ORIGINAL RESEARCH PAPER
Volume-6 | Issue-10 | October-2017 | ISSN No 2277 - 8179 | IF : 4.176 | IC Value : 78.46
INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

Ill Effects of Formalin Exposure on Respiratory System among Students Studying In First Year M.B.B.S – A prospective study.

Anatomy

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ABSTRACT

Background: Dissecting human cadavers is an integral part of the curriculum in anatomy for the first year M.B.B.S., students. Formalin, the prime chemical used to embalm and preserve the cadavers, is an irritant and its vapours when inhaled causes serious health issues among the students.
Aims & Objectives: To assess the nature and degree of ill-effects produced by formalin during dissection hours to the students in the department of anatomy GMC & ESIC, CBE.
Material and Methods: A questionnaire was prepared containing 12 symptoms pertaining to the respiratory system were given to 100 students studying in first year MBBS. The average duration of exposure for each student was 13 hours/week during the academic year.
Results: Out of 100 questionnaires distributed, all were completed and returned (response rate: 100%). Of 100 students, 77% were suffered from running nose, followed by 75 % has complaints of burning sensation of nose, 37% experienced soreness of throat.
Conclusion: Formalin is a harmful chemical known to produce not only short term but long term health complications also. Hence students must be educated how to minimise their exposure to formalin vapours and protect themselves from their ill effects as far as possible.

KEYWORDS

Anatomy; Dissection hall; Formalin; Medical Students

Introduction:
Formalin is infused into the femoral artery during embalming in the ratio of 1:5 with water along with other chemicals like glycerine and common salt. After embalming, the cadaver is immersed in tank fluid also containing 10% formalin solution for a minimum period of 6 months, only after such procedure human body becomes fit for dissection. Formalin is a good preservative for preserving human cadavers, preventing decomposition because of its excellent fixative property. Formalin precipitates intracellular proteins for this action. During dissection formalin evaporates into formaldehyde vapour which is an irritant with a pungent odour. When inhaled, it causes damages to nasal mucosa and is responsible for most of the ill health. It is slightly heavier than air, so it stagnates in the lower levels in the dissection hall and so it is not easily evacuated or flushed out by the conventional exhaust equipment's , which are usually installed close to ceiling. The current OSHA permissible exposure limit is one part of formaldehyde for million parts of air. Levels exceeding the above are likely to cause irreversible adverse health effects. Currently, there is no a regulatory council norm or guidelines to monitor or measure the permissible levels of formalin in dissection halls.

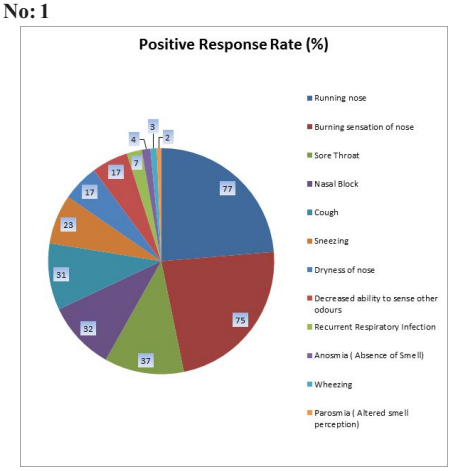
Materials and Methods:
In this present study, a questionnaire was prepared containing 12 symptoms arising during and soon after dissection hours in 100 students studying in first year MBBS (39 male and 61 female). The purpose of study was intimated to the students and informed consent was obtained from all after getting clearance from the ethical committee. The students were in the age group 18-22 years, all were healthy, non-smokers, with no H/o Cardiac, Pulmonary, Dermatological, neurological disorders. Condition of cadavers was good, dissection hall were the cadavers were kept was well ventilated. Students were asked to fill up the questionnaire at the end of academic year.

Results:
Table No: 1

S. NO	Symptoms	Positive Response Rate (%)
1.	Running nose	77
2.	Burning sensation of nose	75
3.	Sore Throat	37
4.	Nasal Block	32
5.	Cough	31
6.	Sneezing	23
7.	Dryness of nose	17
8.	Decreased ability to sense other odours	17
9.	Recurrent Respiratory Infection	7
10.	Anosmia (Absence of Smell)	4
11.	Wheezing	3
12.	Parosmia (Altered smell perception)	2

The results obtained were tabulated as shown in table & figure 1. Running nose was commonest symptom complained in 77% students, burning sensation of nose was reported by 75% students, sore throat was repeatedly troubled by 37% students, nasal block encountered by 32% students, cough was a symptom in 31% students, sneezing was felt by 23% students, dryness of nose was experienced in 17% students, decreased ability to sense other odours was felt by 17% students, recurrent respiratory infection was seen in 7% students, Anosmia (absence of smell) was experienced by 4% students, 3% students were troubled by wheezing and finally parosmia (altered smell perception) was noticed by 2% students.

Figure No: 1



Discussion:
Formaldehyde gas, the vaporised form of formalin produces multiple toxic effects in humans. It has high water solubility which facilitates its easy penetration into mucosal surfaces, thus producing not only

surface irritations on skin and mucosa but toxic effects on almost all organs and systems of the body after entering the blood stream.

In his study Casanova-Schmitz et al says that formaldehyde and it metabolites in the respiratory and olfactory mucosa, combine with macromolecules such as DNA, RNA and Proteins initiates its toxic effects.[1]

Dissecting human cadavers fixed and preserved in formalin solutions remains the gold standard method of teaching and learning anatomy in medical schools. This invariably exposes the students teaching, non-teaching faculty handling the cadavers to serious health risks ranging from inflammation of mucosa during short term exposures to malignancies due to exposures over long periods of time. Edward J Kerfoot et al says formaldehyde vapours is an upper respiratory irritant and produces majority of symptoms, holds good in our study too. Still its popular choice for embalming due to its excellent tissue fixative property.[2] Ohmichi et al stated that while dissecting the body cavity and deeper structures the indoor concentration of formalin vapour will be increased, that depends on contents and size of dissection hall.[3] Wei et al compared the time spent in dissection vs. to toxic symptoms due to formalin, less time spent less symptoms, in our study students spent 13 hours per week on all weekdays, almost all experienced symptoms.[4]

In current study out of the 100 students questioned all the 100 (100%) have expressed few or more health problems pertaining to the respiratory system experienced by them during and after their practical dissection hours. Most common symptoms reported was running nose 77%, followed by burning sensation of nose 75% and sore throat 37%. Farah et al stated that in his study out 74% irritation of nose, 29% had throat irritation, where as in our study 75 % had irritation of nose and 37% had throat irritation.[5] Anderson et al explained that symptoms are directly related to the concentration of dose, thereby increase in formaldehyde concentration causes dryness and burning of nose, sore throat, cough, when compared to this, in our study 75% had burning sensation of nose and 17% had dryness of nose, 37% had sore throat, 31% had cough.[6]

B.S. Mitchell quoted that reduction in formalin concentration does not cause much damage to specimens, but its helps for everyone as a safe work environment.[7] Coleman R et al says in dissection hall using of specialized dissection beds with a fitted internal motor with replaceable active carbon filter system that causes down flow of the formaldehyde rich vapours.[8] Bernstein RS et al, stated that in developed countries permissible exposure limit of formaldehyde is 3ppm in breathing zone for 8 hours, ceiling concentration is 5ppm and maximum of 10ppm is acceptable not more than 30 minutes for one day shift.[9]

In japan, Tanaka et al studies come across various symptoms due to formalin vapours such as nasopharyngeal tumours, so Japan Ministry of Education, Culture, Sports, Science and Technology (MEXT) has set norms and protocols for usage of gaseous formaldehyde in dissection hall.[10]

Walrath et al presented in the "Carcinogenic effects of formaldehyde on embalmers" at the CIIT Conference, New York, states that life expectancy of embalmers was at risk due to increased death due to cancer. Most common sites were nasal passages, buccal cavity, pharynx and larynx.[11]

Raja et al stated that while handling the specimens as well as dissecting the cadavers by using hand gloves, mask and percentage of formalin exposure was reduced there by reduction in their symptoms.[12]

Due to formalin toxicity, some of the researchers says ethanol glycerine fixation with thymol conservation as an alternative to formaldehyde and phenol in embalming stated by hammer et al in 2012.[13]

Among the students, because of this toxic effects, discourage for coming to dissection hall, in some cases complete withdrawn of the program also.[14]

In developed countries, strict rules and regulations as well as legal norms and guidelines are followed for the usage of formaldehyde, if same brought forward to developing countries.[15]

Conclusion:

Formalin is an excellent fixative and continuous to be the cheap and best preservative for human cadavers. But it irritates on the mucosa of respiratory tract producing symptoms ranging from running nose to wheezing. It also penetrates the mucosa entering into systemic circulation and producing ill effects on all others organs depending upon density of vapours inhaled and duration of exposure. Therefore, uniform standard guidelines must be derived to assess the levels of formalin vapour collecting in dissecting rooms to prevent over exposure to the fumes. Exhaust and ventilation equipment must be installed at ground levels to flush out vapours, because the vapours are heavier than air. Students and faculty in anatomy department dealing with formalin fixed cadavers must be well educated to minimise this exposure to formalin, like wearing protective vinyl framed splash guarded safety goggle with adjustable head strap, formaldehyde protective respirator face masks, neoprene or nitrile or butyl rubber gloves etc. Alternate methods of preserving human cadaver like plastination must be promoted.

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