Oral Presentation

Berberine-Based Nanoformulations: Traditional Foundations and Emerging Innovations for Mitigating Diabetic Male Infertility

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ABSTRACT: Hepatocellular carcinoma (HCC) is the most prevalent primary liver malignancy in Egypt, with liver and lung cancers showing mutual metastatic potential. Although berberine exhibits strong anticancer activity, its clinical application is limited by poor solubility and bioavailability. This study aimed to enhance berberine efficacy via nano-formulations: berberine/chitosan, liposome, albumin, and silica nanoparticles (NPs). The objectives included validating large-scale NP prototypes, evaluating their therapeutic potential in vitro and in vivo against HCC and lung cancer, and assessing pharmacokinetics and toxicity. NPs were synthesized and characterized; berberine/chitosan showed poor encapsulation, while liposome, albumin, and silica NPs demonstrated sustained drug release and anticancer effects. In vitro assays on peripheral blood monocytes, WI38, Vero, and CaCo-2 confirmed safety and cytotoxicity against colon and lung cancer cells. In vivo studies using DEN/CCl_4-induced hepatic cancer and heavy metal–induced organ damage revealed that berberine NPs improved liver and kidney function, reduced blood glucose and oxidative stress markers, and increased antioxidant enzymes. Molecular analyses showed downregulation of PI3K/Akt/mTOR, Sirt1, VEGF, and inflammatory markers, with upregulation of AMPK, P53, PTEN, and autophagy-related proteins (LC3, Beclin1). Pharmacokinetic results demonstrated a substantial increase in berberine bioavailability using albumin NPs (Cmax: 49 µg/mL vs. 85 ng/mL), with tissue distribution primarily in the gastrointestinal tract, followed by kidney and lung. These findings affirm that berberine/albumin, silica, and liposome NPs are potent multifunctional therapeutic agents that reverse oncogenic signaling, improve bioavailability, and offer curative potential for HCC and lung cancer.

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