Experimental Evidence of Gold Nanoparticle Radio-sensitization in vitro

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Radiotherapy is a prominent tool in oncology but it can be held responsible for important biological damages as ionizing radiations also induce degradation of healthy tissues. It is the reason why since more than five decades, great efforts have been devoted to increase its efficiency and tolerance. Different approaches have been developed to increase the dose to cancerous cells specifically. Herold and co-workers first showed that gold microspheres, suspended in cell cultures or distributed in tumour tissues, can produce an increased biologically effective dose when exposed to kilovoltage photon beams (1). Later, Hainfeld et al demonstrated that gold nanoparticles (GNPs) injected intravenously to mice bearing subcutaneous EMT-6 mammary carcinomas enhance 250 kVp X-rays radiotherapy (2), an experiment which was confirmed by theoretical studies (3). However, to optimize this treatment, a more complete understanding of the mechanisms responsible for such a radio-sensitization is necessary. For this reason, we studied the effect of X-rays on biologically relevant molecules (DNA, proteins) in the presence of GNPs. Here, we present results obtained with plasmid DNA irradiation in solution. We confirmed the radio-sensitizing effect of GNPs and showed that it is amplified as the ratio gold: DNA grows. As the emergence of resistant bacteria to traditional antibiotics motivates new antibacterial systems development, we also studied the potential application of such an effect towards bacteria. GNPs proved to be non-toxic to E. coli K-12 MG1655 strain and were shown to increase the efficiency of ionizing radiation to induce bacteria cell death. So GNPs submitted to X-Ray radiation appear to be a potential tool for anti-microbial proliferation or pathogenic bacteria killing systems.

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