

A Study of Toxic Effects of Formalin on Health of First Year Medical and Dental Students

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ABSTRACT

Introduction: Formalin is widely and commonly used as a fixative for microscopy, histology, preservative and disinfectant, etc. Despite formalin being extensively used in different fields, its toxicity is frequently ignored. It can be allergenic, carcinogenic or toxic to many organs such as pancreas, liver, kidney and brain.

Aim: To study the toxic effects of formalin on health of first year medical and dental students.

Materials and Methods: The cross-sectional study was conducted over a period of one year (February 2019 to January 2020) in the Department of Anatomy, SMBT Institute of Medical Sciences and Research Center, Dhamangaon, Nashik, Maharashtra. This questionnaire based study was conducted on 200 first year medical and dental students. The percentage distribution of incidence of toxic effects of formalin pertaining to symptoms was

calculated using Microsoft Excel 2019 spreadsheet software. The data were presented as frequency and percentage.

Results: Out of 200 students, 180 students (85 females and 95 males) completed and returned the questionnaire. The toxic effects of formalin with symptoms such as lacrimation in 63.33%, itching of eyes in 81.67%, running nose in 51.11%, redness of eyes in 55%, burning of eyes in 80.5%, and headache in 42.22% of subjects were observed. The results were compared with previous studies conducted.

Conclusion: Formalin toxicity is of concern to people working closely with it including embalmers, anatomists, medical and dental students. Awareness will bring a positive effect on their health. Also, through research, we will be able to contribute towards prevention of occupational hazards, rehabilitation of affected persons and dissemination of knowledge.

Keywords: Disinfectant, Fixative, Occupational hazard, Preservative, Toxicity

INTRODUCTION

Formalin is a common fixative, preservative and disinfectant and is widely used for microscopy and histology [1]. Despite its extensive use in different fields, the toxicity of formalin is frequently ignored [2].

The World Health Organisation (WHO) has developed a guideline for formaldehyde concentration in non occupational settings to be at 100 ppb for 30 minutes [1]. Although formalin is metabolised in body to formic acid which is a non toxic compound excreted in urine or converted to CO₂ or excreted by lungs, it can be allergenic or carcinogenic, or toxic to many organs such as pancreas, liver, kidneys and brain [3].

Dissection of cadaver lays down a strong foundation for sound clinical knowledge and good clinical practice. During anatomy dissection, the fumes of formaldehyde from cadavers, embalming fluid, could negatively affect medical and dental students as well as anatomy teaching and non teaching staff.

Previous studies done by Nisa G et al., Jain SR et al., Alnagar FA et al., Kundu S and Gangrade P, Yadav A and Yadav M, Dixit D, Raja DS and Sultana B, Patil GV et al., Uddin MN et al., Ahmed Y et al., Ramya G et al., Jain R et al., and Chaudhari G et al., have studied the effects of formalin on medical students [1-13]. The present study was undertaken to confirm the findings of previous studies and also to observe the effects of formalin in the institute in order to help identify measures that can be taken to prevent them. Through this study, author wanted to disseminate knowledge and create awareness among students regarding precautions to be taken to minimise the effects of formalin. Therefore, this present study was conducted to observe toxic effects of formalin on first year medical and dental students in terms of incidence of symptoms.

MATERIALS AND METHODS

This cross-sectional study was conducted over a period of one year (February 2019 to January 2020) in the Department of Anatomy, SMBT Institute of Medical Sciences and Research Center, Dhamangaon, Nashik, Maharashtra. Ethical clearance from the Institutional Ethical Committee for carrying out the study (Approval letter No SMBT/IEC/19/640 dated 16/01/2019) was taken. A written informed consent was taken from all of them.

Inclusion criteria: First year MBBS and dental students of age 18 years and above without any co-morbidities were included.

Exclusion criteria: Students below 18 years of age and those who were not willing to participate, students having pre-existing respiratory, dermatological conditions or allergy were also excluded from the study.

Sample size calculation: Sample size was based on the number of students admitted to the courses. Total 200 subjects (150 first year MBBS students and 50 first year BDS students) were included.

Procedure

A questionnaire based study was conducted on 200 subjects (150 first year MBBS students and 50 first year BDS students) who were routinely exposed to formalin during dissection for at least two hours a day and three days a week. Composition of formalin solution used is 10 percent prepared by mixing one part of 37% formaldehyde aqueous solution and nine parts water [14].

The students were given a questionnaire and were asked to fill it up. The self-administered questionnaire of this study included two parts. The first part included information about the demographic profile of the students (age, sex, medical course). The second part listed 21 effects of formalin on eyes, nose, mouth, respiratory tract, Gastro-intestinal Tract (GIT) and skin based on previous studies [1-8]. The cronbach's alpha value was 0.7. The students were

asked to mention which of the effects listed in the questionnaire were experienced by them in the dissection hall during the year.

After completion of the study, an awareness session was conducted for all first year medical and dental students exposed to formalin. It included information regarding all preventive measures and also precautions to be taken while being exposed to formalin. The session included various parameters for betterment of health and was delivered via seminar-cum-skits and also audiovisual clip. It also included preventive measures to be taken by non-teaching faculty (embalmers) while embalming and handling the concentrated formalin. In order to prevent the toxic effects of formalin on their health, all the subjects were taught the use of necessary protective equipments like goggles, aprons, gloves, mask, etc.

STATISTICAL ANALYSIS

The answer to the questionnaires were collected and the data were analysed using Microsoft Excel 2019 spreadsheet software. The incidence of the toxic effects was calculated and expressed as percentage. Severity of the effects was not studied.

RESULTS

Out of 200 students, 180 students (85 females and 95 males) completed and returned the questionnaire. The age of females was in the range 18 to 20 years (mean 18.42 ± 0.61) and that of males was in the range 18 to 21 years (mean 18.8 ± 0.93). The [Table/Fig-1] shows percentage distribution of incidence of toxic effects of formalin pertaining to symptoms observed.

Symptoms	Number of students (Out of 180)	Percentage (%)
Itching of eyes	147	81.67
Burning of eyes	145	80.5
Irritating smell	132	73.33
Lacrimation	114	63.33
Redness of eyes	99	55
Running nose	92	51.11
Headache	76	42.22

[Table/Fig-1]: Incidence of toxic effects of formalin.

In addition to above symptoms, some symptoms were observed such as nausea (12%), itching of skin (2%), syncope (4%), congested nose (11%), shrinkage of palm skin (5%), sore throat (4%), dizziness (4%), disturbed nocturnal sleep (1%), dryness (3%), respiratory infections (2%), gastrointestinal infections (1%), unusual thirst (1%) and unusual tiredness (3%).

Study	Place of study	Symptoms (%)						
		Burning of eyes	Lacrimation	Redness of eyes	Irritating smell	Running nose	Headache	Itching of eyes
Jain SR et al., [2]	Pune	-	87.2	-	30.8	-	6.4	-
Nisa G et al., [1]	Srinagar	-	88.1	20	-	30.7	-	-
Alnagar FA et al., [3]	Libya	75	73	58	-	-	62	42
Kundu S and Gangrade P [4]	Raigarh	-	89.36	58	94.68	52.12	62.77	47.84
Yadav A and Yadav M [5]	Bunde-lkhand- MP	-	24.67	-	30	20.67	14.67	67
Patil GV et al., [8]	Mangalore-Karnataka	-	82	-	-	-	8	-
Uddin MN et al., [9] (Study done in three colleges)	AFMC, Dhaka	-	87.2	63.2	84.8	61.6	52	-
	AMC, Cumilla	-	86	84	86	82	86	-
	EMC, Cumilla	-	49.33	66.67	76	65.33	62.67	-
Ahmed Y et al., [10]	Egypt	-	-	-	79.6	51.5	44.9	63.6
Ramya G et al., [11]	Chennai	82.4	-	-	-	-	23.9	-
Jain R et al., [12]	Bhopal,	-	79.28	-	76.42	62.14	51.42	68.57
Chaudhari G et al., [13]	Dahod- Gujrat	-	-	-	-	-	16.7	-
Present Study	Nashik	80.5	63.33	55	73.33	51.11	42.22	81.67

[Table/Fig-2]: Comparison of toxic effects of formalin in present study with previous studies [1-5, 8-13].

DISCUSSION

In the present study, lacrimation was found in 63.33%, itching of eyes in 81.67%, running nose in 51.11%, redness of eyes in 55%, burning of eyes in 80.5% and headache in 42.22% of subjects. Comparison of toxic effects of present study with various studies is given in [Table/Fig-2] [1-5, 8-13]. According to the study done by Jain SR et al., lacrimation was found in 87.2%, irritation/dryness of throat in 34.4%, tingling sensation in nose in 30.8% and headache in 6.4% of subjects [2]. In the study done by Nisa G et al., lacrimation was found in 88.1%, running nose in 30.7%, redness of eyes 20%, irritation of throat 11.2% and skin problems in 10.8% of subjects [1].

According to the study done by Alnagar FA et al., burning of eyes was found in 75%, lacrimation was found in 73%, headache was found in 62%, redness of eyes was found in 58% and irritation of eyes was found in 42% of the subjects [3]. While in the present study, itching of the eyes was the most common symptom.

According to the study done by Kundu S and Gangrade P, itching of eyes was found in 47.84%, lacrimation was found in 89.36%, headache was found in 62.77%, running nose was found in 52.12%, redness of eyes was found in 58% and unpleasant smell was found in 94.68% of the subjects [4]. As per the study done by Yadav A and Yadav M, itching of eyes was found in 67%, lacrimation was found in 24.67%, headache was found in 14.67%, running nose was found in 20.67% and unpleasant smell was found in 30% of the subjects [5].

According to the study done by Dixit D the three most disturbing symptoms were, unpleasant smell, itching of eyes and excessive lacrimation [6]. Raja DS and Sultana B, in their study state that the immediate effects of that agent are nausea, headache, and ocular irritation that causes tear overflow and a burning sensation in the throat while long term exposure to formaldehyde can cause contact dermatitis, congenital defects, and cancer [7].

In the study done by Patil GV et al., lacrimation was found in 82% and headache was found in 8% of the subjects [8]. While in the present study, lacrimation was found in 63.33% and headache was found in 42.22% of the students. In the study done by Uddin MN et al., the most frequently reported symptoms by medical students of three medical colleges were unfavourable scent (84.8%, 86%, 76%), running nose with prickling sensibility (61.6%, 82%, 65.33%), neuralgia/migraine (52%, 86%, 62.67%), inflammation of eyes (63.2%, 84%, 66.67%), inconvenience in breathing (72.8%, 86%, 66.67%), qualm (80%, 84%, 60%), lacrimation (87.2%, 86%, 49.33%), sore throat (49.6%, 64%, 66.67%), scabies (53.6%, 78%, 62.67%), giddiness (63.2%, 72%, 64%), and blister (52%, 70%, and 65.33%), respectively [9].

The study by Ahmed Y et al., involving 167 students from the first and the second year at the Department of Anatomy showed that approximately 79.6% of the students suffered from unpleasant smell, followed by eye irritation (63.6%), nasal irritation (51.5%), headache (44.9%), breathing difficulties (39.5%), visual disturbance (29.5%), lack of concentration (26.9%), cough (25.1%), lethargy and fatigue (19.2%), nausea (18%), digestive disturbance (14.4%), sore throat and dryness (12%), sleep disturbance (4.8%) and fainting (6%) [10].

Ramya G et al., in their study, found complaints of nausea in 18.7%, headache in 23.9%, irritation of eyes in 82.4%, respiratory problems in 20.4% of 171 medical and dental students [11]. In the study by Jain R et al., 79.28% students of the 140 medical students reported excessive lacrimation and 57.14% students felt that it was the most irritating and troublesome symptom [12]. A total of 76.42% of students experienced unpleasant smell and 63.57% students felt that it was the first symptom to develop. Other symptoms reported were running nose (62.14%), itching sensation in eyes (68.57%), cough (18.57%), sore throat (20.71%), difficulty in breathing (24.28%) and headache (51.42%).

The study conducted on 324 first year MBBS students by Chaudhari G et al., found headache in 16.7%, nausea in 8.6%, lack of concentration in 12.7%, difficulty in breathing in 17.6% and vomiting in 3.7% of students [13].

Increased formaldehyde concentration in dissection and embalming rooms is due to the following reasons:

- Poor working practices leading to spillage of fluid during embalming.
- Poor condition of cadaver causing embalming fluid to leak out of cadaver.
- Using high concentration of formaldehyde in embalming fluid (depends on factors like extent, size of oedema and stage of decomposition of cadaver)
- Poor ventilation of dissection rooms.

The primary routes of human exposure to formaldehyde are inhalation, eye and dermal contact. It then causes inflammatory changes in the mucosa which leads to the various symptoms seen in the students exposed to formalin [1].

Limitation(s)

The present study was limited by its small sample size. Also, the severity of the effects was not assessed in the study. Further studies can be undertaken to overcome these limitations.

CONCLUSION(S)

In the present study, various toxic effects of formalin such as lacrimation, itching of eyes, running nose, redness of eyes, burning of eyes, headache, nausea, itching of skin, syncope, congested nose, shrinkage of palm skin, sore throat, dizziness, disturbed nocturnal sleep, dryness, respiratory infections, gastrointestinal infections, unusual thirst and unusual tiredness in subjects were observed. Formalin toxicity is of concern to people working closely with it including embalmers, anatomists, medical and dental students. Awareness will bring a positive effect on health of subjects. Through dissemination of knowledge, we will be able to prevent occupational hazards and rehabilitate affected individuals. Such awareness sessions can be conducted at institutional level every year at the time of commencement of the first year course of medical and dental students in order to prevent its adverse effects on their health.

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