Research Article

Effect of formaldehyde on nasal mucosa in workers exposed to formaldehyde

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Abstract

Formaldehyde is a chemical widely used in variety of industries and professions including hospitals. The aim of the study was to determine carcinogenicity or any adverse effect of formaldehyde used for fumigation in the operation theatre. The study was carried out on group of 30 people working in the operation theatre and their nasal mucosal histological findings were compared with control group of 25 workers selected with regard to age and smoking habits but with no exposure to formaldehyde. Nasal mucosal swabs were taken from middle turbinate and two slides were smeared for each worker. One smear was fixed with alcohol and one kept dry. Alcohol fixed smear was stained with Heamatoxylin and eosin while dry slide stained with Giemsa. Stained smears were studied under microscope and graded by histological/morphological changes. In the present study, cytotoxic effect of formaldehyde was seen in the form of changes in mucosa i.e inflammation, goblet cell hyperplasia, metaplasia and dysplasia. Changes were more in workers who were exposed to formaldehyde for a longer time. As this study was on the small scale, larger number of cases should be studied for conclusion.

Keywords: Formaldehyde, Carcinogenicity, Nasal mucosa

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INTRODUCTION

Formaldehyde is a chemical widely used in variety of industries and professions including hospitals[1-3]. Formaline is commercially available as a 40% solution and when it is heated formaldehyde vapours generated. Its maximum exposure limit is 2 ppm. It can be toxic, allergenic and carcinogenic[4-5]. At concentration above 0.1 ppm in air formaldehyde may cause headache, burning sensation in the throat, difficulty in breathing and aggravate asthma symptoms. To sterilize operation theatre formaldehyde gas is widely employed for fumigation. 100 ml of formaline + 900 ml of water is used for fumigation of 1000cu feet of space. During the past few years some controversy has arisen over the possible risk of human cancer posed by exposure to formaldehyde. Inside the nasal cavity the surface of the turbinates and meatuses are lined by respiratory mucosa i.e. pseudostratified ciliated columnar epithelium.

AIMS AND OBJECTIVES

To compare the histological changes in nasal mucosa of cases and control group, in order to determine carcinogenicity or any adverse effect of formaldehyde used in fumigation.

MATERIALS AND METHODS

The present study was conducted in the department of ENT and Pathology in tertiary hospital Mumbai. By taking a careful history of the exposure time, past disease, duration to workplace exposure and smoking habits, nasal smears were taken from 30 people working in operation

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theatre including anesthetist. Clinical evaluation done by examination of the nose and nasopharynx. Nasal mucosal swabs were taken from middle turbinate and 2 slides were smeared for each worker. The anterior curvature of middle turbinate was chosen because it is easily identified and it is believed that the tumour favour this region because paricles have tendency to deposite here[6,7,8.] One smear was fixed with alcohol and one kept dry. Alcohol fixed smear was stained with Heamatoxylin and eosin while dry slide stained with Giemsa. Stained smears were studied under microscope and graded by histological/morphological changes. The histological findings compared with a control group of 25 workers selected with regard to age and smoking habits but with no exposure to formaldehyde.

RESULTS

Table 1

Period of exposure	No. of workers exposed	Inflammatory changes	Goblet cell hyperplasia	Squamous Metaplasia	Dysplasia
6 mnths to 1 yr	5	5	1	-	-
1 yr to 3 yr	11	10	6	5	-
3 yr to 6 yr	7	7	6	4	2
6 yr to 12 yr	**7**	**7**	**7**	**7**	**3**

Out of 25 Workers who were not exposed to formaldehyde, inflammatory changes seen in 13 who were also having history allergic rhinitis. 2 workers had goblet cell hyperplasia with history of smoking.

DISCUSSION

Formaldehyde is known to cause irritation to skin, upper respiratory tract, allergic eczematous contact dermatitis and asthma[6.] It is mutagen in fruitfly and in certain bacteria[7,8], is carcinogenic in mice and rat after long term inhlational exposure[9]. Similar pathological changes have earlier been reported due to age, smoking and various occupational exposure[10,11,12] In animal experiments formaldehyde has been shown to induce nasal cancer at rather high exposure level 5-14 ppm. The tumours show a sharp concentration response relation with none occurring in the 2 ppm group. At that exposure level, however, epithelial dysplasia 7 squamous metaplasia were found, the same histopathological changes as found in this study. When considering the carcinogenicity response to formaldehyde It has been discussed whether it is an epigenetic or a genetic reaction. The epigenetic reaction is not due to the reaction of the chemical with DNA but due to the overload of the normal DNA repair mechanism. The important difference in epigenetic, as opposed to genetic, mechanism is that in a genetic mechanism there is potential, no matter how small, for response at any exposure level. An epigenetic mechanism, however, implies a threshold level below which there is no response. The animal data on formaldehyde toxicity suggests that it is an epigenetic agent[13] and that formaldehyde induced metaplasia is an irritant response[14]. We have not been able to study the question of reversibility but if the effect is that of an irritant one might expect a change in the nasal mucosa, such as dysplasia, should be considered to be precancerous[10]. In the present study a possible risk of cancer not only is the endpoint of interest but also the possibility of early detection of any precancerous lesion. Metaplasia is the reversible replacement of one differentiated cell type with another mature differentiated cell type. The change from one type of cell to another may generally be a part of normal maturation process or caused by some sort of abnormal stimulus.

Figure 1: Metaplasia

Dysplasia is the abnormality of development; it is the earliest form of a precancerous lesion.

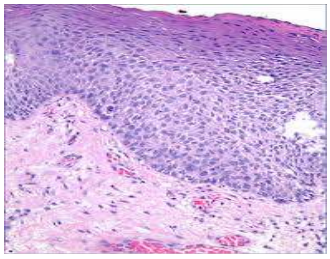

Figure 2: Dysplasia

CONCLUSION

In the present study, cytotoxic effects of formaldehyde is seen in the form of changes in mucosa i.e. inflammation, goblet cell hyperplasia, metaplasia and dysplasia. Changes were more in workers who were exposed to formaldehyde for a longer time. These changes may cause

an inhibitory action on mucociliary function of nasal mucosa which is responsible for development of chronic rhinitis and sinusitis. Metaplasia might however be prerequisite for the development of dysplasia.

A recent study suggests that a higher incidence of epithelial alteration may be detected with this method than small biopsies. The cytological method may therefore be the method of choice in future screening for nasal epithelial alterations. As this study was on the small scale, larger number of cases should be studied for conclusion.

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