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Development of thermo-responsive polymeric micelles for enhanced anticancer drug delivery

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Statement: Achieving targeted and controlled release of anticancer drugs remains a major hurdle in chemotherapy due to systemic toxicity and non-specific drug distribution. This study focuses on the development of thermo-responsive polymeric micelles to improve drug delivery efficiency and reduce off-target effects in solid tumor treatment.

Methodology: Thermo-responsive micelles were synthesized using poly(N-isopropylacrylamide)-block-poly(ethylene glycol) (PNIPAM-b-PEG) via free radical polymerization. Doxorubicin was encapsulated within the hydrophobic core of micelles through a solvent evaporation technique.Characterization included dynamic light scattering (DLS) for size distribution, transmission electron microscopy (TEM) for morphology, and differential scanning calorimetry (DSC) for determining the lower critical solution temperature (LCST). Drug loading efficiency and in vitro release at 37°C and 42°C were measured using UV-Vis spectroscopy. Cytotoxicity and cellular uptake studies were performed on MCF-7 breast cancer cell lines.

Results: The micelles exhibited a uniform spherical morphology with an average size of ~90 nm and an LCST of 41°C. Drug loading efficiency reached 78%, with a significantly higher drug release observed at 42°C compared to 37°C, demonstrating effective thermo-responsiveness. Cytotoxicity assays confirmed enhanced tumor cell killing at hyperthermic conditions due to increased intracellular drug concentration. Minimal toxicity was observed in normal cells under normothermic conditions.

Conclusion: Thermo-responsive polymeric micelles demonstrate a promising approach for temperature-triggered drug delivery in cancer therapy. The system enables targeted release within the tumor microenvironment while minimizing systemic toxicity. Future work will explore in vivo tumor targeting and combination therapy strategies.