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Evaluation of Immune Responses of Gamma-Irradiated, Electron Beam Irradiated FMD Virus Type O/IRN/2007 Vaccines and DNA Vaccine- Based on the VP1 Gene by a Prime-Boost Strategy in a Mouse Model

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Abstract : Most countries use inactivated binary ethylenimine (BEI) vaccines to control and prevent Foot-and-Mouth Disease (FMD). However, this vaccine induces a short-term humoral immune response in animals. This study investigated the cellular and humoral immune responses in homologous and prime-boost (PB) groups in the BALB/c mouse model. FMDV strain O/IRN/1/2007 was propagated in the BHK-21 cell line and inactivated by three methods, including a chemical with BEI to produce a conventional vaccine (CV), a gamma irradiation vaccine (GIV), and an electron irradiated vaccine (EIV). Three vaccines were formulated with the adjuvant aluminum hydroxide gel. In addition, a DNA vaccine was prepared by amplifying the virus VP1 gene pcDNA3.1 plasmid. In addition, the plasmid encoding the granulocyte-macrophage colony-stimulating factor gene (GM-CSF) was used as a molecular adjuvant. Eleven groups of five mice each were selected, and the vaccines were administered as homologous and heterologous strategy prime-boost (PB) in three doses two weeks apart. After the evaluation of neutralizing antibodies, interleukin (IL)-2, IL-4, IL-10, interferon-gamma (INF-γ), and MTT assays were compared in the different groups. The pcDNA3.1+VP1 cassette was prepared and confirmed as a DNA vaccine. The virus was inactivated by gamma rays and electron beams at 50 and 55 kGy as GIV and EIV, respectively. Splenic lymphocyte proliferation in the inactivated vaccinated homologous groups was significantly lower ($P \leq 0.05$) compared with the heterologous prime-boosts (PB1, PB2, PB3) and DNA + GM-CSF groups ($P \leq 0.05$). The highest SNT titer was observed in the inactivated vaccine groups. IFN-γ and IL-2 were higher in the vaccinated groups. It was found that although there was a protective humoral immune response in the groups with inactivated vaccine, there was adequate cellular immunity in the group with the DNA vaccine. However, the strongest cellular and humoral immunity was observed in the PB groups. The primary injection was accompanied by DNA vaccine + GM-CSF and boosted injection with GIV or CV.

Keywords : foot and mouth disease, irradiated vaccine, immune responses, DNA vaccine, prime boost strategy
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