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PLGA nanoparticles for dual release of ion-paired antibiotics to treat bone infections

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Introduction: Vancomycin hydrochloride and gentamicin sulfate are effective in combination for treating orthopedic infections [1]. Poly (lactic-co-glycolic acid) (PLGA) nanoparticles (NPs) are promising antibiotic carrier for bone infections, but the weak interaction between the hydrophobic polymer and hydrophilic antibiotics results in low encapsulation efficiency (EE) and rapid drug release. Hydrophobic ion-pairing (HIP) of antibiotics with hydrophobic surfactants can enhance EE and prolong drug release [2]. **The aim** of this study was to prepare vancomycin- and gentamicin-loaded PLGA NPs for impregnation into allogenic bone grafts for localized infection treatment.

Materials and Methods: Sodium lauryl sulfate (SLS), sodium dodecylbenzenesulfonate (SDBS), and bis(2-ethylhexyl) sulfosuccinate sodium salt (AOT) were tested as HIP counterions. Optimal ion-pair ratios were determined via potentiometric titration (Particle Charge Detector) and confirmed by FT-IR spectroscopy. NPs were prepared with branched PLGA using oil-in-water emulsion evaporation and nanoprecipitation. Particle size, polydispersity index (PDI), and morphology were analyzed using Zetasizer Nano ZS and Scanning Electron Microscopy (SEM). Precipitation efficiency (PE), EE, drug loading, and release were measured using HPLC and UV-Vis spectroscopy.

Results and Discussion: PE for all counterions ranged between 58.3–82.5%, with FT-IR confirming HIP complex formation. The AOT complexes with the antibiotics exhibited the highest EE, reaching 23.8% for the vancomycin and 42.1% for the gentamicin, respectively. All prepared NPs ranged in size from 167–281 nm with PDI <0.2 and have smooth, spherical morphology. Drug release was prolonged up to 12 and 22 days for vancomycin-AOT and gentamicin-AOT complexes, respectively.

Conclusion: The HIP method effectively enhances EE and enables the preparation of PLGA-based NPs for prolonged drug release.

References

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