

An exploration of hazardous effects of formaldehyde fumes on medical students

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Abstract

Introduction: Formaldehyde is a naturally-occurring organic compound with the formula CH₂O. The anatomists, technicians in biological science laboratories, and medical school students in dissection hall are regularly exposed to formaldehyde. My present study is investigates the relation between exposure to formaldehyde and acute changes in respiratory functions and non respiratory functions of 1st year MBBS students.

Material and Methods: The study was carried out on 150 1st year medical students at L N Medical College and Research centre, Bhopal. A pre-validated questionnaire was used to evaluate the opinion of the students of the 1st year.

Result: The observations of this study are tabulated in the tables 1& 2. Maximum number of students was positive response among symptoms described.

Conclusion: Instead of formaldehyde, using of Glutaraldehyde is a feasible alternative chemical for fixation. The concentration of formalin and duration of time should be reduced.

Keywords: Formalin, Hazardous Effects, Medical Students, Bhopal.

1. Introduction

Formaldehyde was discovered in 1856 by the British Chemist, August Wilheld Von Hofman[1]. Formaldehyde is a naturally occurring organic compound with the formula CH₂O. It is the simplest aldehyde and is also known by its systematic name methanol [2]. Formaldehyde that is in a solid state is known as “paraformaldehyde. Formaldehyde is a flammable, colorless, reactive, and readily polymerized gas at normal temperature. The heat of combustion for formaldehyde gas is 4.47 Kcal per gram. It forms explosive mixtures with air and oxygen at atmospheric pressure [3].

Formaldehyde enters in body by breath or when it comes in contact with your skin. Formaldehyde is quickly absorbed from the nose and the upper part of lungs. Once absorbed, formaldehyde is very quickly broken down. Almost every tissue in the body has the ability to break down formaldehyde. It is usually converted to a non-toxic chemical called formate, which is excreted in the urine and is converted to carbon dioxide and breathed out of the body. But formaldehyde can be toxic, allergenic, and carcinogenic

[4]. The primary route of exposure to formaldehyde is by inhalation, where it is absorbed by the lungs and gastrointestinal tract and to a much lesser extent through the skin [5].

Formaldehyde is both an irritant and a sensitizing agent. Acute high-dose contact exposure to the liquid can be highly irritating to skin and eyes. Acute high-dose inhalation exposure is strongly irritating to the nose and throat, and can cause an irritant laryngitis or cough, or allergic asthma (wheezing). Neurological symptoms can be experienced, such as headache and changes in mental status similar to alcohol intoxication.

Formaldehyde is considered a cause of nose and throat cancer in humans who are chronically exposed to formaldehyde for many years. Prolonged or repeated overexposure may also result in respiratory impairment. Chronic exposure can cause bronchitis and pneumonia [6].

The anatomists, technicians in biological science laboratories, and medical school students in dissection hall are regularly exposed to formaldehyde. The level of exposure to that agent depends on the time spent in the anatomy

practical hall and museums, working conditions there and the type of embalming performed (Pabst 1987). The threshold limit value for formaldehyde is 0.3 ppm, which must never be exceeded (American Conference of Governmental Industrial Hygienists, 2001)[7].

A study done by Ohmichi et al. (2006)[8] focused on determining the personal exposure levels to formaldehyde that medical students and instructors were being exposed to as well as the indoor air concentration of formaldehyde in the laboratory during dissections.

The Anatomy faculty, students, embalmers and histopathology technicians are continuously exposed to the toxic vapors of formaldehyde. Hence the anatomy dissection laboratory represents a significant emotional challenge to many medical students [9].

My present study is investigates the relation between exposure to formaldehyde and acute changes in respiratory functions and non respiratory functions of 1st year MBBS students.

2. Material and Methods

The study was carried out on 150 1st year medical students at L N medical college and research centre, Bhopal. A pre-validated questionnaire was used to evaluate the opinion of the students of the 1st year. It is self – administered and made in English, as the medium of teaching in all medical colleges in the country is English. After the start of the study we came across the fact that 21 students didn't match our inclusion criterias, so they were excluded. Hence total 129 students were evaluated for the study.

2.1 Inclusion Criteria

- ✓ The students fall in the age group of 18-22 years.
- ✓ Healthy, non-overweight, non-smoker with no history of cardiac, pulmonary, dermatological system or epileptic disorder and with no previous exposure to formaldehyde fumes.
- ✓ Students who are willing to participate in the study.

2.2 Exclusion Criteria

- ✗ Students not present at the time of data collection.
- ✗ Stress, type-I allergy, respiratory diseases, and smoking habits.
- ✗ Chronic cough and asthma, conjunctivitis, throat problems.

3. Results

Table 1: Respiratory symptoms due to formaldehyde exposure

Symptoms	Yes	No
Running nose	52 (40.3%)	77 (59.6%)
Congested nose	38 (29.4%)	91 (70.5%)
Tingling sensation of the nose	78 (60.4%)	51(39.5%)
Dryness or soreness of nose	56 (43.3%)	73 (56.5%)
Respiration difficulties	88 (68.2%)	41(31.7%)

The above table no: 1 shows that respiratory difficulties were complained by 68.2% students, tingling sensation of nose disturbed in 60.4% students, dryness or

soreness of nose seen in 43.3%, running nose was complained by 40.3%, students had complained of congested nose 29.4%.

Table 2: Non Respiratory symptoms due to formaldehyde exposure

Symptoms	Yes	No
Unpleasant smell	103 (79.8%)	26 (20.1%)
Excessive lacrimation	110 (85.2%)	19 (14.7%)
Headache	80 (62%)	49 (37.9%)
Redness of the eyes	44 (34.1%)	85 (65.8%)
Itching or sore eyes	70 (54.2%)	59 (45.7%)
Nausea	30 (23.2%)	99 (76.7%)
Dry or soreness of throat	84 (65.1%)	45 (34.8%)
Unusual tiredness or dizziness	69 (53.4%)	60 (46.5%)
Post dissection redness of eyes	55 (42.6%)	74 (57.3%)
Post dissection nausea	37 (28.6%)	92 (71.3%)
Post dissection vomiting	48 (37.2%)	81(62.7%)
Itching or sore skin on hands	67 (51.9%)	62 (48%)
Cough	40 (31%)	89(68.9%)
Blurring of vision	51(39.5%)	78 (60.4%)
Skin eruptions	20 (15.5%)	109(84.4%)
Prolonged sleeping time	79(61.2%)	50(38.7%)
Fainting episode	10(7.7%)	119(92.2%)
Disturbed sleep at night	49(37.9%)	80 (62.1%)
Weakness	22 (17%)	107(82.9%)
Peeling of skin	36(27.9%)	93(72%)
Discoloring of nails	15(11.6%)	114(88.3%)

The above table no: 2 shows that Unpleasant smell was seen in 79.8% students, excessive lacrimation troubled in 85.2%, headache was complained by 62% students, redness of the eyes disturbed by 34.1% students. Itching or sore eyes was seen in 54.2%, nausea, dry or soreness of throat and unusual tiredness or dizziness was seen in 23.2%, 65.1%, 53.4% respectively. They include 42.6% as post dissection redness of eyes, 28.6% as post dissection nausea, 37.2% as post dissection vomiting. Itching or sore skin on hands was seen in 51.9%, students had complained by 31% of students. Blurring of vision and skin eruptions, prolonged sleeping time, fainting episode complained by 39.5%, 15.5 %, 61.2%, 7.7%. 37.9% of student feel disturbance sleep at night. 17% student felt weakness because of formalin inhalation, 27.9% students complained skin peeling symptom, discoloring of nails was seen in 11.6% but discoloration of the nails was not a significant symptom.

4. Discussion

The advance level school years prior to university entry, students will learn the basics of human anatomy under the subject of biology and perhaps be exposed to few pre-dissected specimens [10]. Medical students during their dissection course are exposed to formaldehyde, whose exposure is recently considered to be one of the causes of multiple chemical sensitivity [11]. In the present study, result shows that most of the students suffer from respiration difficulties.

Formaldehyde present in formalin definitely has a toxic effect on various body tissues which can adversely

affect the health of I 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 [12].

Our results show that excessive lacrimation trouble was seen in 85.2% students. Excessive lacrimation as a symptom which was most excruciatingly felt and troubled as they were exposed to formaldehyde vapors for the first time[13].

Mohammed Abdullahil *et al* on his article entitled “Nasal Response from Formaldehyde Exposure Used as Cadaver Preservative among Pre-Clinical Medical Students in a Nigerian Medical College” showed that 95% of the respondents have no knowledge of health hazards and precautions to be taken against formaldehyde exposure and this may be a contributory factor for undue exposure, bearing in mind that formaldehyde had been classified as human carcinogen that cause nasopharyngeal carcinoma[14]. Our study shows nose related problem in 40.3% (running nose), 29.4% (congested nose), 60.4% tingling sensation of the nose), 43.3% (dryness of nose).

Itching or sore skin on hands, skin eruptions, skin peeling symptom was seen in our study. Formaldehyde is absorbed through intact skin and can cause severe irritation or allergic dermatitis. Formalin can cause white discoloration of the skin as well as burning, drying, cracking, blistering, and scaling of the skin. These skin disorders can occur after contact with formaldehyde at levels well below those of many formaldehyde workers [15].

Formaldehyde irritates the upper airway. The exposure level of formaldehyde that is instantly hazardous to life and health is 100 ppm. Exposure above 50 ppm can produce severe pulmonary reactions (pulmonary edema, pneumonia, bronchospasm) that can cause death within minutes. Concentrations greater than 5 ppm promptly cause lower respiratory tract irritation characterized by cough, chest tightness, and wheezing [16]. Our result correlated with above authors.

Ingestion of that substance is unusual because of its unpleasant odor and irritant effect, but such exposure has been documented in accidental incidents and suicide attempts [17].

National Cancer Institute surveys have revealed that professionals (such as anatomists and embalmers) who are likely to be exposed to formaldehyde are at greater risk for leukemia and brain cancer than are individuals in the general population [18].

5. Conclusion

Formalin cannot be considered as a suitable chemical for embalment of cadaver for student's dissection. Instead of formaldehyde, using of Glutaraldehyde is a feasible alternative chemical for fixation. Glutaraldehyde is

an aldehyde related to formaldehyde, with similar fixation qualities. Formalin caused eye, nose, throat and skin problems to the undergraduate's medical students. Therefore, the concentration of formalin and duration of time should be reduced.

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