



OCCUPATIONAL HAZARDS OF FORMALIN AMONGST ANATOMY STAFF : A COMPREHENSIVE REVIEW OF RISKS AND PREVENTIVE MEASURES

¹Akanksha Sharma ²Sunil Kumar ³Poonam Sharma

¹PhD Scholar

²Professor

³PG Scholar

^{1,2,3} Department of Rachana Sharir, National Institute of Ayurveda, Jaipur (Rajasthan), India

Abstract –

Cadaveric embalming is a crucial process in the field of anatomy, facilitating the preservation of human bodies for educational and research purposes. Formalin is a commonly used preservative in the anatomy dissection hall and poses occupational health hazards to anatomists, students, and other staff members working with formalin-treated specimens, such as cadaver embalming. Exposure to formalin may lead to respiratory irritation, dermatitis, and, in the long term, even carcinogenic effects. Anatomists are at an increased risk of developing health issues. To address these concerns, anatomy departments implement safety measures such as proper ventilation, dissection hall design, and the use of personal protective equipment (PPE), including gloves, masks, and eye protection, which are also crucial in reducing direct contact and inhalation. This review aims to explore the health risks associated with occupational exposure to formalin during dissection hall and shed light on the importance of implementing safety measures within anatomical facilities to promote the overall well-being of anatomy staff members.

Keywords- Formalin, Embalming, Anatomy, occupational hazard

INTRODUCTION -

Cadavers are an essential teaching resource that needs to be available in anatomy labs for the study of gross anatomy. One of the most crucial needs for using human remains in dissection rooms is proper cadaver preservation, meaning the body must be shielded from damage, deterioration, or degradation. Long-term usage cadavers need to be preserved so that students can observe the anatomical structures in dissections and during dissection while preserving as much of their colour and suppleness as feasible. Embalming is the procedure for doing this by treating the cadaver with special chemicals. In order to preserve tissue for research and educational purposes, cadaveric embalming is a crucial procedure that results in little tissue distortion and shrinkage over time. The use of formalin as a preservative in anatomy departments is integral to the study of human anatomy through cadaveric specimens.

Formalin is frequently used commercially as a 37–40% solution of formalin because of its ease of polymerization at high concentrations¹. Formalin is a solution of formaldehyde gas and water that has been linked to a number of health hazards, such as dermatitis, respiratory irritation, and long-term carcinogenic effects. Anatomists, technicians in histology and embalming laboratories, as well as medical students during their dissection course, are all exposed to formaldehyde, which frequently exceeds the threshold for causing irritation to the eyes and upper respiratory system. There is no doubt regarding formaldehyde's acute hazardous effects or its tendency to produce contact dermatitis. However, the possibility of occupational hazards for anatomy department staff is raised by this widespread and prevalent practice.

Since numerous laboratories worldwide are facing a similar problem, the aim of this study is to assess the health risk of employees and students that are exposed to formalin as well as to suggest permanent solutions. Although a great deal of progress has been made in identifying and treating the disease, multidisciplinary cooperation between occupational health professionals, anatomists, and safety officers is essential for the development of comprehensive strategies to safeguard the well-being of anatomy staff members. Ongoing education and training programmes are essential for promoting awareness and ensuring adherence to safety regulations.

This review underscores the occupational hazards posed by formalin exposure in anatomy departments, emphasising the importance of continuous efforts to improve safety measures and protect the health and well-being of staff members working in anatomical facilities where formalin is employed.

Review of literature –

The study of gross anatomy using cadavers is an important educational tool that should be available in anatomy laboratories². Long-term usage cadavers need to be maintained with as much colour and flexibility as possible so that students can perceive the anatomical structures in prosections and during dissection. Medical students can better understand regional and topographic anatomical structure, including the arteries, nerves, and muscles of the human body, by using cadavers and museum specimens³. However, alcohol, glycerin, phenol, and formaldehyde are the most recent substances employed in cadaver embalming. Formalin, an embalming fluid mostly composed of formaldehyde, is typically used in anatomy labs to preserve cadavers. August Wilhelm von Hofmann, a British scientist, made the discovery of formaldehyde in 1867. Equipped with the chemical formula CH_2O , it is a simple aldehyde⁴. Formaldehyde (formula: HCHO ; IUPAC name: metanal) is a member of the aldehyde family and one of the most basic chemical compounds. formaldehyde (FA) is a colourless, unpleasant gas with a strong odour⁵ formaldehyde is an irritating, colourless gas that has a pungent smell⁵. Typically, formaldehyde is used as a tissue fixative, either by itself or in combination with other substances, including methanol, glycerin, and phenol. The combination generally intends to reduce the amount of formaldehyde needed as much as possible and improve some of its shortcomings, like its rigidity and poor antifungal action⁶. formaldehyde is a strong-smelling, colourless gas that dissolves easily in water. In medical colleges, formalin, an aqueous solution with a concentration of 37%, is frequently used to preserve cadavers. Formalin is used because it is affordable, has good preservation qualities, is readily available, and is cost-effective. The bodies should be formalin embalmed in a 1:10 ratio with water⁷. Its non-degenerative capacity and long-lasting features make it useful⁸. The Embalming solution is injected into the femoral or carotid artery. FA is a popular restorative chemical agent that possesses bactericidal, fungicidal, and insecticidal effects. Its strong disinfectant qualities prevent decomposers from penetrating the material. The formaldehyde standard, the Occupational Safety and Health Administration (OSHA), and similar state laws protect workers exposed to formaldehyde (FA) in

industrialised nations, and these restrictions cover all occupational exposures to FA. When measuring as an 8-hour time-weighted average, the acceptable exposure limit (PEL) for formaldehyde (FA) in the workplace is 0.75 ppm of air, which was found in 37% of the samples over the course of the three-month observation programme⁹. Because formaldehyde evaporates from the solution that is used to preserve tissues and specimens, exposure levels in anatomy and pathology laboratories have long been exceptionally high, frequently exceeding the 2 ppm short-term exposure limit (STEL)¹⁰. When FA is present in the gaseous form in the nasal mucosa at a concentration higher than 6 ppm (part per million), damage and cellular denaturation occur. For this reason, it has been determined that the lethal concentration of formalin has been accepted as the cytotoxic concentration for rat nasal mucosa at 6 ppm¹¹. In fact, earlier research indicates that formaldehyde concentrations were elevated during anatomy classes; concentrations might be as high as 3.1¹², 3.4, or even 9.16 ppm¹³. According to one study, minimum FA concentrations were still above 0.25 mg·m⁻³, with a few extreme cases measuring between 13.01 and 20.94 mg·m⁻³. This was even while the anatomy laboratory was not in operation¹⁴. According to the table below, exposure to high concentrations of formaldehyde can result in both immediate and long-term health issues relating to the respiratory tract, skin, eyes, and gastrointestinal tract¹⁵.

Respiratory	Low levels of formaldehyde can cause coughing, chest pain, shortness of breath, and wheezing by quickly irritating the nose and throat. Increased exposure levels may result in a substantial accumulation of fluid in the lungs and lower respiratory tract irritation. Immunologic Inhalation and skin contact with previously sensitised individuals might result in a variety of skin conditions, asthma-like symptoms, anaphylactic reactions, and, in rare cases, hemolysis.
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Gastrointestinal	Gastrointestinal Ingestion of aqueous solutions of formaldehyde causes severe corrosive injury to the GIT. There may be stomach discomfort, vomiting, diarrhoea, ulcers, and perforation of the oropharynx, epiglottis, oesophagus, and stomach, as well as stomach inflammation.
Ocular	Exposure to low concentrations of formaldehyde vapour can cause eye irritation. Formalin splashed in the eyes can result in corneal ulceration or cloudiness of the eye surface, as well as death of cells on the surface of the eye cells, perforation, and permanent loss of vision.

Dermal	result from exposure to formaldehyde vapour, which can cause burns and skin irritation.
Chronic CNS	Chronic CNS Long-term effects have been linked to adverse effects on the central nervous system, including increased frequency of headaches, depression, mood swings, sleeplessness, irritability, attention deficits, and impairment of dexterity, memory, and equilibrium.
Reproductive	In investigations of humans and lab animals, formaldehyde has been demonstrated to have genotoxic qualities that cause chromosomal abnormalities and sister chromatid exchange. Some impacts on spermatogenesis have been described by studies conducted on experimental animals.

Guidelines for Occupational Health and Safety Preamble: It is best occupational health and safety (OHS) practice to adhere to the hierarchy of controls when a risk assessment suggests that using chemicals at work may pose a risk to employees' health. The hierarchy of controls is arranged as follows: Elimination 2. Substitution 3. Engineering controls 4. Safe work practices (administrative practices); 5. Personal protective equipment¹⁶.

DISCUSSION –

For ages, cadavers have been used as a teaching tool in anatomy labs to teach medical students the gross anatomy of humans. An essential step is formalin, the key component in the embalming procedure that preserves cadavers for anatomical research. A cadaver is preserved using a different embalming chemical to stop it from decomposing. For this purpose, formaldehyde was the most often employed embalming chemical. This chemical might have evaporated during the dissection process in the dissection hall. Because of this, the majority of medical students, teachers, and lab assistants unintentionally breathed in this substance and had symptoms associated with formaldehyde. However, there are serious worries about the health and safety of anatomy staff members because of their exposure to formalin during cadaveric embalming. This discussion explores the possible dangers of formalin exposure and provides mitigation techniques for these workplace concerns. Here we discuss several suggestions made for determining the precise concentration in museums and dissection halls, as well as for lowering formaldehyde concentrations and minimising harmful health risks. FA is a very hazardous, combustible gas that is somewhat heavier than air at room temperature. Even at low quantities, its strong, highly irritating odour can be detected, but for those who are sensitive, the amount of warning of potentially dangerous amounts may not be sufficient. The ultimate goal should be to reduce the risk associated with FA to the lowest possible level. Plastination of anatomical preparations like artificial manikins is one way to reduce the concentration levels of hazardous chemicals in the air in the anatomy laboratory while also improving the quality of instruction. Analysis of the concentration levels of FA and general indoor air quality in various dissection hall locations with various ventilation configurations is the greatest way to stop negative health effects, and crucial to maintaining a safe and healthy atmosphere would be to create a workplace in the anatomy hall. It is recommended that the local exhaust ventilation system be enhanced and situated beneath the employees' breathing zone. The breathing zone is above the upper portion of the room where the ventilation grilles are situated, and bringing them closer to the floor would necessitate a total overhaul of the ventilation system. Protective equipment, such as gloves, safety glasses, and 3M face masks, has to be accessible and utilised to avoid direct contact with the skin, respiratory system, or eyes. Nitrile gloves are more resistant to FA than latex gloves, so workers should wear them instead.

CONCLUSION –

This research study emphasises formalin's irritant properties as well as its long-term harmful impacts on employees. In conclusion, formalin exposure during cadaveric embalming is a significant occupational concern for anatomy staff members. Establishing a secure workplace must be a top priority for organisations if they want to protect the long-term occupational health of their anatomical workers. Because formaldehyde has hazardous consequences for workers' health, it is imperative to discover a cost-effective and ecologically friendly replacement. It is imperative to employ a comprehensive strategy that incorporates strong safety measures, appropriate ventilation, personal protective equipment (PPE) use, continuous training, and investigation of substitute embalming methods in order to protect the health and welfare of individuals participating in anatomical research.

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