & Results:

Five body preservation tanks of 500 litres each having capacity to store 10 cadavers was used for this study. It was observed that the solution

in tanks where intact bodies were preserved was clear without any fungus for a period of 5 years. Students were allocated 10 cadavers for their routine dissection twice a week wherein these cadavers were removed in the morning and were returned to the body preservation tanks in the evening after dissection. The dissected cadavers were kept separately in tanks number 3, 4 & 5. However those tanks in which dissected parts were kept showed minimal growth of fungus after 12 months and the solution was replaced after 12 months as shown in Table No.1.

Table No. 1: Body preservation tanks filled with 10 percent formalin

Tank No.	Cadavers	Capacity of tank in liters	Number of cadavers	Growth of fungus
1	Undissected	500	10	5 years
2	Undissected	500	10	5 years
3	Dissected	500	10	1 year
4	Dissected	500	10	1 year
5	Dissected	500	10	1 year

Discussion:

Anatomy is where students learn the basic language of medicine. Dissection is among the most profound experiences of medical school. Even though most clinicians fail to recall most anatomic details, nearly all remember their first dissection. However, it is in the dissection lab where mentors can model attentiveness to student's needs while accomplishing the instructional objectives in the allotted time. [5], [6]. The routine performance of the dissection provides students with training in spatial appreciation and orientation and also skills in handling the instruments [7-9]. Most of these are directly related to surgery but the acquired skill in eye hand coordination and manual dexterity is relevant in a variety of clinical settings. Hence giving the cadavers an *ante mortem* appearance not only generates interest for dissection but also helps to identify the structures, its course, relation and variations which are encountered during the dissection. There is distinct difference between anatomical and funeral embalming. The end result in anatomical embalming is sterilization and suitability for dissection but neglecting the cosmetic effects, dehydration, discolouration and distortion of the exposed parts. In funeral embalming besides sanitation, cosmetic effect plays an important role for viewing in casket or bed till the funeral. Formalin, a commercial source of formaldehyde, was accidentally discovered by a Russian chemist Aleksandra Butlerov (1828-1866) however August Wilhelm von Hoffman (1818-1892) a British Chemist discovered it in 1856. It is highly toxic to the living being but a miracle drug for the dead, hardening tissues and killing off bacteria, mites, maggots, fungus and the like. Formalin contains 37 percent by weight or 40 percent by volume of formaldehyde gas in water. Commercial solution of formalin becomes acidic on storage through production of formic acid. Formalin converts hemoglobin into purple or black substance called methaemoglobin wherein ferrous iron is oxidized into ferric oxide; hence the embalmed body turns dark or black some days after embalming. It also kills the bacteria themselves and it destroys the colloidal nature of molecules and establishes many chemical cross linkages converting proteins into

inert cross linked lattice. These can no longer serve as food for bacteria as a substrate for enzyme reactions.

It is a biocide, germicide, disinfectant and also effective against fungi and many viruses [10]. It preserves tissues by forming a new chemical compound with the tissue proteins which is insoluble and unfit as food for organisms. Hence adding colouring agent is very useful for the students to identify the structures for better appreciation and knowledge of the subject.

Cetrimide: It consists of Tri methyl tetra decyl ammonium bromide.

It is white free flowing powder, soluble in water and alcohol. It is bactericidal against gram positive as well as gram negative organisms. It has variable antifungal activity and effective against some viruses.

Glycerin: To facilitate the distribution of embalming fluid through vascular bed, for optimum penetration into tissues, is used to reduce the surface tension. It is a clear, colorless, syrupy liquid, miscible with water and alcohol, absorbs and retains moisture and holds the formaldehyde gas.

Eosin: It is used to enhance the cosmetic effect of the deceased. It should impart colour which closely simulates the natural living conditions.

Eucalyptus (perfuming agent): Imparts aroma to mask the odors. Disadvantages with cadavers are that there is alteration with their colour, texture and smell and cadavers cannot be palpated, auscultated or cannot be made to change the position. Hence our desired goal is to produce life like appearance and minimize the offensive smell by adding aromatic compounds like eucalyptus.

It is well known that infectious pathogens in cadavers present particular risks like transmission of Mycobacterium Tuberculosis, Hepatitis B & C, AIDS virus/HIV, Prions-Spongiform encephalopathies such as Creutzfeldt – Jacob disease (CJD), Gerstmann-Straussler-Schinker syndrome (GSS). It is often claimed that fixatives are effective in inactivation of these agents. Unfortunately cadavers, even though they are fixed, may still pose infection hazards to those who handle them. Safety precautions are necessary to avoid accidental disease transmission from cadavers before and during dissection.

Fabric softeners have been used to rehydrate soft tissues of Egyptian mummies [11].

Prior to our study the cadavers were stored in 10 percent formalin and were embalmed with the following embalming fluid containing a mixture of formalin 2 litres, water 3 litres, glycerin 500ml and thymol crystals 5gms. It was observed that there was profuse growth of fungus every 2 weeks which was removed manually and the tank fluid was replaced every 3 months. The fungus was cultured in Sabaraud's Dextrose Agar and the organisms found were aspergillus fumigalis and flavus which cause bronchopulmonary aspergilloma, bronchial asthma and otomycosis, penicillium which causes otomycosis and mucor which cause nasal polyp and catarrh. This problem provided us insight so as to have an alternative chemical composition of embalming fluid for better preservation of cadavers. In our present study it has been observed that the tank number 1 & 2 containing undissected cadavers have not shown any growth of fungus for a period of 5 years as shown in Table No.1. Routine dissected parts

kept in tank number 3, 4 and 5 showed fungal growth only after 12 months as shown in Table No.1, whereupon the scum was removed and the tank solution replaced. 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. The cadavers were free from growth of fungus and maggots during their entire first MBBS course. Not only is this the most cost effective method of body preservation, it also has the added advantage of being environmentally safe for the staff and students, who would otherwise be exposed to harmful bacteria and fungi on a regular basis during routine dissection.

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