Scholars Journal of Applied Medical Sciences (SJAMS) **ISSN 2320-6691 (Online)**
Sch. J. App. Med. Sci., 2015; 3(5A):1867-1870 **ISSN 2347-954X (Print)**

(An International Publisher for Academic and Scientific Resources)
www.saspublishers.com DOI: 10.36347/sjams.2015.v03i05.013

Research Article

How to provide a safe working condition for medical students and professionals in the anatomy dissection room

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Abstract: Teaching and research in anatomy is mainly based on chemical fixed embalmed cadaver dissection and museum specimens. Formalin bases embalming solution is widely used in preserving dead bodies and making museum specimens. Phenoxyethanol may be an alternative to it. Formalin has an odor that many students and faculty members find unpleasant .Chemical hypersensitivity has been attributed to exposure to formaldehyde or other volatile compounds. Medical students develops many troublesome symptoms like nausea, headache, gastrointestinal disturbance during cadaver dissection or complain of disorders due to irritation of the mucous membrane of the eye and nose. The aim of our article is to describe the different preventive measures used and suggest safety guidelines for the protection of all who deals with the chemical fixed cadaver.
Keywords: Anatomy, Cadaver dissection, Embalming solutions, Medical students, Preventive measures.

INTRODUCTION

Cadaver and museum specimens are an excellent medium for 1st year medical students to learn regional and topographic anatomy structure including vessels, nerves and muscles of human body [fig 1]. Requirements for a successful embalming of cadavers include a long-term structural preservation with minimal shrinkage and distortion [1] and prevention of over-hardening . Formaldehyde is most commonly used chemical for embalming purpose . Regular embalmed cadavers prepared using conventional methods, exposes medical students, embalmers, and faculty members having contact with cadaveric materials to formaldehyde fumes that are proven to have diverse toxic effects [2]. It is now recognized that formaldehyde fumes exposure leads to many unwanted health hazards, including irritation, immunologically mediated sensitization, and carcinogenicity [3]. Formaldehyde can also cause nasal squamous cell carcinoma in experimental rats and has been recognized as an irritant for the mucous membranes of the respiratory tract and eyes [4]. In addition, many of the international Environmental Protection Agencies have listed formaldehyde as a possible human carcinogenic agent [5].

The increased formaldehyde fumes in the dissection room and embalming room are due to poor working practices leading to spillage of fluid during embalming , poor condition of the cadaver causing embalming fluid to leak out of the cadaver , using high concentrations of formaldehyde in the embalming fluid and poor ventilation of dissection rooms.

The progress in achieving proper embalming formulas, researchers have introduced different embalming formulas containing a variety of chemicals to ensure preservation of human corpuses and avoid any unwanted harmful hazardous effects [6]. Therefore, prudent practices should seek to minimize more formaldehyde fume exposure and thereafter reducing its unwanted harmful effects and others chemical used within embalming formula's which could be accomplished by using proper and balanced chemicals. There is risk of acquiring infection to person who handle the cadaver during dissection or embalming procedure . Disinfection is considered the prime issue when personal and the environment safety is to be concerned . This article aimed to describe the different preventive measures used and suggest safety guidelines to reduce the toxic effects caused by exposure to emitted chemical fumes, and, in particular, to overcome the various hazardous effects due to exposure to formaldehyde and maintain good preservation of cadavers.

Fig-1 Shows: Medical students indulge in study with embalmed cadaver and museum specimens in the anatomy dissection room

DISCUSSION

Embalmed cadavers remain a principal teaching tool for anatomy but may possess certain physical reactions and infection risks to people who handle them during dissection and embalming procedure [7]. Safe working conditions for handling cadavers can be provided through proper instructions and education to all medical students before they enter into the dissection room . Embalming is a means of artificially preserving the dead human body by injecting an embalming solution in to the body which prevents the process of decomposition of the tissues. The embalming fluid used in anatomy department contains fixatives , disinfectants , surfactants , buffers , glycerol , salts and water . The most frequently used fixatives and disinfectants are formalin , ethanol and phenol [8] . Formalin , the most commonly used chemical for embalming purpose, is 37-50% aqueous solution of dissolved formaldehyde . It is widely used in medical colleges and hospitals , as preservative , disinfectant , embalming solution and in different field like wood and plastic industries . Although formalin is extensively used in different fields , its toxicity is frequently ignored [9].The medical students , anatomists and technicians during dissection and in laboratories are continually exposed to formalin .

The toxicity of formalin is mainly due to the formaldehyde present in the formalin , which has a toxic effect on various body tissues and can adversely affect the health of exposed person. The level of exposure to the agent depends on the duration of time spent in the gross anatomy laboratories . Formaldehyde being water soluble gets dissolved in the mucosa . It than cause degenerative , inflammatory and hyperplastic changes in the mucosa of the target organ . The common symptoms from acute exposure to formalin manifest as irritation of the throat , nose , eyes and skin . It can also cause irritation of upper respiratory tract which can potentially exacerbate asthma symptoms and other respiratory illnesses . While chronic exposure of formalin can cause bronchitis and pneumonia . It has also been found that when formalin is swallowed , it can results in sudden death. So proper precautions should be taken to prevent formalin toxicity . The toxic effects of the formalin can be reduced by using hand gloves , filter mask to prevent direct skin contact while doing cadaver dissection . Irritation and watering of the eyes are prevented by washing of eyes with running water and by using the spectacles [10]. Face visors should be worn for protection against hazardous splashes to eyes , nose and mouth .

Fig-2: Shows Protective and Preventive measures for medical students and professionals in the Anatomy dissection room

Considering this issue World Health Organization (WHO) has developed a guidelines for formaldehyde in non-occupational settings at 100 ppb ($0.1mg/m^3$) for 30 minutes. This guideline was developed to protect against sensory irritation in the general population, but WHO states that it also represents an exposure level at which there is negligible risk of upper respiratory tract cancer in humans [11]. In addition to this some simple measures such as increasing airflow in the affected area by opening windows and doors, by using special local exhaust ventilators in dissection hall is required . By using Proper protective clothing such as long aprons and exposing only that part of the body that is being dissected and periodical removal of fluid dripping collected in the body tray will help in minimizing the toxic effect of formalin . Biological effects associated with using formalin will certainly discourage most of the students from coming to dissection room and in some cases complete withdraw from the dissection [12]. Proper counseling the students hence becomes eminent in inculcating interest in students and inciting in them an initiative to undertake dissection in a more explorable and worth-full manner.

It is well known that chemicals used in embalming play an important role in keeping the cadaver free from decomposition and ensuring maximum preservation that would be accomplished by minimizing the health and environmental hazards [13]. Executed properly , the process of cadaveric preservation using common embalming agents such as formalin, ethanol and phenols is believed to eliminate the presence and growth of bacterial microorganisms . Although some uncertainty exists regarding the post embalming infectious potential of M. tuberculosis bacteria , hepatitis viruses , human immunodeficiency virus (HIV) , and prion diseases [14] . Proper training is required for embalmers and the employees who handle the cadavers. Potential bacterial transmission via properly prepared cadaveric tissue is highly unlikely. Some bacteria may gain resistance and become a danger to students and cadaver handlers . The cadaver might be still infectious at the time of arrival in an anatomy department for subsequent educational purposes. Every cadaver should be regarded as an infectious material therefore, specific safety precautions are mandatory from the moment of the cadaver's arrival at the facility. Single-use latex examination gloves must be worn whenever handling bodies; they should be used once only and then discarded. Safety gloves (e.g. Teflon-made from spectra, or metallic gloves) should be worn over examination gloves to protect from longer term exposure to chemical hazards and accidental penetrating wounds (fig 2). All workers and students should be vaccinated routinely against tetanus, hepatitis B and M. tuberculosis [15].

In embalming process, disinfection is being the most important step that would ensure safety of personnel handling the remains. This step is considered the prime issue when personal and the environment safety is to be concerned. The environment should be cleaned with a phenolic disinfectant daily, and instruments washed in a washer- disinfector, autoclaved, or immersed in a phenolic disinfectant for 20 minutes. After the dissection is completed, tissue remnants, cutting debris, the sheet covering the table, and all the disposable material should be discarded within a plastic container as infectious hospital waste. Contamination of the dissection table should be avoided by a non permeable, disposable plastic sheet or gowns [15] .The role of hand washing in limiting disease transmission in the healthcare setting , as well as in the community , is well understood [16] . In essence, hands should be washed routinely after each procedure and before eating because clean hands save lives (fig 2).

In recent years there has been an increasing awareness of the potential health hazards of exposure to formaldehyde ingredients in correspondence to the work place. The introduction of new standards restricting levels of formalin has resulted in the need to try and find practical solutions to fulfill with health and safety regulations or of gross anatomy laboratories. Classical embalming mixtures , used for decades are now impractical . The search for newer low formalin solutions or those with formaldehyde substitutes has become an urgent issue .Low- formalin embalming technique has been developed in several laboratories due to the health and safety problem as side effect of using high percentage (37%) of formalin to embalm cadaver [17]. More diluted embalming solution in low-formalin technique comprises of 7.5-10% formalin as the active fixative , glycerin , methanol and water. By use of this technique , better quality of cadaver with intact luminal structures conjoined with good consistency of structure were achieved whilst the adverse effect of formalin to the staff , technicians and students [18]. The carcinogenic effect of formalin and phenol used in the embalming solution can be decreased by using the low formalin technique [14,19] . The plastination technique is an another good technique for producing a representive cadaver. The plastination technique was developed by Von Hagen in the 1979 [20]. It preserve the whole body (and organ) by using a curable polymer, which will replace the water and fat from the body tissue whilst becoming hardened [21]. However in developing countries, due to the humidity tropical weather also the availability of expensive equipments to preserve the cadaver, this technique is difficult to do in a routine condition.

At lost but not the least, First-aid box should be kept ready and the place should be well equipped for handling if any untoward incidence happens.

CONCLUSION

Regardless of its toxic effects, formalin remains a popular choice of tissue fixative because of

its effectiveness, low cost and consistent results . The students as well as person involved in process of embalming should be taught regarding hazardous effects and methods to minimize. We recommend need of the above mentioned preventive measures and precautionary guidelines to be taken so as to decrease chemical health hazards.

ACKNOWLEDGMENT

We would like to acknowledge all the medical students and technical staff in our department for their advice and assistance.

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