Radiation-induced "one pot" synthesis for cell therapies

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The dream of Marie Curie lab's expressed by Regaud and Lacassagne in 1927 was to administer radiations with penetration range of molecular dimensions to the organism and selectively fixed in the protoplasm of cells one seeks to destroy. Gold nanoparticles can be employed as a radiation sensitizer by utilizing mainly Auger effect and photoelectrons. Auger electrons are released in large numbers with low kinetic energy therefore these electrons damage cells over a very short range: less than the size of a single cell, on the order of nanometers. Gold-198 is a beta and gamma emitter can be employed for therapy as well as diagnostic. The radioactive properties of gold include: Au (βmax=0.96 MeV; t1/2 = 2.7 days) and Au (βmax =0.46 MeV; t1/2 = 3.14 days), making it a strong candidate for theranostics. However, Gold or Gold-198 need to internalize selectively in tumor cells. Conjugation with proteins and peptides can make them very selective. While radioactive nanoparticles can offer a much higher dose payload than ions for therapy and diagnostic, in addition to the huge surface to bind targeting species presented by the nanoparticles, functionalization with proteins may potentially increases the particle uptake by tumors or tissues. Albumin and Papain features a set of characteristics that assure applications as natural drug carriers with particular attractive properties in oncology. Albumin may be easily crosslinked and engineered towards loading of large number of hydrophobic molecules as well as hydrophilic ones. They can be bound in a reversible way and the delivery controlled by endogenous mechanism. Alternatively to conventional systems, albumin can be crosslinked by radiation in such way that dialdehydes or toxic chemicals are totally avoided . Conjugation of such materials with sugars, peptides, antibodies, proteins among others is routinely used nowadays for targeting. The main purpose of this work was the development of one pot in situ synthesis of radioactive gold 198 nanoparticle encapsulated by albumin for application in cancer Theranostics. While crosslinked albumin may provide a nontoxic coating on AuNPs with a controllable hydrodynamic diameter, conventional AuNP can be activated by nuclear reactor to produce AuNP. The gamma or beta radiation originated from the gold nanoparticle was used to crosslink the Albumin layer. The use of a radioactive particle able to emit radiation for crosslinking of the Albumin layer and simultaneous theranostic application was tried for the first time. The elegant procedure and simplicity of the production process combined with the properties of Au and the safety of AuNP/BSA make this new particle an exciting advancement in cancer therapy and diagnosis. Gold conjugated protein nanoparticles and protein nanoparticles itself were also produced in an radiation induced one pot process. Crosslinking and protein damage werea cessed by different techniques.