Copolymers characterization and effect on the structure of biomimetic systems

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Introduction: Copolymers are macromolecules with high molecular weight, consisting of repeated units linked by covalent bonds that exhibit more than one type of monomer. Here we synthesized, by RAFT polymerization, and characterized three copolymers consisting of two separate blocks, i.e. diblock copolymers. One block is constituted by poly (methylmethacrylate), PMMA, and the other by poly (N,N-dimethylaminoethylmethacrylate), PDMAEMA. The general formula of the diblock copolymer is PMMA_m-b-PDMAEMA_n. We also characterized a PDMAEMA homopolymer. Amphipathic diblock copolymers can aggregate exhibiting different chemical behavior and biocompatibility. The materials were studied concerning their ability to increase the permeability of large unilamellar vesicles (LUVs) prepared with phospholipids mixtures of the zwitterionic phosphatidylcholine (PC) and negatively charged phosphatidylglycerol (PG). Objectives: Characterization of amphipathic copolymers and studies of their interaction with LUVs with different charges. Material and Methods: Copolymers critical aggregation concentration, CAC, was determined by NMR and fluorescence, at several pHs. Polymer aggregates and Polymer-LUV’s interaction were determined measuring the hydrodynamic radius and zeta potential of LUV’s with different PC:PG molar ratios, polymer concentrations and pH’s. Results and Discussion: At high polymer:l lipid molar ratio, the polymers bind to the LUVs and completely neutralized the vesicles charge. When the LUVs and polymer concentrations were similar, a network was formed leading to aggregation and precipitation of the complexes. The copolymers can permeabilize the LUVs, depending on the ratio polymer:l lipid, pH, and hydrophobic and hydrophilic characteristics of each copolymer. The PC:PG ratio determined the interaction between LUVs and copolymers. Copolymer binding to LUVs produced segregation of negatively charged phospholipids in the LUVs bilayer facilitating the permeability of the vesicles. Conclusion: We demonstrated that copolymers can bind to the surface of LUVs, changing its shape and leading to vesicle rupture. These effects were modulated by pH and ionic strength.

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