**Aim:** To examine the level of total and specific IgE to FA in response to the higher FA level.

**Methods:** A gross anatomy lab was evaluated for FA concentration during the 4th, 10th & 14th weeks. Personal samples were taken from instructors and students using a sampling device pinned on individual's collar for 2 to 3 hours. Analysis was carried out using high performance liquid chromatography. Blood samples from all participants were analyzed by radio allergosorbent test (RAST) using Pharmacia ImmunoCAP 250 analyzer.

**Result:** The average indoor FA concentration was 0.68, 0.85, and 0.73, ppm in the 4th, 10th and 14th weeks. The average personal exposure level for students was 0.75, 1.20, and 1.10 ppm and 1.27, 1.44 and 1.33 ppm for instructors. Total blood IgE and IgE specific to FA of all students and instructors did not increase significantly.

**Conclusion:** Increased concentration and personal exposure to FA did not stimulate the production of IgE specific to FA. Thus allergic symptoms are not directly related to IgE but likely to be related with irritants.

**Keyword:** Formaldehyde, dissection lab, IgE

**INTRODUCTION**

FA (also known as formalin) is used as a preservative for human cadavers during anatomy dissection laboratories. Regulatory authorities around the globe including World Health Organization (WHO) proposed that the indoor concentration of formaldehyde must be less than 0.08 ppm. The acceptable level of FA set by the American Conference of Governmental Industrial Hygienists (ACGIH) is 0.3 ppm. The exposure of FA is always greater in the participants of anatomy lab than non-participants.

Recently, people are more apprehensive about the effect of FA and it has long been questioned whether the exposure to formaldehyde in indoor environments may be a risk factor for developing allergic specific IgE-mediated inflammatory responses. Little evidences are present to support this hypothesis at present. FA is declared as a known human carcinogenic agent. Prolong exposure of FA is also considered a carcinogenic in humans. FA is also considered a persusasive contact sensitizer that can produce contact dermatitis and respiratory symptoms, by irritant mechanisms. Symptoms like irritation of throat, nose and eyes have also been reported. FA is a hepten and Formaldehyde-protein complex may be considered as immunogenic.

In 2009, one of our study reported that mean concentration of FA in anatomy lab during week 4th, 10th and 11th were 0.68, 0.85 and 0.73 ppm respectively. These levels of FA concentration in our laboratory during the session exceeded the guidelines of WHO (0.08ppm) and ACGIH (0.3 ppm). Achatzet al. reported an IgE antibody mediated allergic response following to exposure to allergens. In children an IgE mediated sensitization to gaseous form of FA has been observed by Wantke, et al., whereas in atopics, long term exposure is likely to stimulate the typical IgE mediated response. Many researchers reported that there is no production of IgE specific to FA. This study has designed to establish further evidence about IgE-mediated sensitization related to the high level of FA during teaching sessions in anatomy lab.

**MATERIALS & METHOD**

**Anatomy Lab:** The size of the anatomy lab used in this study is 30m x 15m x 4m in dimension with total volume of 1800m³. The lab is provided with 3 doors and 6 fixed windows. The main door (DR1) opens in main lobby whereas, other 2 doors (DR2 and DR3) open in small corridor (Fig. 1). The DR2 and DR3...
used only during practical examinations sessions. The lab has 24 ceiling outlet vents connected to central air conditioning system and 4 exhausts (Fig.1) for general ventilation. There is no natural and cross-ventilation in the lab. A total of fourteen cadavers used during the teaching session of this study. A group of 15 students under the supervision of instructor dissected one cadaver. The cadavers and pro-sections are preserved in a solution containing glycerin, 10% FA and tape water. After dissections session the cadavers are covered in a wet sheet of cotton.

**FA Concentration in Anatomy Lab:** A sampling device manufactured by Sigma Aldrich MO, USA, was used to collect air sample \(^{21,23}\) from 3 different locations; the center (CE), besides the doors (DR1 – DR3 and all 4 corners (CR1-CR4) (Fig.1). The sampling devices were fixed at the mean height of the breathing zones of the participants and were also attached to the collar of participants for about 2-3 hours for personal exposure sample. The collected samples were analyzed by using high performance liquid chromatography (HPLC).

**Blood sampling For IgE:** Ten ml of blood samples were taken from all students \((n=10)\) presenting with clinical signs and symptoms similar to those of allergic reactions during the 4th, 10th & 14th weeks. The samples were analyzed in accordance with the recommendations outlined of the manufacturer’s guidelines using radioallergosorbent test (RAST) to determine the presence of IgE level after exposure to FA. All the samples were collected at the start & at the end of the 4th, 10th & 14th week lab sessions.

**Measurement of Specific IgE:** In order to measure the level of specific IgE, the response of the blood samples were transformed to kU/L by using calibration curve. Only the value that is more than 0.35 kU/L was considered significant.

Table 1 shows the interpretation of RAST score based on quantitative assessment of the IgE in kU/L.

Furthermore 4 samples were collected from four instructors as they spent more time in the lab and were exposed to FA for a longer duration than that of students. Four samples from students to measure the specific IgE to FA. These instructors and students were selected because they had complained of sensitivities to FA. For control 4 samples were collected from the laboratory assistants who did not participate in dissection sessions.

**RESULTS**

**FA Exposure Level in Anatomy Lab:** The mean concentration of FA during the 4th, 10th and 14th week of dissection was 0.68, 0.85 and 0.73 ppm. The sample from different locations (Fig.1) i.e. central (CE), corners (CR1-CR4) and doors (DR1-DR3) showed a significant variation in the levels of FA concentrations. During the dissection of body cavities, a higher FA concentration was noted. The mean personal exposure level of students during 4th, 10th and 14th week was 0.75, 1.20 and 1.10 ppm whereas; the mean personal exposure level of instructors was 1.27, 1.44 and 1.33 ppm (Fig-2).

**IgE Level of Students & Instructors:** Total blood IgE levels of all 10 students and instructors did not increase significantly (Table 1) during the dissection session at 4th, 10th and 14th week. Also, a clear relationship between FA exposure levels and total blood IgE levels was not observed (Table 1). In samples from all instructor and first 4 students the specific IgE to FA was negative (less than 0.35 kU/L). Similarly the control sample did not show any change in total IgE levels (Table 1).

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Fig. 1: Lay out of the anatomy lab
Fig 2: Showing the average concentration and the exposure level of formalin of the instructors and students in the dissection room

![Graph showing average concentration and exposure level of formalin](image)

**DISCUSSION**

FA is a volatile organic compound and recognized as a harmful chemical which produces symptoms of allergic diseases. The cadaveric dissection session is an essential component of anatomy practical in medical and dental colleges. Therefore, the students and instructors participating in the anatomy labs are exposed more to FA than the nonparticipants. At many occasions the participants in our lab reported symptomssimilar to those of allergic reactions. Higher indoor FA concentration during the lab session may provoke the production of IgE which is responsible for producing the allergic symptoms. This study is designed to establish relationship between the higher concentration of FA and IgE production in our lab. Following every dissection session some students developed symptoms similar to allergic reactions with no previous history. These symptoms were linked with the higher & prolong exposure to FA. Our lab exceeded not only the guideline of 0.08 of WHO but also the ACGIH permissible limit of 0.3 ppm. Previous reports documented that indoor FA concentration and personal exposure levels in anatomy labs exceed the permissible limits. Keeping these facts in mind it is anticipated that exposure to FA may evoke total blood IgE and specific IgE to FA during the lab session. Our results do not show any significant changes the blood IgE in the participants. Exposure levels of FA for instructors were higher than students (Fig 2) possibly because the instructors devote more hours in the lab due to occupational reasons. Specific IgE to FA has hardly been found in general workers and participants of pathology lab. Bousquet et al. reported that FA might lead to IgE-mediated sensitization and specific IgE antibodies against FA. Children suffering from respiratory diseases are more susceptible to produce respiratory symptoms when they are exposed to higher FA exposure level. Asthma is also related to higher concentrations of FA in children. Therefore, it is possible that higher and prolong exposure to FA may increase allergic disease in children. Contrary to this Doisal do not consider FA as a major allergens causing childhood asthma. FA is a hepten and Formaldehyde-protein complex may be considered as immunogenic. In fact hapten is a small molecule that elicits an immune response only when attached to a large carrier. In the present study specific IgE to FA was found negative (below 0.35 kU/L) in all instructors, students and control group participants. The total blood IgE levels of participant did not show any significant difference with that of control. Findings of this study shows that exposure to high level of FA do not evoke an IgE-mediated reaction. Indeed no significant difference was observed in production of IgE even during the 10th week when the FA exposure level in the 10th week was highest (Fig 2) during the dissection of body cavities. Higher indoor FA concentration as well as the higher personal exposure level in our lab did evoke IgE production suggesting that in vivo relationship between FA and IgE induced clinical symptoms remains a dilemma. It is recommended that the students enrolled in anatomy courses must disclose their allergic history.

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