

PHYSICAL REACTIONS OF FORMALIN USED AS CADAVER PRESERVATIVE ON FIRST YEAR MEDICAL STUDENTS

Girish V. Patil¹, Shishirkumar², Thejeshwari³, Apoorva D⁴, Javed Sharif⁵, C. Sheshgiri⁶, Sushant N. K⁷

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ABSTRACT: Formalin is used as a preservative for human cadaver. The present study was conducted in 300 1st MBBS students to find out and quantify the toxic effects of formalin. Formalin, which has been a well-established preservative for cadavers in the anatomy laboratory for years, has an odor that many anatomy students find unpleasant. In our study 82% (246) students have reported irritation and watering of eyes and also felt that it was first to be developed and the most troublesome symptom. Others reported symptoms includes tingling sensation in nose (22%-66), irritation of throat (41%-123), cough (14%-42), headache (8%-24), skin problems (15%-45) and other like giddiness, lack of concentration (10% - 30), Difficulty in breathing (2%-6). Cadaver preservative (Formalin) used for decades is causing numerous biological effects, to minimize these effects there is a need of newer low formaldehyde cadaver preservative is needed.

KEYWORDS: Formalin toxicity, MBBS students, Cadaver preservatives.

INTRODUCTION: Formalin is 37-50% aqueous solution of dissolved formaldehyde. In 1867, the German chemist August Wilhelm von Hofmann identified formaldehyde, which is a colorless, flammable gas that is quite soluble in water. Formaldehyde is colorless at room temperature and has an irritating, pungent smell. It is commercially obtainable as formalin. It is widely used in medical colleges and hospitals, as preservative, disinfectant, embalming solution and in different fields like wood and plastic industries. Although formalin is extensively used in different fields, its toxicity is frequently ignored (China SE in 1992).⁽¹⁾

A cadaver is embalmed via the infusion of chemical substances that include formalin (which contains formaldehyde), alcohol, glycerin, carbolic acid, and dye. Those substances have specific roles (e.g., preservation, denaturation, solidification of tissue protein, disinfection and maintenance of the integrity of the anatomic relation), and they are usually infused via the femoral arteries or the internal carotid arteries (Coleman and Kogan, 1998).⁽²⁾ Thus anatomists, technicians in biological science laboratories, and anatomy students during their dissection course are continually exposed to formaldehyde. The level of exposure to that agent depends on the duration of time spent in the gross anatomy laboratory.

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

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swallowed, it can result in sudden death. Some researcher also believes that formaldehyde is a human carcinogen.

MATERIALS AND METHODS: The study was carried out according to the guidelines of ethical and screening committee, set down by the National Institute of Health (NIH) for use of human in scientific experiments. The study employed a descriptive method using self administered semi structured questionnaire in obtaining vital information from informed participants from 1st year medical students from both DM- wayanad Institute of Medical Sciences, Meppadi, Wayanad- Kerala and Srinivas institute of Medical Sciences and Research Centre, Mangalore- Karnataka. Written informed consent was taken from all of them.

A total of 300 hundred students were selected to participate in the study. The questionnaires were divided into parts: duration of contact, type of cadaver preservative, type of physical reaction individual suffered and their possible suggestions and solutions.

The students which are included in the study must have direct contact with the cadavers; formalin must be used as cadaver preservative. Some students are excluded from the studies that are having pre-existing medical conditions such as Asthma, Acute rhinitis and dermatitis. All the students returned their answered questionnaires.

RESULTS:

Sl. No	Symptoms	Number of students affected	Percentage
1	Watering of eyes	246	82
2	Irritation of throat	123	41
3	Tingling sensation in nose	66	22
4	Skin problems	45	15
5	Cough	42	14
6	Lack of concentration	30	10
7	Headache	24	8
8	Difficulty in breathing	6	2

Table 1: Table showing different toxic effects of formalin with number of students affected and their percentage

82% (246) students have reported irritation and watering of eyes. This toxic effect (irritation and watering of eyes) is first to be appear and most commonly seen in the study group, it also sometimes prevents the students to come nearer to the dissecting cadaver. Others reported symptoms includes irritation of throat (41%-123), tingling sensation in nose (22%-66), skin problems (15%-45), cough (14%-42), giddiness and lack of concentration (10%-30), headache (8%-24), difficulty in breathing (2%-6). Students when they go out of the dissection hall their symptoms will reduce immediately. During dissection procedure sometimes if by mistake formalin falls in to the eyes of the students, students were told to wash their eyes by tap water; if the symptoms are not reduced they are referred to the ophthalmology department for the

treatment. But otherwise very few 12% (36) students are subjected for medical treatment for the toxic effects of formalin.

The toxic effects of the formalin can be reduced by using hand gloves, mask while doing dissection of cadavers but there was not so much reduction in the symptom irritation and watering of the eyes by using the spectacles (Raja DS, Sultana B in 2012).⁽³⁾ We do not recommend use of gloves as Environmental Health Criteria 89 of International Program of Chemical Safety states, "It must be regarded that formaldehyde fluid is not absorbed directly into tissues through the skin". So the students may be allowed in some cases to touch the cadaver, treated by formaldehyde fixative, by bare hands to understand the feel of certain organs and tissues.

DISCUSSION: The toxicity of formalin is mainly due to the formaldehyde present in the formalin. Formaldehyde being water soluble gets dissolved in the mucosa. It then causes degenerative, inflammatory and hyper plastic changes in the mucosa of the target organ. The absorbed formaldehyde is then converted to formate by the enzymes present in erythrocytes. Formate can cause cross linking of nucleic acids and amino acids causing cell death. Finally formate is oxidized to carbon dioxide and is excreted via exhalation.

Sometimes binding of formaldehyde to endogenous proteins may result in formation of neoantigens. Such neoantigens may elicit an immune response that might account for the occurrence of asthma and other respiratory symptoms. Thus formaldehyde present in formalin definitely has a toxic effect on various body tissues which can adversely affect the health of MBBS students. So, proper precautions should be taken to prevent formalin toxicity. Considering this issue World Health Organization (WHO) has developed a guideline for formaldehyde in non-occupational settings at 100 ppb (0.1 mg/m³) 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 (Neeraj R, Rastogi SK in 2007).⁽⁴⁾

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, by minimizing direct skin contact with formalin by using protective equipments such as rubber gloves, mask and aprons, exposing only the part of the body that is being dissected and periodical removal of fluid dripping collected in the body trays will help in minimizing the toxic effect of formalin.

It has also been proved that arterial injection is the lowest exposure procedure in the embalming operation and has the least impact on total overall exposure values, so these should be practiced during embalming. Some researcher also believes that ethanol glycerin fixation with thymol conservation can be a potential alternative to formaldehyde and phenol embalming (Hammer N, Loffler S in 2012).⁽⁵⁾

Study conducted by Farah et al in 2009 have revealed that 88 percent subjects suffer from irritation of eye, 74 percent suffers from irritation of nose, while irritation of throat and airways and 29 and 21 percent respectively in expose group.⁽⁶⁾ They also concluded that this toxic effect of formalin can cause exacerbation of asthma and other respiratory illnesses.

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While Anderson and Molhave in 1983 concluded that, increase formaldehyde concentration causes dose related symptoms like dryness in the nose, throat and conjunctiva.⁽⁷⁾

Biological effects associated with using formaldehyde will certainly discourage most of the students from coming to dissecting room and in some cases complete withdraw from the programs (Tschernig T et al in 2000).⁽⁸⁾ Classical embalming mixture used for decades is now impractical. The search for low formaldehyde substitute has become an urgent issue. The new techniques for cadaver preservation such as plastination are not known to the mortuary technicians because of their low academic qualification and also for not attending conferences.

CONCLUSION: Regardless of its toxic effects, formaldehyde remains a popular choice of tissue fixative because of its effectiveness, low cost, and consistent results. We recommend need of the precautionary measures (mentioned above) to be taken so as to decrease exposure and preferable to decrease hours spent learning or working in the gross anatomy laboratory and also need of multiple longitudinal studies. In fact during the short stay in first professional itself students are smart enough to realize the value of dissection and adapt accordingly.

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Questionnaire to assess physical reactions to formalin			
Sl No	Type of physical reaction	Yes	No
1	Irritation and watering of eyes		
2	Tingling sensation in nose		
3	Irritation of throat		
4	Cough		
5	Headache		
6	Skin problems		
7	Giddiness and Lack of concentration		
8	Difficulty in breathing		

AUTHORS:

1. Girish V. Patil
2. Shishirkumar
3. Thejeshwari
4. Apoorva D.
5. Javed Sharif
6. C. Sheshgiri
7. Sushant N. K.

PARTICULARS OF CONTRIBUTORS:

1. Associate Professor, Department of Anatomy, D.M- Wayanad Institute of Medical Sciences, Meppadi, Kerala, India.
2. Assistant Professor, Department of Anatomy, D.M- Wayanad Institute of Medical Sciences, Meppadi, Kerala, India.
3. Assistant Professor, Department of Anatomy, D.M- Wayanad Institute of Medical Sciences, Meppadi, Kerala, India.
4. Assistant Professor, Department of Anatomy, D.M- Wayanad Institute of Medical Sciences, Meppadi, Kerala, India.

5. Professor, Department of Anatomy, D.M- Wayanad Institute of Medical Sciences, Meppadi, Kerala, India.
6. Professor & HOD, Department of Anatomy, D.M- Wayanad Institute of Medical Sciences, Meppadi, Kerala, India.
7. Tutor, Department of Anatomy, D.M- Wayanad Institute of Medical Sciences, Meppadi, Kerala, India.

NAME ADDRESS EMAIL ID OF THE CORRESPONDING AUTHOR:

Dr. Girish V. Patil,
Associate Professor,
Department of Anatomy,
D.M- Wayanad Institute of Medical Sciences,
Meppadi, Kerala, India.
E-mail: girivpatil@yahoo.co.in

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