Nanoparticle-Induced Macrophage Atherogenesis

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Cardiovascular disease is the #1 cause of death in the world, causing over 17.5 million deaths annually. Numerous cardiovascular diseases are preceded by atherosclerosis, a condition caused by cholesterol absorption in certain white blood cells (macrophages) that eventually leads to significant plaque formation in arteries. If macrophages absorb more cholesterol, plaque formation will be exacerbated; likewise, if macrophages absorb less cholesterol, plaque formation will be reduced. Due to their unique properties, nanoparticles are becoming increasingly used in medicine. This project aimed to understand the impact of nanoparticles on plaque formation and macrophage viability. Experiments were conducted in two environments to simulate conditions that exist in the human body. To simulate a natural cholesterol fluctuation, macrophages were exposed to three carefully chosen nanoparticles (20 nm Ag, 110 nm Ag, 20 nm Fe) for two hours and subsequently treated with cholesterol for 24 hours. Nanoparticles were absorbed by the macrophages and induced insignificant cytotoxicity (cell death). Additionally, nanoparticle exposure was found to alter cholesterol absorption by macrophages. In the second environment, experiments were conducted to simulate a 24 hour nanoparticle exposure in a cholesterol-rich environment that may exist in unhealthy individuals. Again, nanoparticles were absorbed by the macrophages and induced insignificant cytotoxicity. Nanoparticle exposure also altered macrophage cholesterol uptake. These experiments conclude that 20 nm Ag nanoparticles can reduce macrophage cholesterol uptake and likely reduce plaque formation, making it ideal for a therapeutic. Further research can potentially advance drug development with nanoparticles and save millions of lives.