

Exposure of Medical fraternity to formaldehyde in Anatomy and search for better alternatives to formalin

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Abstract: The adverse effect of formalin has been discussed many times in medical literature. Anatomists and paramedical workers are all exposed to formalin, and many complaints of irritation of eyes, contact dermatitis and breathlessness have been reported. Moreover formalin has been recently classified as carcinogen which is even suspected of causing adverse reproductive and developmental effects

Formaldehyde is a colorless gas with a pungent odor which is commonly used as a tissue preservative in medical laboratories and embalming. It is commonly bought as 37% solution in water known as formalin (with 10% methanol as stabilizer). The high solubility of formaldehyde in water causes rapid absorption in respiratory and GIT tract. Medical students, anatomists and laboratory technicians are subjected to prolonged exposure to formalin as it is used for preservation of cadavers. Number of acute and chronic health effects has been reported from exposure to formaldehyde. The most common symptoms generally encountered are fatigue, burning eyes and nose. Numerous studies in humans and experimental animals have demonstrated that inhaled formalin produce toxicity, genotoxicity and cancer at distal sites^{1,2}.

I. Minimal permissible limit of formalin

All around the world, the occupational health authorities have laid down permissible level of exposure to formaldehyde through inhalation. These levels are based on outcome of epidemiological and toxicological tests on exposure to formaldehyde in both humans and animals models. The legal standards include²

- 1 Ceiling Limit – limit which should not exceed during working hours even for an instance
- 2 Short term exposure level – is the concentration level which employees can expose themselves for 15 min without any adverse health effects
- 3 Time weighted average concentration – average conc about 8 hr\ working day which all employees are exposed to without any adverse health effects

In the countries of developed world their department of Occupational safety and health administration has defined TWA and STEL permissible exposure limit². The TWA limit is defined as 0.75 parts formaldehyde per million parts of air as a 8 hour time weighted average and STEL limit is defined as 2 parts formaldehyde per million part of air averaged over any 15 min period. At concentration above these permissible limits, protective measures should be employed like giving respirators, putting administrative controls, exposure monitoring and other required procedures. But in India there are no standards for air monitoring of formaldehyde levels in dissection hall. In the last 14 years of my medical career I have never seen anybody monitoring air level of formalin in dissection hall.

Properties of formalin³

- 1 Aqueous solution of about 37% of formaldehyde is called formalin.
- 2 Formaldehyde is a colorless, flammable gas with a pungent odor at room temperature
- 3 Formaldehyde metabolizes easily to formic acid after inhalation.
- 4 Formaldehyde is also rapidly absorbed by gastrointestinal tract because of its presence in various food products like coffee, fruits, etc.

Sources of formaldehyde

Formaldehyde is ubiquitous in our environment

- 1 Formaldehyde is a biogenic compound and part of plant and atmosphere exchange process.
- 2 High formaldehyde concentration is found in urban air which is heavily polluted due to combustion by vehicles, wood or coal burning stoves and cigarettes smoking
- 3 There are many sources of formaldehyde in indoor environment such as electronic equipment, fabric dyes, insulation material in walls and flooring and many others

II. Uses of formalin

Formalin was first described by Russian scientist Alexander Michailowitsch Bullerow in 1855 as quoted by Salthammer T et al³. It has a versatile use in industrial and medical field. Formaldehyde based materials are key to automobile industry, textile industry and used as adhesive in plywood or carpeting. It is also in various cosmetic and personal hygiene products. Thus it is not only medical professional but general public can also suffer adverse health effects due to formalin exposure.

Formalin is also used as preservative, disinfectant and biocide. It is also used topically to dry the skin for treatment of warts. It is also used to kill contaminating bacteria and viruses in vaccine products⁴. In anatomy formalin solutions are used as fixative for microscopy and histology. It is used in embalming to preserve human bodies. Though formalin cannot be used for lifelong preservation, it just prolongs the decaying process. Several western countries have restricted the use of formalin, there are no such rules in India, governing the use of formalin and of it's inclusion in occupational health hazards. The anatomists all over India keep suffering from exposure to formalin.

III. Formaldehyde and nasopharyngeal carcinoma

The major adverse health effects of formaldehyde is the tumors in upper respiratory tract. Many studies in which nasal squamous cell carcinoma in rats have been induced due to exposure to formaldehyde have been conducted².

IV. Conclusion

The acute toxic effects of formalin are well known in medical fraternity. To limit the exposure of formalin, various methods are being followed, like well ventilated dissection hall, use of exhaust fans and use of gloves during dissection. An excellent alternative to formalin that is phenoxyethanol is being used for preservation by few medical colleges. The efficacy of phenoxyethanol as a preservative and fixative is supposed to be better than formalin⁵ and irritating smell associated with formalin is also absent, but is more costly than formalin. Another alternative to formalin use is thiel embalming as suggested by Eisma R et al⁶. Thiel fixed specimens have more life visual and haptic properties but is more expensive and have restrictions for students dissection in facilities with limited storage space and air circulation. Moreover thiel fixed specimens are not suitable for histological investigations and thus more research work is required on thiel fixed specimens

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