Penetration of Gold Nanoparticles Through Blood Brain Barrier and their Accumulation into The Brain: Effect of Nanoparticles' Shape and Surface Chemistry

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Abstract

Blood brain barrier (BBB) is a very selective barrier that protects the brain and the central nervous system (CNS) from the entry of harmful substances and help regulate the exchange of different molecules and nutrients from and into the brain and the CNS. This selectivity makes delivering therapeutic and diagnostic materials across the BBB very challenging. In this study, different shapes and sizes of gold nanoparticles (GNPs) were synthesized and functionalized with five different thiolated ligands to acquire GNPs with various surface chemistry. GNPs of different sizes, shapes and surface modifications were injected intraperitoneally (IP) into laboratory mice. Gold nanorods (GNRs) functionalized with 4-mercaptophenol showed the highest penetration ability across the BBB with no significant toxic effect on brain tissue. However, slight toxic features were observed upon histology examination of spleen and liver tissues. The size and shape of GNPs have detrimental effect on the penetration ability of GNPs across the BBB. Gold nanospheres demonstrated high deposition percentages into different organs compared to the rod counterparts. Large GNRs revealed less accumulation into the brain, however their accumulation into the liver and spleen was maximized. GNPs could be a promising candidate for enhancing brain delivery across the BBB.