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A recombinant vaccine of H5N1 HA1 fused with foldon and human IgG Fc induced complete cross-clade protection against divergent H5N1 viruses

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Development of effective vaccines to prevent influenza, particularly highly pathogenic avian influenza (HPAI) caused by influenza A virus (IAV) subtype H5N1, is a challenging goal. In this study, we designed and constructed two recombinant influenza vaccine candidates by fusing hemagglutinin 1 (HA1) fragment of A/Anhui/1/2005(H5N1) to either Fc of human IgG (HA1-Fc) or foldon plus Fc (HA1-Fdc), and evaluated their immune responses and cross-protection against divergent strains of H5N1 virus. Results showed that these two recombinant vaccines induced strong immune responses in the vaccinated mice, which specifically reacted with HA1 proteins and an inactivated heterologous H5N1 virus. Both proteins were able to cross-neutralize infections by one homologous strain (clade 2.3) and four heterologous strains belonging to clades 0, 1, and 2.2 of H5N1 pseudoviruses as well as three heterologous strains (clades 0, 1, and 2.3.4) of H5N1 live virus. Importantly, immunization with these two vaccine candidates, especially HA1-Fdc, provided complete cross-clade protection against high-dose lethal challenge of different strains of H5N1 virus covering clade 0, 1, and 2.3.4 in the tested mouse model. This study suggests that the recombinant fusion proteins, particularly HA1-Fdc, could be developed into an efficacious universal H5N1 influenza vaccine, providing cross-protection against infections by divergent strains of highly pathogenic H5N1 virus.

Development of colon targeting drug delivery system Ibuprofen

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A novel colon targeted tablet formulation was developed using natural polysaccharides such as chitosan and guar gum as carriers and Ibuprofen as model drug. The prepared polymer-drug blend tablets were coated with two layers of polymers, inulin as an inner coat followed by shellac as outer coat and were evaluated for properties such as average weight, hardness and coat thickness. In vitro release studies of prepared tablets were carried out for 2 hrs in pH 1.2 HCl buffer, 3 hrs in pH 7.4 phosphate buffer and 6 hrs in simulated colonic fluid (SCF) in order to mimic the conditions from mouth to colon. The drug release from the coated system was monitored using UV/ Visible spectroscopy at respected wavelengths. In vitro studies revealed that the tablets coated with inulin and shellac have controlled the drug release in stomach and small intestinal environment and released maximum amount of drug in the colonic environment. Among the matrix polymers used, chitosan was found to be the suitable polymer for colon targeting. The study revealed that polysaccharides as carriers and inulin and shellac as a coating materials can be used effectively for colon targeting of drugs for treating local as well as systemic disorders.

Cancer nanotechnology

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Cancer nanotechnology is currently under intense development for applications in cancer imaging, molecular diagnosis and targeted therapy. The basic rationale is that nanometer-sized particles, such as biodegradable micelles, semiconductor quantum dots and iron oxide nanocrystals, have functional or structural properties that are not available from either molecular or macroscopic agents. When linked with biotargeting ligands, such as monoclonal antibodies, peptides or small molecules, these nanoparticles are used to target malignant tumors with high affinity and specificity. In the `mesoscopic' size range of 5-100 nm in diameter, nanoparticles also have large surface areas and functional groups for conjugating to multiple diagnostic (e.g., optical, radioisotopic or magnetic) and therapeutic (e.g., anticancer) agents. Recent advances have led to multifunctional nanoparticle probes for molecular and cellular imaging, nanoparticle drugs for targeted therapy, and integrated nanodevices. These devices include nanovectors for the targeted delivery of anticancer drugs and imaging contrast agents. Nanowires and nanocantilever arrays are among the leading approaches under development for the early detection of malignant lesions. These developments have opened exciting opportunities for personalized oncology in which cancer detection, diagnosis and therapy are tailored to each individual's molecular profile, and also for predictive oncology, in which genetic information is used to predict tumor development, progression and clinical outcome. These developments raise exciting opportunities for personalized oncology in which genetic and protein biomarkers are used to diagnose and treat cancer based on the molecular profiles of individual patients.