The effects of size, shape and surface functionality on in vivo biodistribution and toxicity: A multiparametric biochemical study of gold nanomaterials

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Gold nanomaterials have a widespread use due to their superior physical and chemical properties. Gold nanoparticles and nanorods are very popular and stable metallic nanomaterials which can be synthesized easily in various sizes and surface chemistry and their surfaces can be functionalized by desired polymers. They have a wide range of uses in medicine, electronics, pharmacy, chemistry, biology and biomedical fields. Gold nanomaterials are often preferred for cell and tissue imaging, photothermal therapy, targeting studies, RNA/drug delivery, biosensors, detection systems and hyperthermia fields[1,2]. The aim of this study, the synthesis of gold nanoparticles and gold nanorods functionalized with polyethyleneimine (PEI) and polyethylene glycol (PEG), multiparametric investigation of their in vivo toxicological effects and biodistributions in mice. Within the scope of this study, it is aimed to synthesize and perform surface functionalization of gold nanomaterials that can remain in the body in sufficient time/amount by creating minimum toxic effects on the tissues. Gold nanoparticles (AuNPs) of two different sizes (20 nm and 50 nm) were synthesized and the nanorods (AuNRs) were successfully produced by extending them up to 15-90 nm. Surface functionalization of the nanomaterials was carried out using PEI and PEG. ICP-MS analyzes were performed to determine the time-dependent biodistribution of different gold nanomaterial groups in different tissues and organs (liver, kidney, spleen, heart, blood and brain) of mice. In vivo analyzes were performed for multiparametric biochemical parameters. Results we obtained at the end of the study coincided with the goals. Gold nanomaterials have been developed that have the potential to be used in systemic teranostics and their effects have been evaluated with a wide range of multiparametric analyzes and their potentials have been revealed. PEI and PEG surface coating increased both biocompatibility and biodistribution at the in vivo levels. The shape and size of the gold nanomaterial are important parameters for potential applications. Surface functionalization processes provide superior properties to the gold nanomaterials in terms of nanotoxicological parameters and the potential in vivo teranostic applications in the future studies. “This study was supported by The Scientific and Technological Research Council of Turkey (Grant no: 217S135).”

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