Artificial antigen-presenting gel droplet

Artificial antigen-presenting gel droplets (APGDs) are a type of engineered biomaterial designed to mimic the role of natural antigen-presenting cells (APCs) in activating T-cells. Antigen-presenting cells are a key component of the immune system that present antigens to T-cells, thereby initiating an immune response against pathogens or abnormal cells, including cancer cells.

APGDs are typically composed of a hydrogel matrix that contains specific signaling molecules, such as antigens and co-stimulatory molecules, which are necessary for T-cell activation. These gel droplets can be engineered to present antigens in a controlled and sustained manner, providing a platform for precise modulation of T-cell responses.

The advantages of APGDs include:

Spatial and temporal control: APGDs allow for precise control over the presentation of antigens and other signaling molecules to T-cells, enabling modulation of the immune response in a spatially and temporally controlled manner.

Enhanced T-cell activation: By mimicking the natural interactions between APCs and T-cells, APGDs can enhance the activation and proliferation of T-cells, potentially leading to a more robust immune response against target antigens, such as those expressed by cancer cells.

Customizability: APGDs can be tailored to specific antigens or immunomodulatory molecules, allowing for customization based on the desired therapeutic application.

Biocompatibility: Many APGD formulations are biocompatible and can be safely administered in vivo without causing significant adverse effects.

Research into APGDs is ongoing, with potential applications in cancer immunotherapy, infectious disease vaccination, and autoimmune disease treatment. By leveraging the unique properties of APGDs, researchers aim to develop innovative strategies to harness the power of the immune system for therapeutic purposes.

Adoptive T-cell therapy for cancer therapy is limited by the inefficiency ofin vitroT-cell expansion and the ability ofin vivoT-cells to infiltrate tumors. The construction of multifunctional artificial antigen-presenting cells is a promising but challenging approach to achieve this goal. In this study, a multifunctional artificial antigen-presenting gel droplet (AAPGD) was designed. Its surface provides regulated T-cell receptor (TCR) stimulation and co-stimulation signals and is capable of slow release of mitogenic cytokines and collagen mimetic peptide. The highly uniform AAPGD are generated by a facile method based on standard droplet microfluidic devices. The results of the study indicate that, T-cell proliferatedin vitroutilizing AAPGD have a fast rate and high activity. AAPGD increased the proportion ofin vitroproliferating T cells low differentiation and specificity. The starting number of AAPGDs and the quality ratio of TCR-stimulated and co-stimulated signals on the surface have a large impact on the rapid proliferation of low-differentiated T cellsin vitro. During reinfusion therapy, AAPGD also enhanced T-cell infiltration into the tumor site. In experiments using AAPGD for adoptive T cell therapy in melanoma mice, tumor growth was inhibited, eliciting a potent cytotoxic T-lymphocyte immune response and improving mouse survival. In conclusion, AAPGD promotes rapid low-differentiation proliferation of T cellsin vitroand enhances T cell infiltration of tumorsin vivo. It

simplifies the preparation steps of adoptive cell therapy, improves the therapeutic effect, and provides a new pathway for overdosing T cells to treat solid tumors [1].

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Tian Y, Chen W, Du G, Gao J, Zhao Y, Wang Z, Su M, Hu R, Han F. Microfluidic-based preparation of artificial antigen-presenting gel droplets for integrated and minimalistic adoptive cell therapy strategies. Biofabrication. 2024 Mar 15;16(2). doi: 10.1088/1758-5090/ad2fd4. PMID: 38437712.