Biomonitoring of workers involved in the graphene production process

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The increasing production and use of nanomaterials (NM) in several applications raises concerns about the potential health risk for workers involved in their production and handling. During NM production process workers can be unintentionally exposed, particularly by inhalation, to NM and other chemicals used in the NM synthesis process, so it is important to have suitable biomarkers for the biomonitoring of potential effects. In this study, we identify a panel of sensitive biomarkers and suitable biological matrices to evaluate and monitor over time genotoxic and oxidative effects induced on workers unintentionally exposed to graphene nanoparticles during the production process. The workers were monitored using: Buccal Micronucleus Cytome (BMCyt) assay (exfoliated buccal cells) and fpg-comet test (lymphocytes) for genotoxic effects, oxidized DNA bases 8-oxoGua, 8-oxoGuo and 8-oxodGuo measurements (urine) and analysis of oxidative stress biomarkers in exhaled breath condensate (EBC) for oxidative damage, FENO measurement and cytokines release detection (serum) for inflammation. Since buccal cells are among the main targets of NM occupational exposure, particular attention was paid to the non-invasive BMCyt assay. This pilot study, performed on 6 workers *vs* 11 controls, demonstrated that BMCyt and fpg-comet assays are the most sensitive biomarkers of early, still reparable, genotoxic and oxidative effects. We applied such biomarkers in a follow up study on the same workers, after the introduction of exposure mitigation measures, and we observed a reduction of MN induction and oxidative DNA damage. The results of study show that these sensitive and non-invasive biomarkers could represent useful tools for the biomonitoring of workers involved in graphene production process, but they need to be confirmed on a higher number of subjects. The findings also suggest that these biomarkers could be suitable for the biomonitoring also at long-term of workers exposed to complex scenario, including nanoparticles exposure at low dose.