Formalin Effects on the Nose and Throat of Personnel of Anatomical Sciences Departments in Iran Medical Schools

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Additional Files:
- Manuscript
- Illustration 1
- Illustration 2
- Illustration 3
Formalin Effects on the Nose and Throat of Personnel of Anatomical Sciences Departments in Iran Medical Schools

Author(s): Namavar M

Abstract

Background: Formaldehyde (and its compositions) is a chemical substance that is widely used in chemical industries (detergents, cosmetics and so on), medicine (for sterilization of operation room and its instruments and fixation of histological specimens and cadavers) and even in textiles and papers.

Methods: In recent years many studies have been done in formalin effects on people health. But anybody did not study formalin effects on nose and throat in persons that have direct contact with this substance in Iran. For this reason, questionnaires were sent to personnel of anatomical sciences departments in medical schools were selected as experimental group and personnel of high schools as control group. Questionnaires were prepared that had following indexes: Nasal signs (runny nose and smell sense changes), throat signs (sore throat), occupation, sex, age, formalin contact (duration and direct or indirect contact) and diseases history. Data were analyzed by Chi-square test.

Results: Results showed that contact with formalin causes decrease (or loss) of smell sense and increase of runny nose and sore throat. These changes have direct relation with contact duration and direct contact. Relation between contact with formalin and these changes is significant (P < 0.05).

Conclusions: Formalin decreases smell sense and increases runny nose and sore throat. It is suggested that people should not have any direct contact with formalin. Also, departments of anatomical sciences use low formalin (or formalin free) agents for fixation of cadavers.

Introduction

Formaldehyde (HCHO) is a flammable, colourless, pungent and chemically reactive and readily polymerized gas at normal temperature that heavily used in many industries (detergents, cosmetics, wood products etc.), medicine (as disinfectant and preservative) and even in textiles and papers. It is also a component of cigarette smoke and diesel exhaust. It is found frequently in indoor and outdoor air. Its odour is detected and/or recognized by most human beings at concentrations below 1 part per million (1 ppm formaldehyde = 1.2 mg/m3). Many studies have been conducted on health effects of formalin. When it occurs in the air at higher levels than normal, it has short and long time effect on body structures. It causes tearing and burning sensation in the eyes. It causes skin eruption and dermatitis as well. It affects upper airways and may trigger asthma attacks in asthmatics and cause irritation and dryness of nose and throat. Controversy surrounds its acute and chronic effects on the function of the respiratory system.

Formalin is a genotoxicant and increase numbers of DNA-protein cross-links have been found in the upper respiratory tract of monkeys and in the rat nasal mucosa. It causes cancer in the nasal passages and lungs of rodents. Overall, IARC (2004) concluded that formaldehyde is carcinogenic to humans on the basis of sufficient evidence in humans. IARC has classified formalin as Group 2A carcinogen.

Formalin metabolizes rapidly, for this reason, it rarely reaches to lower respiratory tract, nevertheless, it causes bronchitis, cough, respiratory tract obstruction and asthma. It affects upper airways and may cause irritation and dryness of nose and throat. Respiratory tract irritation, on the one hand, is localized pathophysiological response to a chemical involving local redness, swelling, pruritis or pain. On the other hand, respiratory tract irritation and eye irritation can also involve a chemosensory irritation effect, i.e., interaction with local nerve endings (trigeminal nerve) which is called trigeminal stimulation or sensory irritation. Over a broad range of concentrations, the trigeminal stimulation will not necessarily lead to cell or tissue damage. The onset of the response is usually observed within a few seconds and when low enough it will be characterized by a pause during the expiratory phase of respiration. From the results of the long-term inhalation toxicity studies in experimental animals, a level of 1 ppm formaldehyde has been considered a NOAEL for nasal injury.

Besides various experimental techniques, subjective measurements such as questionnaires can be used to study chemical induced irritation, such as nasal or
throat irritation in humans. Since the type and magnitude of chronic effects of formaldehyde on the nose and throat were unresolved by these studies, we studied employees in departments of Anatomical Sciences in Iran for effects by comparing them with a stratified random population sample of employees of high schools in Iran.

Methods and Materials

There were two questionnaires. First questionnaire comprising 7 questions was applied for heads of departments of Anatomical Sciences. There were questions about work place (number of cadavers for dissection in one year, formalin amount for fixing a cadaver and refreshing it or in histology lab, ventilation in labs, using fridge for preserving cadaver). Second questionnaire form was applied to the employees who accepted to participate. This questionnaire form comprising two pages. First page questions was about work place and employee personal information (name of university, age, sex, occupation, education, former occupation of employee, cigarette, disease history, duration of working in department of anatomical sciences, duration of formalin contact in year, month, week, and day, direct or indirect contact to formalin, distance to dissection room or histology lab, severity of formalin odour). Second page questions were about some symptoms observed since working in this department (runny nose, changing of smell, and sore throat and other symptoms about other system).

Questionnaires were sent to personnel in departments of anatomical sciences as experimental group (n=160) and personnel of high schools as control group (n=100) of Iran Symptom questionnaires were completed. Smell changes was scored as 1 = decreased, 2 = no change. For runny nose (nasal discharge) and sore throat scores were as 1 = increased, 2 = no change. Statistical calculations (including regression analysis, percent, $\chi^2$) were performed with a Pentium IV computer using SPSS 11.5.0 (SPSS Inc, USA). Analysis of variance using the SPSS statistical program in a Pentium IV computer compared function values for employees with the samples of high schools personnel. A P value of less than 0.05 was used to demonstrate significance.

Results

None of the workplaces (in date that questionnaire were completed, before 2002) used any form of ventilation other than fans and natural ventilation (windows and doors). Some workplaces were not ventilated on a daily basis, while others were ventilated for up to 8 hours a day. There were 160 persons (42 females and 118 males) who accepted to participate. There were 103 professors (64.4%), 37 personnel (23.1%), and 20 service worker (12.5%). Twenty-seven (16.9%) of participants were younger than 30 years old, 120 (75%) were 30-50, and 13 (8.1%) older than 50 years old. Working duration in these departments for 69.9% of participants was less than 10 years, 22% 10-20 years, and 8.1% more than 20 years.

In $\chi^2$ test, significant association was found between smell change and occupation, former occupation, direct contact with formalin ($P < 0.05$), but there was no significant difference between smell change and other variables (Illustration 1).

No statistically significant association was found between runny nose and variables except sex ($P < 0.05$) (Illustration 2), although most of employees had runny nose whenever they were working in dissection or histology labs.

In $\chi^2$ test, there was only significant association between sore throat and distance of working place from dissection or histology labs ($P < 0.05$), but there was not found any significant association between sore throat and other variables (Illustration 3).

The multiple logistic regressions were also used to study synchronous effects of effective variables upon smell change, runny nose and sore throat. This analyze showed that age and direct contact with formalin are effective variables on smell ($P = 0.044$). Occupation in departments of Anatomical Sciences and working in other places in that time (secondary occupation) of employees were two effective variables on runny nose ($P = 0.016$). For sore throat, they were occupation and former occupation of employees ($P = 0.044$). The control group did not significant change any signs and symptoms as compared with experimental group ($P >0.05$)

Discussion

Sensory irritation induced by formalin in humans mainly consists of eye and nasal/throat irritation even an anatomy laboratory below 0.75 ppm for very short-lives persons. In most studies, only subjective methods (questionnaires) were used to examine eye or nasal irritation. In these studies, it appeared that both eye irritation as well as nasal irritation was reported in healthy volunteers at level below 1 ppm. Overall, studies have shown that formalin level ≥1 ppm.
causes eye irritation, \( \geq 2 \) ppm causes nasal irritation and \( \geq 3 \) throat irritation. Most of studies in humans have been done are upon cellular changes in nasal cavity and throat. There is also some case reports about formalin effect on nose and throat as well, but there is few study about formalin effects on smell, runny nose and sore throat. In the present study, data analysis showed that direct contact with formalin decreased smell sense (P = 0.05). It is in line with previous studies. In those studies, smell decrease was dependent upon formalin levels. This association was also significant for occupation and former occupation of employees (P = 0.037 and 0.045, respectively). For example, employees who were working in hospital or laboratory, their smell sense decreased 1.82 times of those who were not. Multiple logistic regression study showed that employees have had direct contact with formalin decreased smell sense 3.11 (odd-ratio) times of employees without contact with formalin.

For runny nose, there was only significant association with sex (P = 0.049). Males had runny nose 2.09 times of females. There was only one report that female increased runny nose three times of males. That study was carried out on students with short time contact and only for few sessions contact. This study showed that employee distance to dissection or histology labs are important variables for sore throat (P = 0.029). For example, technicians who were working on dissection rooms had 2.02 times sore throat more than employees whose work places were about 10 meters away. In another study that has used 2% formalin for fixing cadavers, found sore throat in only 10.6% of students. We expected that formalin odour should have association with smell sense, but it was not significant (P = 0.09).

Employees indicated that these symptoms (especially runny nose) were more severe during their first years in this branch of employment, but that they decreased over time, as they get accustomed to the work environment. This suggests that employees in this branch may develop a formalin tolerance. This finding is in line with one study in Turkey.

It is concluded that direct contact with formalin can decrease smell sense and increase runny nose and sore throat.

It is recommended that departments of anatomical sciences should improve ventilation in the dissection and histology labs with high formalin levels, as well as training of employees on the importance of ventilation. Symptoms such as runny nose were higher in employees with direct contact with formalin; therefore similar studies should be carried out in anatomical departments with measuring formalin level in workplaces. Also, departments of anatomical sciences use low formalin (or formalin free) agents for fixation of cadavers.

**Acknowledgement**

We thank Mr. Mohammad Hossein Tabatabayi, faculty member of Shiraz University of Medical Sciences, for data analyzing. This study was financially supported by Vice-chancellor of Research of Shiraz University of Medical Sciences.

**References**

Illustrations

Illustration 1

Relation Between Smell Sense change and variables in Employees in departments of Anatomical Sciences at Iran

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Formalin, Formaldehyde, * Statistically significant
Illustration 2

Relation Between Runny Nose change and Variables in Employees in Departments Of Anatomical Sciences at Iran

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*Statistically significant
Illustration 3

Relation Between Sore Throat Change and Variables in Employees in Departments Of Anatomical Sciences at Iran

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formalin, Formaldehyde; * Statistically significant
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