

Inflammation and clinical immunology

0019

Is there an adaptation to occupational inhalative exposure to moderate endotoxin concentrations? - Results of an experimental study with chronically exposed and only acute voluntary subjects in sewage treatment plants in Germany

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Occupational exposure to endotoxin is typical for working conditions e.g. in sewage industries. Several studies show adverse health effects induced by acute or chronic inhalation of endotoxin. Amongst others changes in lung function and mediators of inflammation in the airways and/ or the blood are known. Clinically, acute exposure to higher levels of endotoxin may lead to organic dust toxic syndrome which has been shown to be a predictor of chronic bronchitis in farmers. Yet, especially when exposed to moderate endotoxin concentrations many workers seem to develop no symptoms but to adapt to the exposure.

We aimed to answer two questions:

1. a) Is there a difference between chronically exposed (= workers of sewage treatment plants) and only acute exposed subjects (= students) with regard to immunological parameters (nasal lavage fluid (NALF), blood, serum) during exposure to endotoxin (= work on a sewage treatment plant)?
2. b) Can dose-dependent changes be observed?

The study was approved by the ethics committee of the University of Wuppertal. The present analysis is based on data obtained in 2002 and 2003. All subjects gave their informed consent.

Methods

The endotoxin exposure resulted from routine working activities during one working shift in the area of 4 sewage treatment plants. The endotoxin exposure was between 3 and 1.039 EU/m³ (plant 1: 6 - 89 EU/m³; plant 2: 6 - 120 EU/m³; plant 3: 3 - 58 EU/m³; plant 4: 162 - 1.039 EU/m³). Subjects were matched to pairs according to the very exposure, i.e. workers (n = 8) were escorted by students (n = 10). Immunological parameters (including e.g. albumin, IL-1 β , IL-5, IL-6, IL-8, sCD14, NO, ECP) were investigated at three time points: before, after and 16 hours after the end of the shift. In students, 2 weeks after the experimental exposure additional samples were collected on 3 following days without any specific exposure. In addition, a lung function examination and a complaint-related standardized survey were performed.

Results

Differences were found between workers and students before and after the working shift (NALF: NO, IL-8, IL-1 β ; serum: sCD14, IL-1 β), most of the biomarkers were higher in workers than in students (exception: IL-1 β in the serum). In the students, the concentrations of immunological parameters assessed on the 3 non-exposed days showed great variability and included almost all values obtained also on the exposed days.

Conclusions

Differences between sewage workers and normally non-exposed volunteers in the concentration before shift as well as in the reaction pattern during the shift indicate an adaptation effect due to chronic occupational exposure. On the basis of the available data a clear decision if a protective or pathogenic mechanism occurs, is not possible, depending on the high individual variability. Dose-dependent effects could not be established due to unexpected rather low endotoxin concentrations on 3 out of 4 sewage plants investigated.