The Utilization of LCHN Technology in Combination with pH Reactive PLGA Core Synthesis for the Treatment of Acute Myeloid Leukemia

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Abstract

Acute Myeloid Leukemia is characterized by malignant blasts that rewire the bone marrow microenvironment into a protective niche, compromising healthy hematopoiesis. Current standards of care, such as the 7+3 regimen and subsequent G-CSF injections, often fail due to a combination of poor niche penetration and a lack of focus on extracellular matrix restoration. This paper proposes a dual-action, biomimetic platform utilizing leukocyte-coated hybrid nanoparticles with a pH-sensitive PLGA core to bridge the gap between cancer eradication and niche recovery.

By using harvested primary leukocyte membranes, these nanoparticles achieve immune system evasion and active homing to the inflamed leukemic niche. During the eradication phase of treatment, the LCHNs deliver Daunorubicin specifically to acidic microenvironments through pH sensitive polymer degradation, which minimizes collateral damage to the healthy cells in the body. In the subsequent restoration phase, the platform is transitioned to a regenerative payload of G-CSF and ECM-mimetic peptides. This combination simultaneously stimulates progenitor proliferation and provides necessary adhesion ligands to restore the damaged marrow scaffold.

The proposed study outlines a validation framework using DLS, SEM, FTIR, TEM, And Western Blotting to confirm successful synthesis and cloaking. In vivo efficacy will be assessed in murine models by measuring minimal residual disease and the rate of absolute neutrophil count recovery. This innovation approach seeks to replace systemic, non-specific treatments with a targeted strategy that treats leukemia and bone marrow repair as a single, integrated biological challenge.