**Title:** Development and Characterization of a Novel Nanoparticle-Based Drug Delivery System for Targeted Cancer Therapy

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**Abstract:**

**Background/Objectives:**
Conventional chemotherapy drugs often suffer from limited specificity and significant systemic toxicity. Nanoparticle-based drug delivery systems (NDDS) have emerged as a promising solution to improve the targeted delivery of chemotherapeutics while minimizing adverse side effects. The objective of this study was to develop and characterize a novel NDDS for the targeted delivery of doxorubicin (DOX) to cancer cells overexpressing the HER2 receptor.

**Methods:**
We synthesized biodegradable polymeric nanoparticles using poly(lactic-co-glycolic acid) (PLGA) as the carrier for DOX. The nanoparticles were surface-functionalized with anti-HER2 monoclonal antibodies to enhance tumor specificity. Particle size, surface charge, and drug loading efficiency were characterized using dynamic light scattering (DLS) and transmission electron microscopy (TEM). In vitro release kinetics were studied in simulated physiological conditions, and cytotoxicity assays were conducted on HER2-positive breast cancer cells (BT-474) using the MTT assay.

**Results:**
The average size of the functionalized nanoparticles was 150 ± 10 nm, with a surface charge of -25 mV, indicating good stability in physiological conditions. Drug loading efficiency was 85%, and the release profile demonstrated a sustained release of DOX over 72 hours. In vitro cytotoxicity results showed a 60% reduction in the viability of HER2-positive cancer cells compared to free DOX at the same concentration, demonstrating enhanced therapeutic efficacy of the nanoparticle system.

**Conclusion:**
The developed NDDS showed significant potential for targeted drug delivery in cancer therapy. By enhancing the specificity and reducing the systemic toxicity of DOX, this nanoparticle system could provide a new therapeutic option for patients with HER2-positive cancers. Further in vivo studies are planned to evaluate the efficacy and safety of this delivery system in animal models.

**Keywords:**
Nanoparticles, drug delivery, targeted therapy, cancer, HER2, doxorubicin