Nanoparticles as tool for enhanced ophthalmic delivery of vancomycin: a multidistrict-based microbiological study, solid lipid nanoparticles formulation and evaluation

Seham Elkheshen ,Rania Hassan Fahmy, Tamer Essam, Hanan M. Ellaithy

Abstract

Context: A microbiological multidistrict-based survey from different Egyptian governorates was conducted to determine the most prevalent causative agents of ocular infections in the Egyptian population. Antibiotic sensitivity testing was then performed to identify the most potent antimicrobial agent. Vancomycin (VCM) proved the highest activity against gram-positive Staphylococcus bacteria, which are the most commonly isolated causative agents of ocular infection. However, topically applied VCM suffers from poor ocular bioavailability because of its high molecular weight and hydrophilicity. Objective: The aim of the present study was to develop VCM-loaded solid lipid nanoparticles (SLNs) using water-in-oil-in-water (W/O/W) double emulsion, solvent evaporation technique to enhance ocular penetration and prolong ophthalmic residence of VCM. Method: Two consecutive full factorial designs (24 followed by 32) were adopted to study the effect of different formulation and process parameters on SLN formulation. The lipid type and structure, polyvinyl alcohol (PVA) molecular weight and concentration, sonication time, as well as lipid:drug ratio were studied as independent variables. The formulated SLN formulae were evaluated for encapsulation efficiency (EE%), particle size (PS), and zeta potential as dependent variables. Results: The statistically-optimized SLN formula (1:1 ratio of glyceryltripalmitate:VCM with 1% low molecular weight PVA and 1 min sonication time) had average PS of 277.25 nm, zeta potential of −20.45, and 19.99% drug encapsulation. Scanning and transmission electron micrographs showed well-defined, spherical, homogenously distributed particles. Conclusion: The present study suggests that VCM incorporation into SLNs is successfully achievable; however, further studies with different nanoencapsulation materials and techniques would be valuable for improving VCM encapsulation.

Drug Development and Industrial Pharmacy 2016, March