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Cellular migration as a Stress Relieving Strategy to Nanotoxicology

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Abstract

Nanoparticles are exponentially being used for their enormous sectors of applications. Human exposure and the ensuing distress is thus an inevitability. Despite the scores of ongoing research, there is still a lack of comprehensive revival strategies for treatment of the affected tissue. There is also no single standard procedure of prognosis, as the implications of toxicity are varied, and their symptoms also vary with each individual case of affliction. There is thus always a need for discovery of new targets and routes of treatment for better efficacy at therapy. We have discovered that encouraging cell migration could be one of these solutions.

Keywords : Nanoparticles; EMT; Stress; Recovery

Abbreviations : NP: Nano Particle; Me Ox: Metal Oxide; EMT: Epithelial to Mesenchymal Transition

Introduction

Nanotoxicology is a growing concern, particularly stress incited by exposure to Metal oxide (Me-Ox) nanoparticles (NPs), as they are commonly utilized in a broad range of fields [1]. Rising pollution and pulmonary distress are more apparent than ever before. There is thus a growing need for discovery and design of effective stress revival strategies to nanotoxicology.

From our research, we have discovered that encouraging cellular migration could be one such solution. Similar dose-time exposure to TiO_2 NPs confers less lethality as compared to ZnO NP treatment with A549 cells. Remarkably, cellular migration is greatly enhanced with TiO_2 NP exposure against ZnO NPs (unpublished data) within the same dose-time bracket. This is the first documentation of its kind and has the potential to unravel novel routes of recovery strategies towards nanotoxicology.

Cellular Migration

Cellular migration broadly connotes to movement of cell from one location to another in two-dimensional space. Triggers for migration activate crucial cell surface receptors and induce morphological changes [2]. It is executed by a polarized cell morphology that enables protrusion over a trailing end. Potency for integrin associated attachment to basal lamina is also vital. Together the contraction and release of cytoskeletal structures enable cell movement [3].

Cell movement is ordained by a series of signal transduction pathways that include small GTPases, cytoskeleton-modifying proteins, kinases, lipid second messengers and motor proteins [4]. Cells achieve movement when different signaling cascades are consistently presented in specific locations within the cell while maintaining potency of response to extra cellular triggers [5]. Both epithelial and mesenchymal cells can migrate, although what external cues trigger specific cellular changes to channel directional movement is still under considerable research. However, mesenchymal phenotype has increased migratory and invasive capabilities, combined with a greater resistance to cell death [6]. Epithelial to mesenchymal transition (EMT) thus greatly enables migration and invasiveness, though migration alone does not necessitate EMT [7].

Zone of Stress

Every toxicological model presents a zone of stress, where in the cell survival is more sensitive than in other zones. For example, with *in vitro* models, cells close to the basal membrane may suffer from incumbent nutrient deprivation, lack of space and mechanical shear [8]. Further for adherent cultures, confluence influence dregression in proliferation has been extensively observed [9].

Conclusion

Thus, a greater potential for migration such as alteration in surrounding environment or by trans differential processes such as epithelial to mesenchymal transition may enable cells in moving away from this zone of stress, thereby enabling

greater tolerance to stress and thus enhanced survival. Allows cells to float away from the lamina into a region more conducive for survival [10]. Any number of quorum sensing signals such as dissemination of chemokines and cytokines from the stress affected cells on the lamina may also affect the migrated cells to a lesser degree simply because of a lack of ample access.

This hypothesis is especially true with a monolayer tissue system, such as the internal lining of the pulmonary alveolus. Pulmonary tissue is highly susceptible to distress by aerosolized material in the atmosphere, that increasingly includes metal oxide nanoparticles.

Declaration of Interest

The Authors report no conflict of interest.

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