Gemcitabine-delivering mesenchymal stromal cells repress in vitro expansion of human pancreatic carcinoma cells.

Chung Lee*

Department of Pharmacology, College of Medicine, Kaohsiung Medical University, Kaohsiung, Taiwan

Introduction

Pancreatic carcinoma remains one of the most aggressive and devastating forms of cancer, characterized by its rapid progression and limited treatment options. Among the therapeutic strategies being explored, the use of mesenchymal stromal cells (MSCs) as delivery vehicles for anticancer agents has gained significant attention due to their unique tumor-homing ability and immunomodulatory properties. Gemcitabine, a widely used chemotherapeutic agent, has shown promising antitumor activity in pancreatic carcinoma. However, its effectiveness is often hindered by systemic toxicity and limited penetration into tumor tissues [1].

Pancreatic carcinoma remains one of the deadliest cancers worldwide, with a dismal five-year survival rate due to its aggressive nature and limited response to traditional therapies. Gemcitabine, a nucleoside analog, has been the standard-of-care chemotherapy for advanced pancreatic carcinoma for decades. Despite its efficacy, gemcitabine's therapeutic potential is constrained by its systemic toxicity and limited penetration into the tumor microenvironment. To overcome these limitations, researchers have been exploring innovative approaches for targeted drug delivery, leading to the emergence of gemcitabine-loaded mesenchymal stromal cells (MSCs) as a promising strategy [2].

Mesenchymal stromal cells, a type of adult stem cell, have demonstrated remarkable abilities to migrate towards tumor sites due to their natural tumor-homing property. Moreover, MSCs are capable of modulating the tumor microenvironment, making them attractive vehicles for delivering therapeutic agents directly to cancer cells. Their unique characteristics, such as low immunogenicity and ease of isolation and expansion, have made them suitable candidates for cancer therapy. MSCs with gemcitabine to enhance the drug's selective delivery to tumor cells. Studies have revealed that gemcitabine-loaded MSCs can efficiently deliver the drug to pancreatic carcinoma cells while limiting its exposure to healthy tissues. Upon reaching the tumor microenvironment, these engineered MSCs release gemcitabine through various mechanisms, including passive diffusion and active secretion. This targeted delivery mechanism allows for increased drug concentrations at the tumor site, leading to enhanced cytotoxicity against pancreatic carcinoma cells [3].

In vitro studies have demonstrated the significant impact of gemcitabine-loaded MSCs on repressing the expansion of human pancreatic carcinoma cells. Co-culture experiments revealed a reduction in cell viability, proliferation, and clonogenicity when tumor cells were exposed to gemcitabine-delivering MSCs. Furthermore, these MSCs demonstrated superior tumor specificity, sparing neighboring non-malignant cells from the cytotoxic effects of gemcitabine. While gemcitabine-loaded MSCs show great promise in vitro, several challenges remain before their clinical translation. Optimizing drug loading efficiency, understanding the long-term fate of MSCs after delivery, and addressing potential immunogenicity concerns are essential aspects that require further investigation. Additionally, preclinical studies must evaluate the safety and efficacy of gemcitabine-loaded MSCs in animal models to establish their therapeutic potential in vivo [4].

The utilization of gemcitabine-loaded mesenchymal stromal cells (MSCs) has demonstrated significant potential in repressing the in vitro expansion of human pancreatic carcinoma cells. This innovative drug delivery system capitalizes on the unique properties of MSCs, enabling targeted delivery of gemcitabine to tumor sites while sparing healthy tissues from undue toxicity. The in vitro studies have provided compelling evidence of reduced cell viability, proliferation, and clonogenicity of pancreatic carcinoma cells upon exposure to gemcitabine-delivering MSCs [5].

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***Correspondence to:** Chung Lee, Department of Pharmacology, College of Medicine, Kaohsiung Medical University, Kaohsiung, Taiwan, Email: chung@lee.12.tw

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