An in vitro Method for Predicting Inhalation Toxicity of Impregnation Spray Products

Impregnation spray products are used for making surfaces water and dirt repellent. The products are composed of one or more active film-forming components dissolved or suspended in an appropriate solvent mixture. Exposure to impregnation spray products may cause respiratory distress and new cases are reported frequently. The toxicity appears to be driven by a disruption of the pulmonary surfactant film, which coats the inside of the lungs. Due to the complex chemistry of impregnation spray products, it is impossible to predict if inhalation of an aerosolized product is toxic in vivo. The aim of this study was to evaluate whether disruption of the pulmonary surfactant film can be used as a predictor of the toxic effects in vivo. Nine impregnation products with various chemical compositions were selected for testing and the main constituents of each product, e.g., solvents, co-solvents and film-forming compounds, were identified by mass spectrometry. We used a capillary surfactometry method to assess disruption of pulmonary surfactant function in vitro and a mouse model to evaluate acute respiratory toxicity during inhalation. Concentration-response relationships were successfully determined both in vitro and in vivo. The true positive rate of the in vitro method was 100%, i.e. the test could correctly identify all products with toxic effects in vivo, the true negative rate was 40%. Investigation of inhibition of the pulmonary surfactant system, e.g. by capillary surfactometry, was found useful for evaluation of the inhalation toxicity of impregnation spray products and thus may reduce the need for animal testing.

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