

Risk assessment of innovative nanohydrogels developed for skin regeneration applications

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Skin is the largest organ of the human body with diverse functions and any skin impairment leads to a cascade of events, known as wound healing. Infections or pre-existing conditions, such as obesity or diabetes often delay the healing process, resulting in the development of chronic wounds. An ideal wound dressing material should be able to protect the wound from bacterial infections, prevent excessive fluid loss, maintain a moist healing environment and promote the healing process.

Nanotechnology-based materials incorporated into scaffolds allow the creation of nanocomposite smart materials with unique physicochemical and biological properties promoting skin regeneration. The aim of the TENTACLES project is to develop an innovative multifunctional nanogel that integrates the protective (polymer-based nanohydrogel) and healing functions (iron oxide nanoparticles and targeted miRNA) within one nanocomposite smart structure. Our task is a comprehensive assessment of the biological effect of these nanocomposites using different types of skin cells (keratinocytes and fibroblasts) as well as 3D EpiDermFT skin model. The experiments are focused on determining the cytotoxic and genotoxic effect of three hydrogels (Alginate, Pluronic F-127, and Gelatin methacrylate - GelMA) with a different chemical compositions and iron oxide nanoparticles content.

A significant increase in both cytotoxicity and genotoxicity after 24 h nanohydrogel treatment, measured by LDH assay, micronucleus test, and comet assay, was observed only in higher concentrations of GelMA nanohydrogel. Moreover, we noticed a higher amount of apoptotic and necrotic cells after GelMA exposure, and also the percentage of micronuclei was significantly higher. Using H&E staining, we determined that nanohydrogels exposure did not cause any histopathological changes in skin structure.

These results suggest that above mentioned hydrogels loaded with iron oxide nanoparticles could be promising candidates for wound dressings as they do not show any toxic effects, but further investigation is essential for their implementation in practice.

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