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Cytotoxicity: Interactive threats of nanoparticles to the cell

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Abstract

While Nanotechnology is providing exponentially new products based on Nano tools, equipment and nanoparticles, the study of their toxicity would be essential. The reduction in size to Nano scale leads to change their surface properties and also increases their chemical activity that causes toxicity. The knowledge of Nano particles entrance mechanism to the body is useful in evaluation of nanoparticle content in the cell; therefore we are able to answer some of the questions about toxicity. Endocytosis, membrane flows, channels and adherence reactions are some of their entrance mechanism to the cell. A variety of Nanoparticles have different size, shape, surface and chemical composition and they have different toxicity mechanism in the interface with living systems. We will focus to the interaction of nanoparticles with cells, blood and immune system. When immune system interact with nanoparticles as drug delivery vehicles, resist and take protective reactions. Nanoparticles influence on blood factors, too. Complement system, blood cells and hemostatic system which are three important parts of blood, take effect from the nanoparticle. We will briefly express the steps of toxicity identification of nanomaterial, because it is necessary for identifying their toxicity.
Key words: nanoparticle, cytotoxicity, cell, blood.

Introduction

Recently, nanoparticles have been widely investigated because of their potential applications in biomedicine. Nanoparticles are of great concern to the environment because their small size and high catalytic properties. Attention must be given to the potential of these particles to interact with cells. Because they are used in medicine and will interact with cells[1].
Cell lines are commonly used to study the effects of nanomaterials, since they are relatively easy to handle. Hoewer, they are usually cancer-cell-lines which have different characteristics compared to healthy cells and are thus mainly useful for performing preliminary screenings of potential toxic or immunogenic effects. To approach a more *in vivo* like situation, one may rather use human primary cells.
A comprehensive material characterization is a critical requirement for each nanotoxicological study and will lead to a better understanding on how different nanoparticle properties affect their biological response[2].

Entrance mechanism of nanoparticles in cell

The postulated mechanisms of internalization include endocytosis, membrane fluidity, passing through channels, or through adhesive interactions [3]. Macrophages are professional phagocytes which unlike other cells are capable of efficient uptake of particles by phagocytosis and are present in many tissues as resident macrophages such as alveolar macrophages and Langerhans cells.

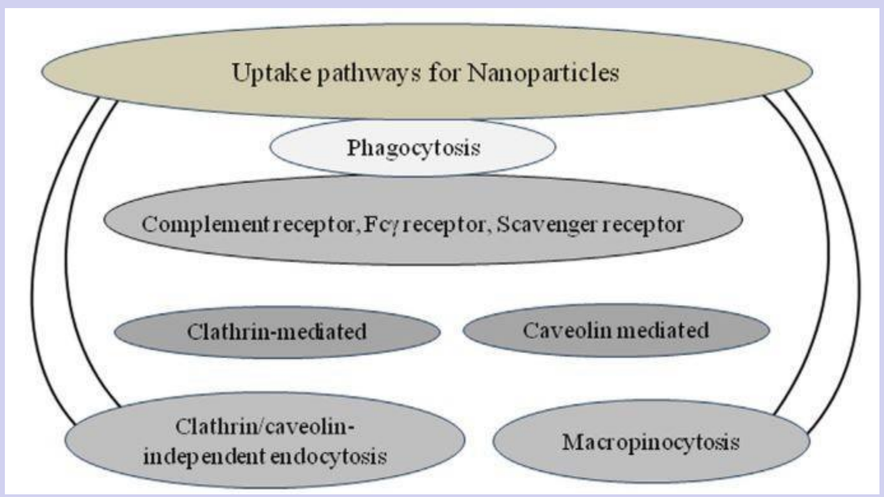


Fig 1: Entrance pathways of nanoparticles [1]

Interaction of nanoparticle with cell

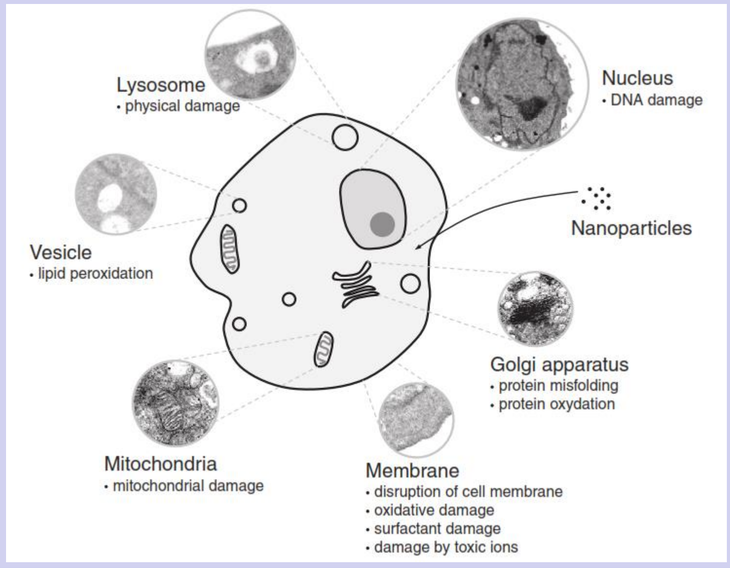
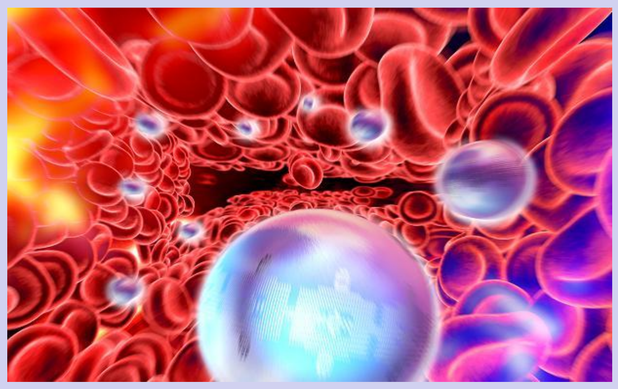


Fig 2: intracellular targets and nanotoxicological mechanisms [3].

Threats of nanoparticle to the immune system

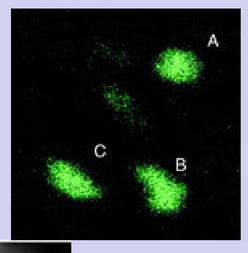
By considering the interaction between nanomedicines and the immune system, an interaction is most likely to occur Immediately at the blood level in the case of intravenous administration.
These are based on tow parts:
1- Immune mediated destruction
2- Immunotoxicity



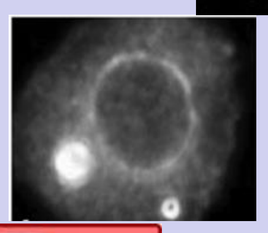
toxicity identification

In order to know about nanoparticle toxicity we should do:

A) Characterization of nanoparticle



B) Morphological study



C) The sufficient dose of nanoparticle

References

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