

Using nanomaterials based on iron oxide to advance the diagnosis and treatment of cardiovascular and inflammatory diseases

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The most common form of cardiovascular disease (CVD) and also the leading cause of sudden death is atherosclerosis, a chronic progressive inflammatory disease of the arterial vessels. Unstable, vulnerable atherosclerotic plaques can rupture and cause thrombosis, resulting in myocardial infarction (MI) and stroke. Magnetic resonance imaging (MRI) has been used as a powerful and indispensable tool in medical research and clinical diagnosis due to its high spatial resolution and non-limited penetration depth. We have developed both targeted negative contrast agents and targeted dual positive/negative contrast agents for molecular imaging of atherothrombosis^{1,2,3}. The simultaneous use of positive and negative MRI imaging that employs the same contrast agents will significantly improve the detection accuracy. Using these dual contrast agents, both T¹- and T²-weighted MRI of thrombosis can be recorded simultaneously which enables self-confirmation of images and leads to a greater diagnostic accuracy. We have also designed and developed smart MRI nano-sensors that can not only detect, but also sense and report the stage or progression of CVD such as thrombosis⁴. The early detection and accurate characterization of life-threatening diseases such as CVD and cancer are critical to the design of treatment. Knowing whether a thrombus in a blood vessel is new/fresh or old/constituted is very important for physicians to decide a treatment protocol. Theranostic nanoparticles based on iron oxide and cerium oxide have also been developed in our group as potential materials for diagnosis and treatment of reactive oxygen species related inflammatory diseases such as CVD^{5,6}. Another class of theranostic nanoparticles based on iron oxide and silver/gold with NIR absorption has also been synthesised as a potential material for the simultaneous detection and treatment of thrombosis.

References

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