>> Janus nanoparticles << studies on the effect of duality of active substance carriers in targeted therapy of skin cancer

Abstract

Skin cancers are one of the most common forms of cancer (Fig. 1), with two main categories: non-melanoma skin cancer (NMSC) and melanoma. Due to varying diagnostic criteria and underreporting, accurately determining the incidence of skin cancer is challenging. However, numerous epidemiological studies have shown an increase in the incidence of both NMSC and melanoma over the past few decades. Diagnosing and treating these cancers involve significant health concerns, affecting patient well-being and healthcare costs. Various treatment options are available, including surgical excision, cryotherapy, chemotherapy, immunotherapy, and radiation therapy. The challenge for modern medicine is to develop new, more effective pharmaceuticals to prevent the growth and multiplication of cancer cells as much as possible.

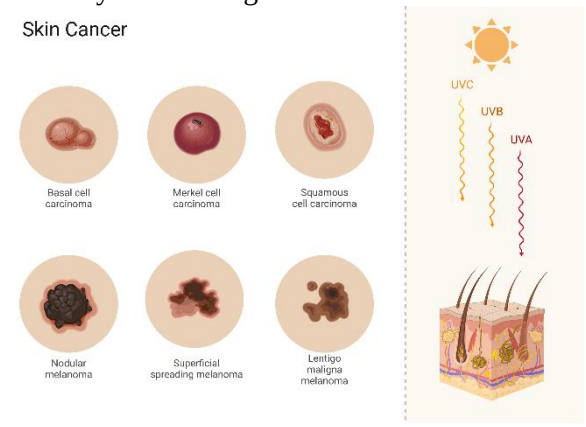

Fig.1. Types of skin cancer [Created with BioRender.com]

The main objective of the project is to develop advanced transdermal systems using 3D printing technology, containing magnetic Janus nanoparticles functionalized with sialic acid and anthracyclines. This process is based on a hierarchical approach, encompassing several key stages that are implemented sequentially and closely interconnected: First Level: Synthesis of anisotropic Janus nanoparticles (Fig. 2) with magnetic properties, enabling precise control and localization within the body using an external magnetic field. The nanoparticles will then be functionalized: one side will be coated with sialic acid to target cancer cells, and the other side with anthracyclines to provide effective anticancer action. Second Level: Creation of transdermal systems that encapsulate the functionalized nanoparticles, ensuring controlled drug release and enhanced therapeutic efficacy. Third Level: Examination of the physicochemical and mechanical properties of the produced transdermal systems, as well as their behavior in simulated body fluids. Additionally, tests will be conducted to evaluate the ability of these materials to effectively penetrate the skin barrier. Fourth Level: In vitro tests on selected cell lines to assess the cytotoxicity and anticancer efficacy of the functionalized nanoparticles.

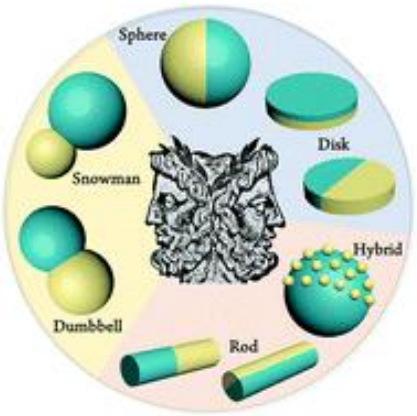

Fig.2. Schematic illustration of typical Janus nanostructures
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Each of these hierarchical levels is crucial for achieving the overall research goal and ensuring that the developed transdermal systems will be effective and safe for skin cancer therapy.

The project team will focus on developing a process for producing materials with the scientific objective of the project in mind. The main research issue centers on the creation of new materials and the determination of their interaction with cancer cells, specifically anisotropic carriers encapsulated within a transdermal system.