A guidance value of 1-hydroxypyrene in urine in view of acceptable occupational exposure to polycyclic aromatic hydrocarbons

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Abstract

Occupational exposure limits for carcinogens are increasingly based on excess lifetime risks of cancer. Acceptable limits in some countries in Europe are set at 4/1,000 (= highest tolerable risk level) and 4/100,000 (= acceptable risk level) based on 40 year working exposure for the occupational population. When an exposure metric is used that is fairly new, epidemiology does not offer dose-response data that is needed for the derivation of a science based limit value. The urinary concentration of 1-hydroxypyrene is a fairly new bioindicator of exposure to Polycyclic Aromatic Hydrocarbons (PAH). Nowadays, measurements of 1-hydroxypyrene in urine are routinely applied to control industrial exposure to PAH as present in coke ovens and primary aluminium production and to control exposure of professionals when handling coal tar derived products. Due to lacking dose-response data from epidemiological studies, a cancer risk based limit of 1-hydroxypyrene in urine cannot be derived. An alternative derivation procedure is proposed for the limit value that can be used as guidance for the intermediate period. For the period in-between, it is suggested to take the ‘no observed genotoxic effect level’ (= NOGEL) in PAH-exposed workers as the point-of-departure for setting the limit value. The genotoxic endpoints are genotoxic effects in white blood cells of PAH-exposed workers (chromosomal aberrations, sister chromatid exchanges, micronuclei, comet assay, DNA adducts).

In order to assess the point-of-departure for limit setting, cross-sectional studies were searched for that report on the response of early genotoxic effects in white blood cells of workers that could be related to the degree of PAH-exposure (expressed as 1-hydroxypyrene in urine). Nine cross-sectional studies were traced that met these requirements. From each study, the concentration of 1-hydroxypyrene in end-of-shift urine samples was determined, at which no genotoxic effects was found. From 4 out of 9 studies a no-observed genotoxic effect level could be derived, the lowest level was 1.0 μmol/mol creatinine. This limit level is recommended as a state-of-the-art guidance, valid when the PAH-profile in the work environment is similar to that of coke oven with a typical pyrene/BaP ratio of 2.5. For work environments with a deviating PAH-profile an adjustment procedure with the pyrene/BaP ratio is suggested.