Dissecting the Molecular Mechanism of Apoptosis during Photothermal Therapy using Gold Nanoprisms

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Nature has been utilizing nanostructures for millions of years. The following two properties, (i) being about the size of "typical" biological objects and (ii) the possibility of tailoring their properties by changing their size or their shape, make nanoparticles attractive for biomedical applications. One the most promising application for gold nanoparticles (NPs) is their use as "heaters" during photothermal therapy of solid carcinomas using near-infrared laser light (NIR). The most common cellular response to photothermal therapy treatment (PTT) using this kind of nanomaterials is necrosis, producing detrimental inflammatory responses. Here we report the use of PTT using gold nanoprisms (NPRs) to specifically induce apoptosis in cells. In order to understand the different molecuar pathways involved in this cellular death, we have analysed the mechanism of apoptosis using embryonic fibrobast cells from different knock out mice, which are deficient in proteins involved in the different routes of apoptosis. Our results show that "hot" NPRs activate the intrinsic/mitochondrial pathway of apoptosis mediated by Bak and Bax through the activation of the BH3-only protein Bid. Finally, apoptosis and cell death is dependent on the presence of both caspase-9 and caspase-3.