

The Carcinogen in Our Daily Life - A Cross-Sectional Study

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ABSTRACT

Objective: To study about the awareness of toxic effects of Formaldehyde in Chronic users

Design: Questionnaire study. Questionnaires were sent to chronic formaldehyde users and responses were analysed.

Setting: Large teaching hospital-various medical colleges in south Karnataka and Kerala.

Results: Most of the participants are aware about the adverse effects of formaldehyde but they are unaware of the major carcinogenic and teratogenic risks. Most of the participants don't know the safe limit of exposure to formaldehyde and most of them don't care whether the exhaust fans are working or windows are open. Majority of the participants had experienced the short term effects of formaldehyde whereas only 67 had experienced long term sequelae.

Keywords: Formaldehyde, Carcinogen, Embalming

INTRODUCTION

In 1867, the German chemist August Wilhelm von Hofmann identified formaldehyde, which is a colorless, flammable gas that is water soluble. Formaldehyde is colorless at room temperature having an irritating, pungent smell. It is commercially available as formalin, which contains 37% by weight or 40% by volume of formaldehyde gas in water ^[1]. Formalin is a widely prevalent fixative used in laboratories of anatomy, pathology and forensic science and used in embalming since the 20th century. A

cadaver is embalmed via the infusion of chemical substances that include formalin, alcohol, glycerin, carbolic acid, and dye which is infused via the femoral arteries or the internal carotid arteries. Thus anatomists and 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, ventilation and working conditions. According to American Conference of Governmental Industrial Hygienists, 2001, the threshold limit value for formaldehyde is 0.3 ppm. The legal airborne permissible exposure limits are 0.75 ppm averaged over an eight-hour labour shift and 2 ppm not to be exceeded during any of the 15-minute labor period (Formaldehyde, Occupational Safety and Health Standards, 1998).

The present study aims at determining the awareness of handlers about the hazardous effects of formaldehyde, the way they handle the chemical and how it's different in people who are aware of its adverse effects and people who are unaware and how the protective measures taken by them vary accordingly. The study also analyzes whether they are experiencing the side effects of formaldehyde, acute as well as chronic and how they are handling it. The study also seeks the opinion of the handlers the best that can be done to improve their quality of life.

METHODS

The study was conducted in 300 chronic formalin users, who deal with formalin for more than 5 years who deal with the chemical more or less on a daily basis. The subjects of the study were teaching staff of department of anatomy of

various medical colleges in south Karnataka and Kerala, the technicians, attenders and embalmers.

A questionnaire set was given to the candidates and collected back. The answers were analysed. (Table: 1, 2, 3)

TABLE.1: Candidates view on the topic regarding formalin exposure and safety.

Statement	Yes	No	Don't know	Not answered
Is your working environment with formaldehyde well ventilated?	108	110	81	01
Do you have exhaust fans working during dissection/embalming?	85	104	98	13
Do you use protective measures during exposure time?	289	2	3	6
Have you ever dealt with formaldehyde with naked hands?	298	2	-	-
Have you ever experienced any of the following symptoms on exposure to formaldehyde a. burning of eyes b. lacrimation c. redness of eyes d. running nose e. itching of nose f. dyspnea g. Headache	299	1	-	-
Have you ever had accidental cuts or puncture wounds drawing blood during dissection?	38	106	55	1
Are you sure that you always wash your hands after dissection before taking food or smoking cigarettes?	202	12	84	2
Do you experience aggravation of symptoms on subsequent exposure?	4	258	37	1
Do you experience a decrease in symptoms after chronic exposure over months/years?	279	8	13	-
Are you suffering from any of the following: a. contact dermatitis b. chronic conjunctivitis c. asthma and COPDs d. migraine e. infertility f. easy fatigability g. frequent infections h. loss of appetite and weight	67	203	21	9
Do you attribute any of the above mentioned illnesses as a result of exposure to formaldehyde?	39	97	131	33

TABLE.2: Candidates understanding regarding the adverse effects of formaldehyde

Statement	True	False	Don't know	Not answered
The permissible exposure limit (PEL) for formaldehyde is 0.75ppm(OSHA)	98	23	153	26
Formaldehyde is a known teratogen	79	93	118	10
Formaldehyde is classified as a known human carcinogen by International Agency For Research on Cancer	106	111	83	-
There is an increased risk of death due to myeloid leukemia among workers exposed to formaldehyde	13	260	24	3

TABLE.3: Candidates agreement with the statements to improve on the present situation

statement	Agree	Disagree	Neither agree/disagree	Not answered
Make personal protective devices(PPDs) compulsory	297	-	-	3
Substitute formaldehyde with other preservatives	279	18	3	-
Use of plastinated specimens	112	186	1	1
Granting work holidays for specified periods/year thus limiting exposure	293	4	1	2
Keeping exposure records.	278	3	7	12

RESULTS

Of the 370 candidates approached, 38 opted out and 32 returned the questionnaire unfilled. The study was conducted in 300 chronic formaldehyde users and the results were analysed. The response rate was 81.08%. Of those who

responded, 268(89.33%) were teaching staff who are taking regular dissection classes to medical and paramedical students, 6(2%) were museum technicians who work with formalin on a regular basis, 26(8.66%) were attenders who assist in dissection and perform embalming procedures.

Most of the participants are aware about the adverse effects of formaldehyde but they are unaware of the major carcinogenic and teratogenic risk. Most of the participants don't know the safe limit of exposure to formaldehyde and most of them don't care whether the exhaust fans are working or windows are open. Majority of the participants had experienced the short term effects of formaldehyde whereas only 67(22.33%) had experienced long term sequelae such as bronchial asthma, eczema etc. Majority don't use proper personal protective devices but very few only deal formalin with naked hands. 297 (99%) suggest compulsory use of P.P.Ds, 279 (93%) advocated substituting formaldehyde, 112 (37.33%) goes with the idea of using plastinated specimens and majority (278, 92.66%) recommends work holidays. 278 (92.66%) advocated medical surveillance and are aware that the medical records should be maintained.

DISCUSSION

The routes by which formaldehyde exposure may occur include (1) absorption through the respiratory tract via inhalation through the nose or mouth, (2) absorption through the skin following dermal contact, (3) absorption through the digestive tract via ingestion, including splashes into the mouth or by eating or smoking using contaminated hands or (4) injection directly into the bloodstream (e.g. through cuts and puncture wounds). Formaldehyde is irritating to the respiratory tract, eyes, skin and the lining of the mouth, nose, throat and stomach.^[2] Of these, the risk of inhalation exposure is particularly high due to the close proximity of embalmed tissue to the breathing zones of the students and instructors.^[3]

Acute exposure is highly irritating to the eyes, nose, and throat and can make anyone exposed cough and wheeze. Subsequent exposure may cause severe allergic reactions of the skin, eyes and respiratory tract. Exposure to high levels of formaldehyde can cause skin rashes, chest tightness and other allergic reactions. Once

a person has become sensitized to formaldehyde, lower exposures can bring on health effects similar to those previously caused by higher exposures.^[4] Ingestion of formaldehyde can be fatal, and long-term exposure to low levels in the air or on the skin can cause asthma-like respiratory problems and skin irritation such as dermatitis and itching. Eye discomforts can range from mild burning eyes and lacrimation to corneal clouding and loss of vision. The vapours may be trapped behind contact lenses, which usually results in discoloration and solidification of lenses. Concentrations of 100 ppm are immediately dangerous to life and health (IDLH).^[5] Tolerance to formaldehyde exposure can develop within one to two hours and can enable workers in an environment of steadily increasing formaldehyde concentrations to be oblivious to their increasingly hazardous exposure (Burge, Harries, Lam, O'Brien, & Patchett, 1985).

Formaldehyde is classified by the U.S. Environmental Protection Agency as a probable human carcinogen⁴ and by the International Agency for Research on Cancer as a known human carcinogen⁵ primarily because of its association with nasopharyngeal cancer in humans and nasal cancer in rodents. Formaldehyde is a proven teratogen in rats and mice in which it crosses the placental barrier and can affect the embryo.^[6] Several 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.^[7]

A number of guidelines and regulations are recommended by various agencies for limiting the exposure to formaldehyde and by offering personal protection. These include proper ventilation, usage of personal protective devices, material based proper labeling, eyewashes and showers, modified dissection practices, environmental monitoring and periodical medical surveillance. Idea of replacement of

some preserved cadaver dissection lessons with technology-based lessons and plastinated specimens as well as substitution of the solution used to preserve cadavers with a formaldehyde alternative should be considered. Educational programs should be designed to inform instructors, labourers and students about the potential health effects of formaldehyde and other laboratory hazards and make them aware of the protective measures.^[3]

Although the exposed personnel know that they are getting exposed to a harmful substance they don't know the real picture of what they are dealing with. Despite the known toxicity of formaldehyde, its widespread use as a preservative places the students, technicians and instructors to be affected by both acute and long-term adverse effects, and the extent to which they are protected by workplace regulations is less known. Appropriate protective measures should prioritize the health of potentially exposed instructors and the educational goals of cadaver dissection.^[3] Students, instructors and workers should be aware of the potential health hazards of formaldehyde. They should be taught regarding the side-effects and sequelae and make them aware of the importance of P.P.Ds. Regular health check ups should be carried out in institutions, health records maintained and the vulnerable population had to be sought out and followed up.

CONCLUSION

The adverse effects of formaldehyde in anatomy should be kept in perspective without underestimating them but also without overreacting. Monitoring, Personal protective devices, proper ventilation etc will substantially diminish its harmful effects. While using formalin, appropriate working practices should be observed as the safety rationale. Formalin can remain for a long time as the ubiquitous fixative reagent in anatomy until a real revolution in the field of preservation ensues.

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