Effects of Nanomaterials on Human Blood Coagulation

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Abstract

Common and serious human diseases such as myocardial infarction and stroke are caused by abnormalities of blood coagulation that predispose to thrombosis (clots). These diseases are clearly influenced by environmental factors. Because of their large surface area and reactivity, nanomaterials that enter the workplace or home have the potential to adversely affect blood coagulation, which could result in abnormal clotting and/or bleeding.

Thus, a comprehensive approach will be used to study how a wide-range of commercially prepared nanomaterials affects human blood coagulation. Techniques will focus on the two major components of the clotting system, namely, blood coagulation proteins and platelets. First, the effects of nanomaterials on blood clotting proteins will be studied using coagulation-specific laboratory assays. We will focus on the ability of nanomaterials to promote and/or retard the catalytic activity of coagulation enzymes. This is because adsorption of enzymes on the extensive available surface of nanomaterials may alter the functional groups of the enzymes and hence, their enzymatic activity. Next, classes of nanomaterials will be identified that "activate" human platelets because platelet activation plays a role in many thrombotic diseases. Finally, the complex interactions between blood coagulation elements and nanomaterials will be characterized at the molecular level.

Research findings will be used to: (1) identify nanomaterials that can harm human coagulation; (2) determine nanomaterial thresholds of toxicity and dose-response effects on clotting proteins; and (3) classify engineered nanomaterials based on their physiologic effects on blood coagulation.