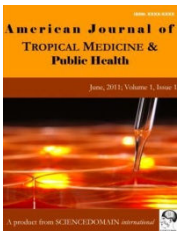

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Acute Effects of Formalin-Treated Cadaver on Nigerian Medical Students

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Research Article

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ABSTRACT

Aims: To determine acute effects of Formalin-Fixed Cadaver (FFC) among Nigerian medical students (MS)
Study design: A cohort study.
Place and Duration of Study: College of Health and Medical Sciences, Universities of Abuja and Maiduguri, Nigeria respectively, between January, 2010 and February, 2011.
Methodology: We conducted a survey of 226 MS for acute effects of FFC on general conditions (feelings), eyes, nasal and skin symptoms on their first and subsequent exposures during gross anatomy dissections. The duration for relieve of bodily symptoms and protective devices used to reduce the effect of formalin on bodily organs were documented.
Results: The most common feelings and symptoms among study cohort on first exposure to FFC include general discomfort 183 (81%), eye irritation/itching 108 (48%) and nasal irritation/itching 113 (50%). By the fifth hour after the first exposure most of the studied MS were relieved of eyes 177 (78%) and nasal 186 (82%) symptoms. On subsequent exposures, most 199 (88%) had no nasal symptoms and many 106 (47%) also had no eye symptoms. However, many still experienced at least mild eye 120 (53%) and nasal 27 (12%) symptoms. Many used bodily protective measures including laboratory coats 86 (38%), hand gloves 78 (35%) and eyes goggles 62 (27%) to reduce/prevent the toxic effects of formalin. Most 197 (87.2%) rated high the benefit of protective measures.
Conclusion: These findings confirmed the irritating actions of FFC on MS. Thus, the

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concentration of FFC for dissection should be controlled and the exposure time should be limited. User friendly alternative preservative to formalin can be sought. Education of MS on formalin related health hazards ahead of their first exposure and the use of protective measures among them should be highlighted.

Keywords: Bodily symptoms; formalin; health hazards; medical students;

1. INTRODUCTION

Formaldehyde is an organic compound discovered by a German chemist August Wilheim von Hofmann in 1867 (Schwarcz, 1943). Approximately 30 years following its discovery, formaldehyde was introduced to medical world as a disinfectant and tissue hardener (Waker, 1964). It is a simple aldehyde with the molecular formula CH_2O. At room temperature formaldehyde is a colourless gas, possesses flammable properties and has a repugnant odour. The importance of this compound can be deduced from the annual world production which was estimated to be 23 million tons in 2005 (Gunther et al., 2002). It is produced in animals and plants via natural metabolic processes but is usually rapidly metabolized through a metabolic pathway involving formaldehyde dehydrogenase (Bendino, 2004, Mason et al., 2004). Formaldehyde is soluble in polar solvents and its' aqueous solution is termed formalin. Formaldehyde has many uses which include disinfection, photography, tissue fixation and embalmment, wood production, textile industry processes, etc. Despite its widespread usage, a primary concern about formaldehyde is safety (IARC Monographs, 2006). Formaldehyde can be toxic, allergenic and carcinogenic (Hauptmann et al., 2009, Binawara et al., 2010). Exposure occurs primarily by inhalation of formaldehyde gas or vapour, or through absorption via the skin of formaldehyde containing fluids. These effects and associated disorders of formaldehyde exposure include airway irritation and obstructive disorders such as asthma (Binawara et al., 2010), ocular irritations, cancers such as leukaemias (Hauptmann et al., 2004) and nasopharyngeal cancers (Taskien et al., 1999), female reproductive disorders (Fowler et al., 1992) such as spontaneous abortions and menstrual irregularities, dermatitis (Khaliq and Tripathi, 2009), etc.

The toxicity of formaldehyde is worsened by the tendency to develop tolerance within a few hours of exposure by individuals in an environment harbouring the chemical. Such individuals may thus remain in environments of gradually elevated formaldehyde concentrations without necessarily being appreciative of the increased exposure levels and consequent hazards (Andersson and Molhave, 1983). Amongst the groups who are at risk of the effects of formaldehyde exposure are MS at dissections. A formaldehyde concentration higher than $0.5mg/m^2$ caused dose related symptoms like dryness in the nose, throat and conjunctiva (Loomis, 1979). More recently, it has been recognized as an allergic skin sensitizer (Keil et al., 2001). Studies have shown that evaporation of formaldehyde from formalin treated cadavers in the anatomy dissection rooms can produce high exposures amongst students (Gross et al., 1967). This study is to assess the acute effects of 10% formalin-treated cadaver on exposure by MS at dissection in Nigerian medical schools.

2. MATERIALS AND METHODS

This study was conducted between January, 2010 and February, 2011 among two hundred and thirty one (231) 200 and 300 levels students [including Bachelor of Science Anatomy (B.Sc.); Bachelor of Medicine and Surgery (MBBS) and Bachelor of Dental Surgery (BDS)] of Universities of Abuja and Maiduguri, Nigeria. For the purpose of this study all the studied cohort will be referred to as medical students (MS).

The students had cadaver dissection as a compulsory course in human anatomy. Cadavers treated with 10% formal saline were allowed for 24 hours, and then the following day the students were exposed to it at their first dissection.

The objective of the study was explained to each of the MS and assurance was given that the information to be collected would be used for research purpose only. Also, the MS were requested to avoid peer group filling of the questionnaires as it was not about right or wrong judgments or about award of marks for examination purposes. Both male and female students had equal distribution of the questionnaires.

After participants were informed, consent was obtained from each participant; a self-administered semi-structured questionnaire was given to each participant for completion. The questionnaire bothered on students' experiences during their first and subsequent exposures to FFC at the gross anatomical dissections. The experiences were categorized including general feelings, effects on eyes, nostrils and skin. The estimates of duration for relieve of symptoms of effects of formalin as well as some protective measures towards reducing the effects of formalin were noted.

The data was collated and simple proportional analysis carried out.

3. RESULTS

Out of 231 questionnaires distributed, 226 were filled and returned (response rate, 98%). The most common feelings and symptoms among studied MS on first exposure to FFC include general discomfort 183 (81%), eye irritation/itching 108 (48%) and nasal irritation/itching 113 (50) (Table 1).

The estimated duration for relief of bodily symptoms among the MS after their first exposure to FFC is as in Table 2. By the fifth hour after the first exposure most of the MS were relieved of eye 177 (78%) and nasal 186 (82%) symptoms (Table 2).

Following subsequent exposures, most 199 (88%) were no longer having nasal symptoms and many 106 (47%) were no more having eye symptoms. However, many still experienced at least mild eye 120 (53%) and nasal 27 (12%) symptoms (Table 3).

Table 1. Feelings and Symptoms experienced on first exposure to formalin-fixed cadaver

Feelings/Number of respondents (%)		Symptoms in the affected body areas/ Number of respondents (%), N=226					
		Eyes		Nostrils		Skin	
Discomfort	183 (81)	Irritation/itching	108 (48)	Irritation/itching	113 (50)	Irritation/itching	2 (1)
Nausea	21 (9)	Tearing	93 (41)	Discharge	77 (34)	No symptoms	224 (99)
Vomiting	9 (4)	Redness	21 (9)	Sneezing	28 (12)		
Collapse	2 (1)	Blurring	3 (1)	Blockage	3 (1)		
Normal	11 (5)	Spasm	1 (1)	Suffocation	5 (3)		

% = percentage

Table 2. Durations for relief of symptoms on first exposure to formalin-fixed cadaver

Duration	Relieved affected body areas/ Number of respondents (%), N=226		
	Eyes	Nostrils	Skin
<1 hour	86 (38)	84 (37)	2 (0.9)
1-5 hours	91 (40)	102 (45)	
6 hours - 1 day	43 (19)	40 (18)	
>1 day	6 (3)		

% = percentage

Table 3. Cohort bodily adaptations to subsequent exposure to formalin-fixed cadaver

Degree of symptoms	Symptoms in the affected body areas/ Number of respondents (%), N=226		
	Eye	Nostrils	Skin
Nil	106 (47)	199 (88)	221 (98)
Mild	75 (33)	20 (9)	5 (2)
Moderate	35 (16)	7 (3)	
Severe	10 (4)		

% = percentage

A number of bodily protective devices were used by MS to reduce/prevent the toxic effects of formalin (Figure 1).

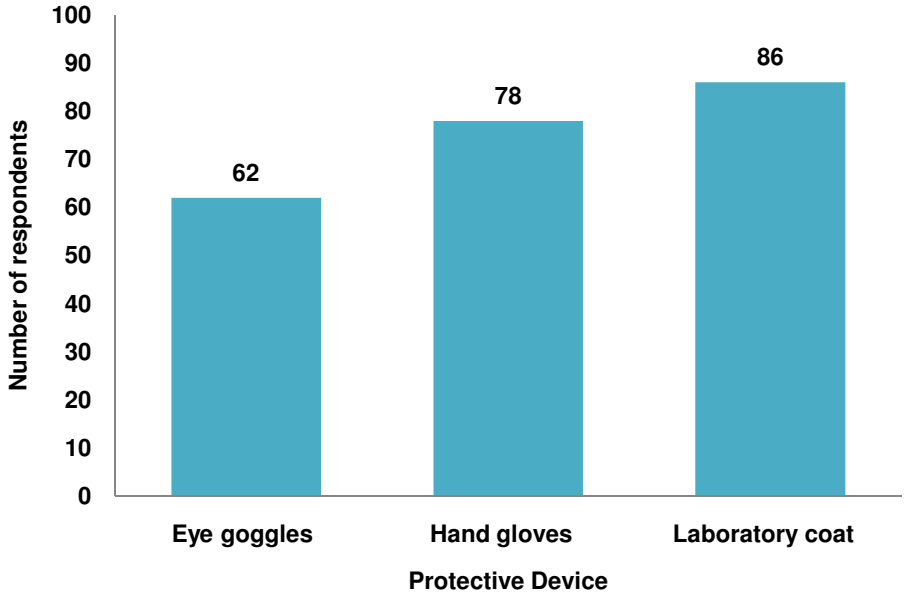

Fig. 1. Distribution of respondents by protective devices used during dissection of formalin-fixed cadaver

Note: Some indicated use of multiple protective devices while some did not indicate any.

Most of the MS with a response 197 (87.2%) rated high the benefit of protective devices for formalin (Figure 2).

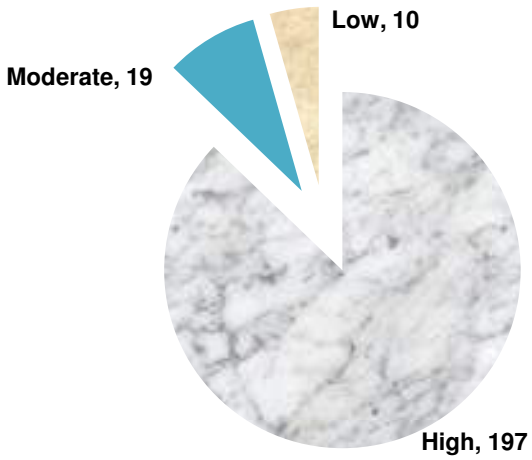

Fig. 2. Respondents' benefit rating of protective role of devices use during dissection of formalin-fixed cadaver

4. DISCUSSION

The benefits of formaldehyde include among others disinfection, photography, tissue fixation and embalmment, wood production and textile industry processes. This notwithstanding formaldehyde has its shortcomings; it is toxic, allergenic and carcinogenic (IARC Monographs, 2006; Binawara et al., 2010). The result of this study has shown that MS developed toxic effect on acute exposure to FFC during gross anatomy dissection session.

Except for 11 (5%) of the studied MS, most (95%) were symptomatic including discomfort, nausea, vomiting and collapse on their first exposure to FFC due to its irritant nature as found in this study (Loomis, 1979). It is possible that diffuse formalin vapour (irritants) excites mast cells (in the conjunctiva, nostril) and release chemicals including histamine, serotonin etc which provoke vascular engorgement. The irritating odour of this noxious gas may provoke or exacerbate asthmatic symptoms in MS (Yodaiken, 1981). Though, this study bothered not about history of asthma among the studied MS however; idiosyncrasy as well as a history of atopy might play a role on its severity on acute exposure to FFC. Also, formalin vapour might mix with the cornea tear film/moist nasal surface (Kanski, 2001) causes cornea/nasal irritation with vascular engorgement. These might provoke ocular itching, tearing, redness; nasal discharge and sneezing as found in this study. Engorged nasal vessels could induce nasal blockage leading to reduce air exchange/flow and sense of suffocation as also reported by some of the MS (Yodaiken, 1981). The blurring of vision as reported in this study could result from disruption of refraction of light rays on the cornea-tear interface caused by light scattering on account of excess tears from reflex tearing (Kanki, 2001).

It was of note that only 1% of studied MS experienced skin irritation/itching following their first exposure to FFC unlike many who had eye and nasal symptoms. This might be due to fact that formalin is classed upper respiratory irritant but has local (skin) irritant qualities (Keil et al., 2001). Aside usually, the MS rarely get in contact with 'liquid' formaldehyde (formalin) during cadaver dissection. Furthermore, the MS made use of devices including eyes goggles, hand gloves and laboratory coats at dissections.

It is remarkable that as many as 47% and 88% of studied cohort reported no eye and nasal symptoms respectively on their subsequent exposures to FFC. Furthermore, most of the rest MS only admitted to mild to moderate eyes and nasal symptoms. This might be due to MS tolerance over time due to the low concentration (10%) FFC used. This is not without implication as individuals may be exposed and get adapted until a toxic level of formaldehyde and consequent hazards (Loomis, 1979).

The time interval for the relief of eyes and nasal symptoms in about one third of the MS was below an hour and more among the rest two third. This is may be due to the fact that the irritant effects are reversible when exposure is discontinued (Keil et al., 2001). Hence, the concentration of formalin should be controlled by trainers before exposure of MS to FFC. Furthermore, it is necessary for trainers/instructors to educate the MS ahead of their first exposure to cadaveric dissection the expected challenges and possible health implications of their exposure to formalin.

Many (87%) studied MS found useful during cadaver dissection protective devices such as eyes goggles, hand gloves and laboratory coats. It is indisputable that these protective devices to some extent protect bodily areas against direct contact with formalin; however, it is ineffective in preventing formalin vapour from being absorbed and inhaled by conjunctiva

of the eye and nasal mucosa respectively. Thus this may explain why some of the MS rated the benefit of these devices as either moderate or low protective.

5. CONCLUSION

So far, this study demonstrates the irritating and sensitizing actions of FFC on MS. Thus the toxicity is of importance to both the trainer and MS. Therefore, the concentration of FFC for cadaver dissection should be minimal and controlled for adaptability by MS. Again the exposure time to FFC should be planned and integrated in the dissection schedule. Also, there should be concerted effort towards getting user friendly alternative preservative to formalin. Finally, trainers should educate MS on the formalin related health hazards ahead of their first exposure and encourage the use of protective measures among them.

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REFERENCES

Andersson, I., Molhave, L. (1983). Controlled Human Studies with Formaldehyde. In: Gibson J.E (ed) Formalin Toxicity. Washington. Hemisphere Publishing Corporation, 154-165.

Bendino, J.H. (2004). Formaldehyde Exposure Hazards and Health Effects; a Comprehensive Review for Embalmers, Champion Expanding Encyclopaedia of Mortuary Practices, 650, 2.

Binawara, B.K., Rajnee, choudhary, S., Mathur, K.C., Sharma, H., Goyal, K. (2010). Acute Effect of Formalin on Pulmonary Function Tests in Medical Students. Pak J Physiol., 6(2), 8.

Fowler, J.F. Jr., Skimmer, S.M., Belsito, D.V. (1992). Allergic Contact Dermatitis from Formaldehyde Resins in Permanent Press Clothing: an under Diagnosed Cause of Generalized Dermatitis. Journal of American Academy of Dermatology, 962-8.

Gross, P., Rinehart, W., deTreville, R. (1967). The Pulmonary Response to Toxic gases. Am Ind Hyg Assoc J., 28, 315.

Gunther, R., Walter, D., Armin Otto, G., Albrecht, H. (2002). “Formaldehyde” in Ullmann’s encyclopaedia of Industrial Chemistry. Wiley-VCH, Weinheim.

Hauptmann, M., Stewart, P.A., Lubin, J.H., Beane Freeman, L.E., Hornung, R.W., Herrick, R.F., Hoover, R.N., Fraumeni, J.F. Jr, Blair, A., Hayes, R.B. (2009). Mortality from Lymphohaematopoietic Malignancies and Brain Cancer among Embalmers Exposed to Formaldehyde. Journal of the National Cancer Institute, 1001 (24), 1696-1708.

Hauptmann, M., Lubin, J.H., Stewart, P.A., Hayes, R.B., Blair, A. (2004). Mortality from Solid Cancers among Workers in Formaldehyde Industries. American Journal of Epidemiology, 159(12), 1117-1130.

IARC. (2006). Monographs on the Evaluation of Carcinogenic risks to Humans 88, Formaldehyde, 2-Butoxyethanol and I-tert-Butoxypropranolol-2-ol. International Agency for Research on Cancer, 36-325.

Kanki, J.J. (2001). Clinical Ophthalmology. 6th edition. Butterworth-Heinemann-Elsevier. China, 153.

Keil, C.E., Akbar-Khanzedeh F., Konency, K.A. (2001). Characterizing Formaldehyde Emission Rates in a Gross Anatomy Laboratory. Appl. Occup. Environ. Hyg., 16, 967-972.

Khaliq, F., Tripathi, P. (2009). Acute Effects of Formalin on Pulmonary Functions in Gross Anatomy Laboratory. Indian Journal of Physiology and Pharmacology, 53(1), 93-96.

Loomis, T.A. (1979). Formaldehyde toxicity. Arch Pathol. Lab. Med., 103, 321-324.

Mason, D.J., Sykes, M.D., Panton, S.W., Rippon, E.H. (2004). Determination of Naturally-occurring Formaldehyde in Raw and Cooked Shiitake Mushrooms by Spectrophotometry and Liquid Chromatography-mass Spectrometry. Food Addit Contam, 21(11), 1071-1082

Schwarcz, L. (1943). Sanitary Products. Mac Nair-Dorland Company, 61.

Taskien, H.K., Kyyronen, P., Sallmen, M., Virtanen, S.V., Luikkonen, T.A., Huida, O., Lindbohm, M.L., Anttila, A. (1999). Reduced Fertility among Female Wood Workers Exposed to Formaldehyde., American Journal of Industrial Medicine., 36, 206-212.

Waker, J.F. (1964). Formaldehyde, Reinhood, New York. 3rd ed., 483-510.

Wilhelmsson, B., Holmstrom, M. (1987). Positive Formaldehyde-RAST after Prolonged Formaldehyde Exposure by Inhalation. Lancet 2, 164.

Yodaiken, R.E. (1981). The uncertain Consequences of Formaldehyde Toxicity. JAMA 246, 1677-1678.

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