A STUDY ON THE ADVERSE EFFECTS OF FORMALDEHYDE ON THE STAFF OF ANATOMY DEPARTMENTS WORKING IN VARIOUS MEDICAL COLLEGES

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ABSTRACT: Formaldehyde is the widely used chemical for embalming cadavers, for fixation of tissues in histology, for fumigation of operation theatres and sterilization of surgical instruments. Formaldehyde cannot be absorbed through the skin but becomes vapor at room temperature. Anatomists, pathologists, forensic surgeons, staff of dissection hall, embalming laboratory, histology laboratory and medical students will get exposure of formaldehyde gas.

It is estimated that an anatomist gets exposed to formaldehyde (gas) for about 30,000 - 60,000 hours in his/her lifetime. Formaldehyde is the “drug of choice” for above purpose if it is used with proper precautions, but it can produce harmful effects on many systems as on skin, respiratory system, central nervous system, gastrointestinal system and produce minor to major problems ranging from burning of eyes to carcinomas.

A cross sectional survey is conducted by selecting 120 members of anatomy staff (both teaching and nonteaching) who are working in colleges in and around Hyderabad city. The effect of formalin on above group is studied. Results of this survey are grouped system wise and known protective measures are discussed.

KEY WORDS: Formalin, anatomy staff, systemic effects.

INTRODUCTION: Formalin, an aqueous solution of formaldehyde, is the chemical most commonly used for embalming. In 1867, the German chemist August Wilhelm von Hofmann identified formaldehyde, which is a colorless, flammable gas that is quite soluble in water. Formaldehyde is colorless at room temperature and has an irritating, pungent smell. It is commercially obtainable as formalin, which contains 37% by weight or 40% by volume of formaldehyde gas in water. In the body, formaldehyde quickly metabolizes to formic acid. The measurement of formate (formic acid minus 1 hydrogen ion) levels indicates the severity of formaldehyde intoxication.

Faculty of anatomy, staff of histology and embalming laboratory, medical students are getting exposure of formaldehyde gas. Gas evaporated from embalmed bodies in an important factor which is responsible for its harmful effects.

Concentration of this formaldehyde gas will be highest as the bodies are removed from the tanks and it slowly decreases with in 30mts to 1 hr. Authorities of America have
set a ceiling of 0.3 ppm for formaldehyde gas and authorities of Japan set the ceiling between 0.008 to 0.3 ppm. The ceiling levels are assessed by taking air samples from different places by using a diffusive sampling device for organic carbonyl compounds and analyzed through high performance liquid chromatography. The recommended airborne exposure limits are 0.016 ppm averaged over a 10-hour work shift and 0.1 ppm not to be exceeded during any 15-minute work period (Agency for Toxic Substances and Disease Registry [ATSDR], 1999).

Formaldehyde gas produces its effects on many systems. It produces various effects like

1. Irritation of eyes
2. Irritation of air passage mainly upper respiratory tract
3. Contact allergic dermatitis
4. Vertigo
5. Convulsions
6. Pain abdomen, nausea, vomiting
7. Renal failure

A cross-sectional survey is conducted on anatomy staff and medical students of various colleges of Hyderabad and results as per system are grouped, analyzed to assess the magnitude of the problem.

**MATERIAL AND METHOD:** A group of 120 members are selected from Deccan College of Medical Sciences, Osmania Medical College and Gandhi Medical Colleges. This group is composed of 40 teaching staff members, 20 non-teaching staff members, and 60 Medical students. They are working in the anatomy department for a period ranging 1 year to 25 years.

A format as shown was prepared. It includes

1) Preliminary data
2) Protective measures practicing at the both departmental and individual levels
3) Effects of formalin on various systems like mucosa of the eye, nose, skin, gastrointestinal, renal and reproductive systems.

Maximum care is taken to exclude problems arising from other causes and importance is given to treatment history. General and systemic examinations are conducted for required members. Percentages of effects of formaldehyde on various systems are calculated and presented.

**OBSERVATIONS:**
Departmental protective measures practicing

<table>
<thead>
<tr>
<th>Measures against fire risk</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Checking of formalin gas levels in dissection hall</td>
<td>No</td>
</tr>
<tr>
<td>Checking of formalin gas levels individually</td>
<td>No</td>
</tr>
</tbody>
</table>

Personal protective measures practicing
### Symptomatic History

<table>
<thead>
<tr>
<th></th>
<th>Regular</th>
<th>Occasional</th>
<th>Never</th>
<th>Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Burning of eyes</td>
<td>60%</td>
<td>24%</td>
<td>16%</td>
<td></td>
</tr>
<tr>
<td>2. Running nose</td>
<td>36%</td>
<td>42%</td>
<td>22%</td>
<td></td>
</tr>
<tr>
<td>3. Skin</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Contact allergic dermatitis</td>
<td>21%</td>
<td>12%</td>
<td>67%</td>
<td>+</td>
</tr>
<tr>
<td>4. Gastro intestinal system:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a) Abdominal pain</td>
<td>6%</td>
<td>6%</td>
<td>88%</td>
<td></td>
</tr>
<tr>
<td>b) Nausea</td>
<td>18%</td>
<td>12%</td>
<td>70%</td>
<td></td>
</tr>
<tr>
<td>c) Vomiting</td>
<td>6%</td>
<td>6%</td>
<td>88%</td>
<td></td>
</tr>
<tr>
<td>5. Respiratory system:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Breathlessness</td>
<td>3%</td>
<td>24%</td>
<td>73%</td>
<td></td>
</tr>
<tr>
<td>6. Renal system:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a) Urine output</td>
<td>Normal</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>b) Renal pain</td>
<td></td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>7. Central nervous system:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a) Vertigo</td>
<td>3%</td>
<td>6%</td>
<td>91%</td>
<td></td>
</tr>
<tr>
<td>b) Convulsions</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
DEPARTMENTAL PROTECTIVE MEASURES PRACTICING: All dissection halls are having exhaust fans and windows for ventilation but no institution (Deccan college of medical sciences, Osmania medical college and Gandhi medical college where the study is done) is having facilities for estimation of formaldehyde gas levels in the hall or personal exposure levels. No institution is having preventive measures against fire risk, but no fire accident is noted till now.

PERSONAL PROTECTIVE PRACTICING: Most of the members are using shoes, 67% are using gloves, but usage of masks is very less i.e. 6% regularly.
SYSTEMIC EFFECTS: 67% members are suffering from burning eyes and 36% are troubled by running nose regularly.

Abdominal pain, nausea, vomiting are troubling 6%, 18%, and 6% of staff respectively.

Dermatitis is causing a problem in 21% of members regularly and 12% of members occasionally. They are given history of taking treatment repeatedly.

About 3% of members are suffering from symptoms of breathlessness immediately after exposure to formaldehyde gas.

One person had corneal ulceration due to direct fall of formaldehyde in to eyes and had undergone surgery for the same.

10% of members suffering from sinusitis gave the history of exacerbations of symptoms by exposure to formaldehyde gas.

DISCUSSION: Formaldehyde gas produces many harmful effects on various systems. This is studied in 100 members including staff and medical students of various colleges of Hyderabad. The findings are tabulated and discussed.

- Pabst observed Squamous cell carcinoma in rats and mice in experiments by high exposure of formaldehyde gas, but epidemiological studies didn’t provide evidence for carcinogenicity in man.
- Miziuki M T Proved atopic individuals show exacerbation of basic allergic symptoms by exposure of formaldehyde which is seen in most of the staff members in our study.
- Tanake measured formaldehyde concentration in dissection hall and found it was high (0.062 ppm after 10min) and low (0.11ppm after 30 min)
- Ohnichi K et al compared formaldehyde exposure in dissection hall and with personal exposure level and found out personal exposure level is higher. It is described that the indoor concentrations varied depending on the contents of laboratory sessions and seemed to increase when body cavity or deep structures were being dissected.
- White head mc, Savoia mc- Evaluated methods to reduce formaldehyde in the dissection hall by using “inutrance” and “perfect” solutions along with formaldehyde solution.
- Medical Management Guidelines for Formaldehyde gives permissible exposure limit as 0.75 ppm (averaged over an 8-hour work shift ) and short -term exposure limit as 2 ppm (15 minute exposure ). The health effects may be narrowing of the bronchi and an accumulation of fluid in the lungs ,corrosive injury to the gastrointestinal tract, especially the pharynx , epiglottis , esophagus , and stomach. The systemic effects are primarily due to its metabolic conversion to formate , and may include metabolic acidosis, circulatory shock, respiratory insufficiency , and acute renal failure. It is a potent sensitizer and a probable human carcinogen.

Present study shows 84% are suffering from mucosal irritation (eye and nose) , 21% are suffering from skin allergy, 30% are suffering from gastro intestinal symptoms regularly, 3 % are complaining of shortness of breath and 3% are suffering from giddiness immediately after exposure to formalin gas.
It is noticed that a staff member suffered with corneal ulceration by direct fall of formaldehyde into eyes who is been operated for the same.

CONCLUSION: Formaldehyde gas is undoubtedly showing its harmful effects on various systems which can be prevented by some simple and some difficult preventive measures as:

• Taking out the cadavers from tanks well before starting of dissection (As peak levels of formaldehyde gas before 30 min).
• By keeping windows open and exhaust fans on. The gross anatomy laboratory should have a standard ventilation system. According to the American Conference of Governmental Industrial Hygienists (2001), the ventilation rate should exceed 15 room changes per hour.
• By using masks containing activated carbons.
• By taking care formalin not to fall into eyes.
• Adopting special care by atopic individuals.
• Using perfect solution and infutrance solutions for embalming the bodies in addition to formaldehyde.
• Having facilities to check formalin gas levels in dissection halls and individual exposure levels.
• The bucket at the end of the cadaver table should be emptied frequently.

REFERENCES:

4. Tanake (2003) Formaldehyde exposure levels and exposure control measures during anatomy dissecting course, Kaibogaku Zasshi 2003 Jun;78 (2) ;43 -51
8. Levels of formaldehyde, phenol and ethanol in dissection Room air and measures for reduction: japanese journal of occupational medicine and traumatology : Vol. 54 no. 1 January 2006