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Towards a formalin-free hospital. Levels of 15-F2t-isoprostane and malondialdehyde to monitor exposure to formaldehyde in nurses from operating theatres

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Purpose: nurses are exposed to formaldehyde when managing surgical samples that are to be later transferred to histopathology. We evaluated the conditions favouring the risk of exposure to this toxic reagent and the effect of measures to prevent it. *Methods*: we conducted a cross-sectional study where 94 female workers were enrolled as being potentially exposed to formaldehyde. From each nurse were collected: (1) personal air-formaldehyde by a personal dosimeter (8 hours), (2) a standardized questionnaire, (3) a urine sample to test 15-F2t-isoprostane, malondialdehyde, cotinine. *Results*: the results indicate a marked difference related to the adoption of the under vacuum sealing procedure, as an alternative to formaldehyde for preserving tissues. Nurses using the under vacuum sealing system in the operating rooms are exposed to levels of formaldehyde 75% lower than those who do not use that system. Oxidative stress biomarkers (15-F2t-isoprostane, malondialdehyde) are significantly higher in nurses using formaldehyde ($p < 0.001$) and in the absence of the under vacuum sealing system ($p = 0.027$), in particular in those workers who use liquid formaldehyde in the operating theatre ($p = 0.012$). *Conclusions*: analysis of the biological biomarkers confirms a direct responsibility of air formaldehyde on the onset of oxidative stress while the use of the under vacuum sealing technique is associated with a significant reduction of the exposure to air-formaldehyde and redox status. Our findings can be useful to characterize the environmental health risk in operating theatres and to plan preventive measures such as the under vacuum sealing procedure.

Introduction

Formaldehyde (FA) is an important chemical widely used in many working environments including hospitals.[1–5] Since FA represents a ubiquitous pollutant, breathable at variable levels in every living and working environment, the study of the relationship between exposure to this reagent, its biological effect and related diseases is important, but rather complex.

On the whole, exposure to FA is associated with a wide range of adverse health effects, from mild to severe.[6,7] In particular, acute exposure to FA can cause irritation (of eyes, nose, throat, and skin), nasal congestion, sore throat, headache, cough, conjunctivitis, fatigue, rashes, shortness of breath, nausea and nosebleeds.[8,9] FA is also known as a human carcinogen and an inducer of chronic toxicity, being endowed with genotoxic and oxidant activities.[1,10–12] Among the chronic effects of FA, an increased incidence of nasopharyngeal cancer in definite FA-exposed workers was demonstrated by some authors[13,14] while others have shown a relationship between FA and leukemia.[15,16]

Previous studies of our group already showed that FA, breathed in appropriate concentrations, is able to induce an oxidative imbalance.[17] To overcome and counteract this oxidative imbalance induced by FA, detoxifying enzymes are produced through different metabolic pathways.[18,19] For example, F2-isoprostanes (F2-IsoPs) are prostaglandin-like bioactive compounds formed *in vivo* from the free radical-catalyzed peroxidation of essential fatty acids, like arachidonic acid. F2-IsoPs are stable and reliable molecules, detectable in all human tissues and biological fluids, including plasma, urine, the fluid of bronchoalveolar lavage and cerebrospinal fluid. Based on their mechanism of synthesis, four F2-IsoP regioisomers (5-, 12-, 8-, or 15-series) may be generated, depending on which

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