Original article:

Effect of two hours formaldehyde exposure on lung functions in the 1st MBBS medical students

Dr. Lad Umesh Pralhadrao, Dr. I. Anil Kumar, Dr. Lad Shital Umesh. Dr. Chintansinh Parmar

Department of Physiology, Government Medical College, Latur (Maharashtra)
Corresponding author : Dr. Lad Umesh Pralhadrao , Associate Professor , Department of Physiology, Government Medical College, Latur (Maharashtra)

Abstract

Introduction: First year MBBS students are exposed to the formaldehyde gas during their Anatomy dissection classes almost every day. Effect of acute exposure of formaldehyde on the lung functions is not well documented in the available literature. So this study was planned to study effect of two hours of formaldehyde exposure on first year medical students.

Materials and Methods: 80 first MBBS students were enrolled in the study, after application of inclusion and exclusion criteria. Their anthropometric parameters were recorded by standardized methods and BMI was calculated using Quetlet's Index. FVC maneuver was performed in the students before and after the formaldehyde exposure for two hours during their anatomy dissection classes. Data was analyzed using paired t-test.

Results: The FVC and FEV_1 were decreased after the exposure to formalin but the difference between the values was statistically non-significant ($p > 0.05$). Moreover the values of the FVC/FEV_1, FEF_{25-75}, PEFR were also decreased after exposure to formalin and the difference between them was statistically significant ($p < 0.05$).

Conclusion: Two hour exposure to formaldehyde in the anatomy dissection hall causes decrease in the lung functions. The results indicate that there Might be mid airway constriction which leads to decreased FEF_{25-75}, PEFR. The decreased lung functions are indicative of the respiratory derangement due to acute effect of formaldehyde

Key word – 1st MBBS, medical students , Anatomy dissection, Lung functions, formaldehyde.

Introduction

Formalin, an aqueous solution of Formaldehyde is widely used as embalming fluid to preserve human body and organs. In India, medical students must perform human dissection as a part of their curriculum. This exposes them to vaporized formalin gas daily for minimum two hours. Though formaldehyde brakes down to non –toxic formate form and excreted by kidneys and converted to carbon dioxide and exhaled from the lungs.[1-2] The acute exposure to formalin evokes irritation in the upper respiratory tract, and difficulty in respiration is most common complaint of many students in the Anatomy Dissection hall. Several published reports, research papers and industrial experience suggest that exposure to formaldehyde is associated with adverse effects on respiratory health. Recent review of the studies have indicated that upper respiratory tract is the critical target of the toxicity of air borne formaldehyde.[3-5]

There are several studies studied the effect of formaldehyde in the medical students and other workers exposed to formaldehyde at the workplace but the results are contradictory, furthermore there are very few studies from India. So, we have evaluated Lung functions among medical students exposed to formaldehyde for two hours during their Anatomy dissection, and have investigated the relation between exposure to formaldehyde and acute changes in lung function.

Methods and materials

The present study was conducted at KIMS Amalapuram, in the month of Nov-Dec 2014. The study was approved by institutional ethical committee. Total 80 (56 males and 24 females) students in the age group of 18-20 years voluntarily participated in the study. They were included after obtaining an informed written consent.

Participants were included by following a strict inclusion and exclusion criteria, healthy, non-smoking students without any acute or chronic respiratory illness or any musckuloskelatal deformity of spine in the age group of 18-20 years and Body Mass Index(BMI) between 18-25 Kg/M^2 were included in the study. Students who had history of smoking, respiratory illness like asthma, chronic respiratory diseases, upper or lower respiratory tract infection in recent past, kyphoscoliosis or musckuloskeltal diseases and BMI more than 25 Kg/M^2 were excluded from the study.

Study protocol

First year students attending anatomy dissection in our institute were informed about the purpose of the study and were asked for voluntary participation. Those who consented for participation were briefed about the methodology. The participants were asked to come in the morning at 11 AM, their anthropometric parameters and the basal spirometry record were obtained as per study protocol. Then they attended dissection for 2 hours. At the end of two hours again spirometry was performed to access the effect of formalin on the lung functions. Daily four students record was obtained, at the end of the study data was compiled and analyzed statistically.

Measurement of the Anthropometric Parameters

The standing height of the subjects was measured with the same stadiometer, without footwear; to the nearest centimetre. Weight was measured, which was the nearest to 0.1 kg, with the subjects in the standing position, before lunch, with light clothes and without footwear, by using a standardized weighing scale [6]Body mass index [BMI] was calculated by using Quetlet's index [body weight in kg/height in m2]. [7]

Measurement of the pulmonary functions

The pulmonary functions were measured by using a computerized portable spirometer MIR [Medical International Research] SPIROLAB II as per the ATS/ERS [American Thoracic Society/European respiratory Society] guidelines.[8] The volunteers were asked to avoid beverages like tea, coffee and other stimulants and to report on a light breakfast. The pulmonary functions were recorded in the forenoon to avoid the diurnal variations. The subjects were demonstrated the FVC [Forced Vital Capacity] maneuver in spirometry. After they were allowed to rest for 5–10 min and after educating them about the technique of FVC [maximum inhalation followed by maximum exhalation and this had to be sustained until they were asked to inhale again], the test was carried out in a private and quiet room, with the subjects in a standing position, with the nose clip held in position on the nose. The flow volume/time graphs were taken and best of the three acceptable curves was selected as the recording. The values of

FVC [Forced Vital Capacity], FEV_1 [Forced Expiratory Volume in the first second] and FEF $_{25-75}$ [Forced Expiratory Flow in 25-75% /Mid expiratory flow] were taken for the statistical analysis. The instrument was calibrated daily by using a 2 liter syringe. [6]

Statistical analysis

The data was analyzed statistically, paired *t*-test was used and the *p*-value <0.05 was taken as level of significance.

Results

Table -1. Anthropometric parameters of the study participants.

Parameter	Values (n=80)
Age (Years)	19±0.6
Height (cm)	167.2±8.5
Weight(kg)	64.6±8.3
BMI(Kg/M^2)	21.67±2.6

Table-2. Comparison of lung functions before and after exposure to formalin for 2 hours.

Parameter	before exposure (n=80)		after exposure (n=80)		t-value	p-value
	Mean	±SD	Mean	±SD		
FVC (L)	3.45	0.78	3.37	0.93	0.8	>0.05
FEV1(L)	2.93	0.86	2.52	0.85	0.5	>0.05
FVC/FEV1(%)	86.9	4.5	83.2	5.8	1.3	<0.05
FEF25-75(L/s)	4.3	5.4	3.9	6.8	1.2	<0.05
PEFR (L/MIN)	510	156	467	135	1.5	<0.05

Table no -2 shows the comparison of the lung functions before and after exposure to formalin. The FVC and FEV_1 were decreased after the exposure to formalin but the difference between the values was statistically non-significant (*p*>0.05). Moreover the values of the FVC/FEV_1, FEF $_{25-75}$, PEFR were also decreased after exposure to formalin and the difference between them was statistically significant (*p*<0.05).

Discussion

There are various studies suggesting the hazardous effects of exposure of the formaldehyde. Formaldehyde binds with endogenous proteins and forms heptens, these hapten elicit an immune response which is responsible for symptoms like redness and itching of eye, irritation of nose and throat and increased lacrimation

First MBBS students in the medical colleges of India are exposed to formaldehyde gas almost every day in the Anatomy dissection hall. Throughout the year they perform anatomical dissection as a part of their curriculum. Acute effects of exposure to the formaldehyde vapors on the lung function of the first year medical students was studied in order to understand if there is any change in the lung functions.[9]

In the present study, we studied FVC,FEV_1, FEV_1/FVC, FEF_{25-75},and PEFR. We found there is decrement in the values of all these function after 2 hours of exposure to formaldehyde in Anatomy dissection hall. The difference between FVC and FEV_1 was statistically no-significant and the difference between the FEV_1/FVC, FEF_{25-75} and PEFR was statistically significant. Our finding indicate that the acute effect of formaldehyde is on mid airway and the total lung functions are unaffected. Decrease in the PEFR can be associated with the irritation of the upper respiratory tract.

There are various previous studies that reported decreases in the FVC immediately after exposure to formaldehyde indicating there can be a mild transient bronchoconstriction effect which might lead to decreased in the FVC and FEV_1. A study conducted by Khaliq F *et al* in a group of 34 workers in an anatomy laboratory reported decrease in the FVC but increase in the FEV_1/FVC ratio[10]. Similarly a study conducted in 280 histology technicians by Kilburn KH *et al* shown the reduction in the pulmonary function like FVC, FEV_1 and FEF_{25-75} compared to the controls[11]. Our findings are similar to the findings of the others.

Chia, *et al* studied 150 first-year medical students exposed to formaldehyde during the dissection of cadavers in a gross anatomy laboratory and reported no significant differences in the pre- and post-exposure mean FEV_1 and FVC[12]. Our findings are in agreement with the finding of Chia et al and we also found that though there is decrease in the absolute values of the FVC and FEV_1 the decrement is statistically non-significant.

Binawara BK et al studied the effect of two hour exposure to the formaldehyde in Anatomy dissection hall in 80 healthy (male) first year medical student's between the age of 18–23 years. They reported a statistically significant decrement in the values of FVC, FEV_1, and PEFR. FEV_1/FVC ratio and FEF_{25-75} did not show any significant change[13]. Contrary to their finding we found that there is statistically significant change in the FEV_1/FVC ratio and FEF_{25-75}. This might be due to the geographical variations and the change in the humidity of ambient air as there study is conducted in a different geographical area than that of ours.

Similar study conducted by Malhotra R and coworkers in the AIIMS Rhisikesh (India) in a group of 40 healthy, non- smoker first year medical students who were exposed for two hours to formaldehyde. They reported that the acute exposure of embalming fluid fumes was associated with significant decrease in FEV_1/FVC ratio and FEF_{25-75}. Rest of the respiratory parameters did not show significant changes[14]. Our results are similar to the results of this study.

Wei CN *et al* stated that symptoms during the anatomy dissection classes were related to the Time spent in the anatomy dissection room. Their study suggests that reducing the time of each anatomy dissection practical class and reduction of the number of cadaver tables could help to reduce symptoms[15].

Formaldehyde exposure is a major health hazard for medical students in the first year. They are exposed to the formaldehyde vapors almost every day and complaint suffering from the respiratory difficulties every now and then. There are various suggested modifications in the anatomy dissection rooms by various authors. Few increased ventilation might decreases the formaldehyde exposure[16], others suggested change in the design of dissection tables with an exhaust/ negative graded suction system at the base of the dissection table which will create moderate negative pressure and the formaldehyde gas will be sucked and sent out through exhaust system. This might achieve

less part per million (PPM) of the formaldehyde gas and decrease the exposure of the students to the formaldehyde gas[17]. There a an acute need to change the design and infrastructure of the anatomy dissection room so as to decrease the level of exposure to formaldehyde in medical colleges.

Scope and limitations

Our study was conducted in a single medical college a large scale study at various institutes across the geographical location throughout the country and correlating the effect of the real time formaldehyde levels in the dissection room with the lung function might best ascertain the relationship between the formaldehyde and the decrement of lung functions in the medical students.

Conclusion

First MBBS students are exposed to formaldehyde which might decrease the lung functions on acute exposure. We found that FVC, FEV_1, FEV_1/FVC , FEF $_{25-75}$ and PEFR are reduced in the students after two hours of exposure to formaldehyde. Thought the decrement in the levels of FVC, FEV_1 was statistically non-significant and only the decrement in the FEV_1/FVC , FEF $_{25-75}$ and PEFR was statistically significant. Our study conclude that the exposure to the formaldehyde is health hazard for medical students it might caouse mid airway disease in the persons exposed to it . Concrete measures should be taken to decrease the level of exposure below the international permissible limits and improve the working environment for medical students in the dissection hall. Modifications in the ventilation and decreasing the concentration of formaldehyde as well as the changing the design of the dissection table to suck and throw out the formaldehyde gas by exhaust mechanisms can be incorporated in the dissection hall.

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