The Colon as a Site for Vaccination: Preliminary Immunisation Studies in Mice using a Nanoparticle Vaccine

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Purpose.

To determine whether the mouse colon is a good site for vaccination, by determination of the immune responses generated following the administration of vaccine formulations (solution and nanoparticle suspension). Furthermore, to compare the extent of, and to study differences in, the immune responses following vaccine delivery to the small intestine, colon, and rectum.

Methods.

Ovalbumin (model antigen) was encapsulated into poly (lactic co-glycolide) (PLGA) nanoparticles using a double solvent evaporation method. The nanoparticle vaccine, or antigen solution (with cholera toxin subunit B [mucosal adjuvant], or alum [intramuscular adjuvant]), were delivered to Balbc mice (i) orally, (ii) to the rectum (by pipette) (iii) to the colon (by flexible gavage tubing) and (iv) intramuscularly (IM). Three booster doses were given at two-weekly intervals. Animals were bled before each booster and faecal material was collected to measure antibody levels. After sacrifice, the small intestine, colon, and vaginal mucosa were sampled. IgG levels in serum and IgA levels in the mucosa were determined by enzyme-linked immunosorbent assay (ELISA).

Results.

Colonic delivery of particulate vaccine, or antigen solution, produced higher IgA and IgG levels than oral or rectal delivery. Colonic delivery produced IgG levels similar to that produced by IM delivery, but much higher IgA levels. Following colonic administration, IgA was also found in the small intestine and vaginal mucosa. As expected, particulate vaccination tended to achieve higher antibody levels than soluble antigen.

Conclusion.

Colonic vaccination produced an immune response that differed from, and often improved upon, those achieved by oral, rectal and IM administration. Furthermore, the nanoparticulate vaccine prepared was superior to antigen solutions with adjuvants.