

Unexpected metal micro/nanoparticles in mediastinal lymph nodes: a combined μ XRF and INAA case study

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A number of heavy metals, such as, for instance, chromium and cobalt, are well known to be hazardous for human organisms, also at low doses, given their genotoxicity, mutagenic and carcinogenic effects. The subject of the present study, a deceased 73-year-old male, was initially considered for a μ X-Ray Fluorescence and μ X-ray Absorption Near Edge Spectroscopy characterization at in the context of an experiment about silicosis. The unexpected and totally occasional finding of metals, such as very high amounts of Cr and Ti, in mediastinal lymph nodes, lead us to further investigate the available tissue samples. We undertook a characterization by high lateral resolution μ XRF and nanoXRF at ID21 and ID16b beamlines, respectively, at ESRF (Grenoble, France). This characterization was coupled to Neutron Activation Analysis investigations, aimed at assessing the total amount of such elements in the tissue matrix. The results of our characterization pointed out the presence of Cr and Ti nanoparticles in the tissue, located in correspondence of the silicotic nodules. On the basis of the previous history of the subject, two different sources of such metals in the organism were identified: a recent (two weeks before the death) hip implant, and an old heart valve replacement with a mechanical valve. Both implanted components are possible sources of the metal nanoparticles detected in the lymph nodes. Additional INAA analyses conducted on other tissues of the same subject confirmed the diffused presence of toxic elements. Although still under interpretation, the preliminary results of our study suggest the hip implant as the most likely source of nanoparticles in the lymph nodes. This study reinforces the attention to be paid to the fate of metal nanoparticles in the body deriving from implant activities. The finding of metal particles is indeed crucial from a clinical point of view, given the potential toxicity of chromium and cobalt and their impact on the risk to develop neoplasm. Such results call for more research about the safety of orthopedic prosthesis and, for clinicians, may be regarded as a warning for a more careful evaluation of the benefits vs risks of this kind of surgery on the patients.