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Research Article

EFFECTS OF FORMALIN VAPORS ON PULMONARY FUNCTION TESTS IN FIRST YEAR MEDICAL STUDENTS

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ABSTRACT

Formaldehyde is extensively used in department of Anatomy for preservation of biological specimens as well as cadavers. Formaldehyde being a noxious chemical may cause respiratory health problems among first year medical students. **Aim:** The aim of this study was to assess the effects of acute exposure of formalin on the pulmonary function of first year M.B.B.S. students during dissection hours. **Materials and Methods:** The present cross sectional study was conducted on total 50 healthy first year medical students in age group of 18-20 years. The lung function tests assessed were FEV1, FVC, FEV1/FVC% using computerized Spiro-excel PC based Spirometer., All these tests were done before start of anatomy dissection (pre-exposure) and within 02hrs after dissection (post-exposure). All these parameters helped in evaluating pulmonary functions among medical students exposed to formaldehyde for two hours during their anatomy dissection. The data was entered in the MS Excel spreadsheet. Appropriate statistical analysis was done applying Paired students 't' test and Pre and post exposure changes in PFT parameters were compared. **Result:** In the present study acute exposure to formalin resulted in significant decrease in FEV1, FVC and FEV1/FVC% following acute exposure. **Conclusion:** The study concluded that formalin vapors can affect the pulmonary function parameters. The students exposed to formalin vapors presented with obstructive changes in form of bronchoconstriction at some extent due to acute exposure. (P < 0.001).

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INTRODUCTION

Formaldehyde is the simplest aldehyde. Formaldehyde based solutions are used as preservative and disinfectants. An aqueous solution of formaldehyde is referred to as formalin. It was discovered by British chemist, August Wilhelm Von Hoffman in the year 1856 (*Vanajakshi B J et al*). Formalin has been used as fixative chemical since ages for preserving cadavers and other biological specimens. It is extensively used by both medical and dental colleges in anatomy dissection laboratory and pathology specimen museum. Formalin contains 37% of formaldehyde which readily vaporizes at room temperature. Many research papers and industrial reports have indicated that upper respiratory tract is the critical target of the toxicity of air borne formaldehyde and suggest that exposure to formaldehyde is associated with adverse effects on respiratory health. (*Banoo Hajra et al, Mathur N, Khaliq Farah et al, Onyije FM et al*). This chemical is commonly used in Medical colleges in Anatomy Dissection hall and Pathology Museum.

The first year Medical students, the anatomists and technicians working in these laboratories are constantly exposed to formalin vapors. The primary route of exposure to formaldehyde is through inhalation, from where it enters and is absorbed by the lungs. After entering it get quickly dissolved and in the tissues it converted to non-toxic form called Formate. The most common symptoms that are seen after acute exposure to formalin vapors include burning, itching sensation in eyes nose and skin. (*Vanajakshi B J et al*).

There has been an increasing number of reports that students suffer from various physical symptoms including burning eyes, lacrimation, irritation of airways, dermatitis with a high prevalence during gross anatomy dissection. In view of its widespread use, toxicity, and volatility, exposure to formaldehyde is a significant factor affecting human health (*Abha Shrivastava et al*). However there are only few studies on pulmonary function tests revealing the effect of formalin in first year medical students attending anatomy dissection.

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Therefore present study was conducted to asses acute effects of formalin on pulmonary functions in medical students.

MATERIAL AND METHODS

The present cross-sectional study was carried out at the department of Anatomy and Physiology Dr. S. C. Government medical college Nanded. Total 50 healthy first year medical students in the age group of 18-20 years who had given informed consent were selected in the study after necessary screening. Students with history of smoking, and suffering from any chronic respiratory diseases and allergies were excluded. Students with congenital anomalies of spine and thoracic cage, connective tissue and Musculoskeletal disorders were also excluded. Following Informed consent, the parameters like age, height, and weight were recorded and BMI was calculated. Pulmonary function tests were carried out by Spiro Excel PC based Spirometer. The individual respired into a transducer which is connected to the instrument by means of a cable which gave a detailed analysis of Forced Expiratory Volume in first second (FEV1), Forced Vital Capacity (FVC), FEV1/FVC% ratio. The Pulmonary function test were done just before and within 02 hrs after the dissection hours of anatomy laboratory so that pre and Post exposure to Formalin Pulmonary function test data was obtained..

RESULTS

The collected data was entered in Microsoft excel spread sheet and analyzed using paired t test by MS excel, A significance level of “P” < 0.05 was considered for the student’s t-tests. The data were expressed as mean +_ standard deviation.

The observed results were tabulated. Anthropometric parameters of students were shown in **Table 1**.

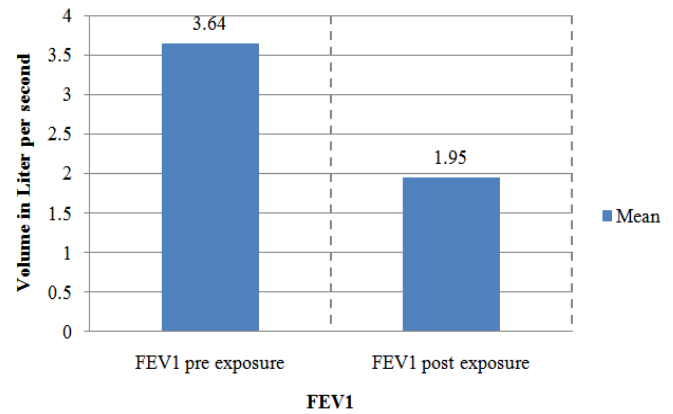
Table1 Anthropometry Profile of study subjects

Baseline parameters	Mean value	SD
Age	18.9	0.67
(Height) ²	2.5	0.2
Weight	53	10
BMI	21.35	4.245

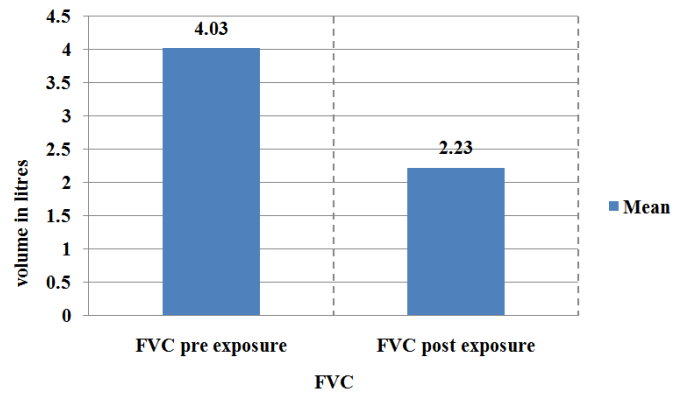
In **table 2** Comparison of Pulmonary Function test Pre and post exposure to Formalin Vapors was depicted. It was observed that there was highly significant decrease in values of FEV1 and FVC, (p<0.001), and significant decrease in FEV1/FVC % ratio (p<0.05) after exposure to formalin in first year medical students.

Table2 Comparison of Pulmonary Function test Pre and post exposure to Formalin Vapors:

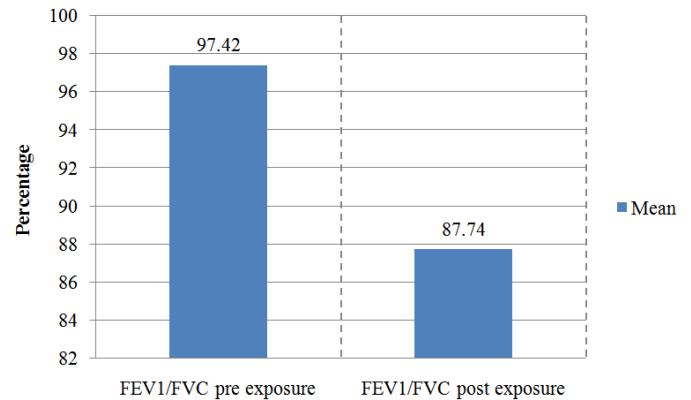
PFT parameters	Pre exposure		Post exposure		Level of significance
	Mean	SD	Mean	SD	
FEV1	3.644	0.191	1.956	0.265	Statistically highly significant (P<0.001)
FVC	4.031	0.131	2.23	0.28	Statistically highly significant (P<0.001)
FEV1/FVC%	90.4	4.07	87.74	7.172	Statistically significant (P <0.05)



FEV1 changes in Pre and Post exposure to formalin in medical students



FVC changes in Pre and Post exposure to formalin in medical students



FEV1/FVC% changes in Pre and Post exposure to formalin in medical students

DISCUSSION

Formalin has been used for preservation of cadavers in dissection halls and also preserving other tissues in laboratories. It is a aqueous solution of formaldehyde (37-50%). In dissection hall medical students are exposed to it. Recently its exposure has been considered as one of the multiple causes of chemical sensitivity. (Shrirang N. Patil et al)

In present study we evaluated effects of acute exposure of formalin in Anatomy dissection hall on Pulmonary function test of medical students .After acute exposure to formalin there was statistically highly significant reduction in values of Forced Expiratory Volume in first second (FEV1), Forced Vital

Capacity (FVC), (P value <0.001) and statistically significant reduction in values of FEV1/FVC% ratio (P value <0.05).

This indicates that there is bronchoconstriction resulting from hypersensitivity reaction. The adverse effects on ventilatory mechanics of the participants as observed in the present study are consistent with the fundamental biological behavior of formaldehyde and resonate with similar research works carried out elsewhere by other authors.

Shrirang N. Patil, Milind Thorat et al also observed that There was significant decrease in values of FVC, FEV1, (p<0.05) after acute exposure to formalin. But There was no any noticeable change in FEV1/FVC ratio (p>0.05).

Dr. V Ravi Kumar, Dr. M.C. Sudhakaran *et al* also observed significant decrease in values of FVC, FEV1 on acute exposure to formalin

Banoo Hajra, Arya Manjulata, et al also reported statistically significant (p<0.001) decrease in values of FVC, FEV1, after acute exposure to formalin.

Ayesha Anjum, Vanajakshi B J et al also observed significant decrease in FVC, FEV1, FEV1 /FVC.

Shital Ramesh Rao Mankar and Amita Rajesh Ranade et al also observed significant decrease in FEV1, FEV1/FVC, but in FVC They observed no significant change in male students but decrease in all parameters in female students after acute formalin exposure.

Abha Shrivastava, and Yogesh Saxena et al also observed statistically significant (P<0.0001) decreases in FVC, FEV1%, after 1 month of exposure to formalin at anatomy dissection.

Binawara BK, Rajnee, Choudhary S, Mathur KC et al, also observed highly significant (p<0.0001) decrease in values of FVC, and FEV1 .

Okonkwo Chukwudi Onyeka, Metu Stephanie Chiemerie, Maduka Stephen Ozoemena *et al* also found statistically significant (p < 0.05) decrease in values of Forced Vital Capacity (FVC), FEV1,

Dipak Kumar Dhar, Sudeepa Chaudhuri et al also reported statistically significant (P = 0.004) decline in FEV1/FVC ratio.

Vanajakshi B J, Ayesha Anjum et al also observed statistically significant decrease in FVC, FEV1 and also FEV1/FVC ratio

Studies have found formaldehyde to be toxic, allergenic, and carcinogenic .The formaldehyde production is increasing worldwide due to its wide spread use, but due to its toxicity and carcinogenic properties many European countries have restricted its use and import and have recently banned its use as a biocide (including embalming) under the Biocidal Products Directive

For the numerous health challenges that formaldehyde causes on the students in anatomy

dissection hall, it cannot be considered as an ideal chemical for embalming of cadaver. Medical students, teachers and laboratory technicians are exposed to formaldehyde fumes on

regular basis during the daily dissection schedules; they should be informed of potential health hazards of formalin. Attempts should be done to reduce the concentration of formaldehyde and by using other chemicals like glutaraldehyde, which can serve a good substitute for formaldehyde. (Banoo Hajra *et al*)

The probable measures which can be taken will be the lesser concentration of formaldehyde as it will reduce the toxic effects and the other chemicals like surgical spirit, glycerine and

carbolic acid will help in maintaining a good preservation of the cadavers. As is quoted by BS

Mitchell et al "reduction in formaldehyde concentration is not deleterious to specimen preservation, but leads to a safer working environment(O'Sullivan E, Mitchell BS et al).As for the other alternative chemicals in place of formaldehyde, Frolich *et al* in 1984 tried using phenoxyethanol as its non-toxic substitute. It proved to be impractical as the amount required was large, i.e., about 600 liters for each cadaver needing continuous emersion to prevent mould formation and the fixation process taking 5 to 10 months.(Frolich et al)Similarly, Glutaraldehyde is an aldehyde related to formaldehyde, with similar fixation qualities. It would be a feasible alternative, but because of the volumes that would be required, it is prohibitively expensive. Also Reinhard Pabst in his follow up study has advocated the use of glutaraldehyde as a good substitute for formaldehyde. (Pabst R. et al and Binawara BK, Rajnee, *et al*)

CONCLUSION

Formaldehyde causes obstructive changes as is evidenced by decrease in FVC, FEV1, FVC/FEV1.It can cause broncho constriction due to acute exposure. We would like to recommend proper ventilation system in the dissection hall So local exhaust ventilation system should be installed and personal protective equipments such as safety eyeglasses, gloves and use of mask may reduce personal exposure to Formalin and prevent adverse effects on health of students.

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