Limitations with carbon nanotubes in blood facing medical devices discovered

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Scientists in the School of Pharmacy and Pharmaceutical Sciences in Trinity College Dublin, have made an important discovery about the safety issues of using carbon nanotubes as biomaterials which come into contact with blood. The significance of their findings is reflected in their paper being published as the feature story and front page cover of the international, peer-reviewed journal *Nanomedicine*.

When blood comes into contact with foreign surfaces the blood's platelets are activated which in turn leads to blood clots being formed. This can be catastrophic in clinical settings where extracorporeal circulation technologies are used such as during heart-lung bypass, in which the blood is circulated in PVC tubing outside the body. More than one million cardiothoracic surgeries are performed each year and while new circulation surfaces that prevent platelet activation are urgently needed, effective technologies have remained elusive.

One hope has been that carbon nanotubes, which are enormously important as potentially useful biomedical materials, might provide a solution to this challenge and this led the scientists from the School of Pharmacy and Pharmaceutical Sciences in collaboration with Trinity's School of Chemistry and with colleagues from UCD and the University of Michigan in Ann Arbour to test the blood biocompatibility of carbon nanotubes. They found that the carbon nanotubes did actually stimulate blood platelet activation, subsequently leading to serious and devastating blood clotting. The findings have implications for the design of medical devices which contain nanoparticles and which are used in conjunction

with flowing blood.

Speaking about their findings, Professor Marek Radomski, Chair of Pharmacology, Trinity and the paper's senior author said: "Our results bear significance for the design of blood-facing medical devices, surface-functionalised with nanoparticles or containing surface-shedding nanoparticles. We feel that the risk/benefit ratio with particular attention to blood compatibility should be carefully evaluated during the development of such devices. Furthermore, it is clear that non-functionalised carbon nanotubes both soluble and surface-bound are not blood-compatible".

Speaking about the significance of these findings for nanomedicine research, the paper's first author Dr Alan Gaffney, a Trinity PhD graduate who is now Assistant Professor of Anaesthesiology in Columbia University Medical Centre, New York said: "When new and exciting technologies with enormous potential benefits for medicine are being studied, there is often a bias towards the publication of positive findings. The ultimate successful and safe application of nanotechnology in medicine requires a complete understanding of the negative as well as positive effects so that un-intended side effects can be prevented. Our study is an important contribution to the field of nanomedicine and nanotoxicology research and will help to ensure that nanomaterials that come in contact with blood are thoroughly tested for their interaction with blood platelets before they are used in patients."

More information: "Blood biocompatibility of surface-bound multi-walled carbon nanotubes." DOI: dx.doi.org/10.1016/j.nano.2014.07.005

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