

The Colon as a Target for Vaccination: Quantification of Lymphoid Tissue in Mouse Colon Prior to Vaccination

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Currently, most vaccines are given by injection. However, due to the inherent problems associated with injections, other routes of drug delivery are being researched, among them, the oral route. So far, research into oral vaccination has not differentiated between vaccine uptake by the different parts of the gastro-intestinal tract, such as the small and large intestine. It is likely that following oral vaccine administration, the vaccine is mostly taken up by the lymphoid tissue of the small intestine.

We are investigating vaccine delivery targeted to the colon, as the differences between the small and large intestine's immunological environment may mean that colonic vaccines are more appropriate for certain diseases such as Crohn's disease. Before administering vaccines to the colon, we need to establish the presence of, and quantify, the colonic lymphoid follicles, with respect to the small intestine in the mouse (our experimental animals), as the literature is scant. The colonic lymphoid follicles in man have been quantified and shown to exist as patches, similar to those in the small intestine (Langman and Rowland, 1986). While Owen (1991) has demonstrated microscopically that lymphoid tissue and M cells are present in the mouse colon, no significant quantitative and comparative data exist.

The aim of the investigation was therefore to determine the number and location of the lymphoid tissue patches in the colon, in comparison to the small intestine. The caecum was also investigated. Ten female adult Sox-1 and T/O mice were used. Mice were culled by cervical dislocation and dissected. The gastrointestinal tract was removed and sectioned (small intestine, caecum and colon). The sections were flushed with water, opened lengthways, and then incubated in 10% v/v acetic acid aqueous solution overnight at 5°C. The following day the sections were examined visually and the patches of lymphoid tissue and the number of follicles within were counted and photographed.

The results are shown in Table 1. Patches were evenly distributed within the small and large intestines. However, they were denser in the large intestine, as seen from the number of patches per cm of intestine (Table 1). The photographic images showed clearly the presence of the lymphoid tissue in the colon, in which the follicular nature of the patch can be seen. Visually, the patches were smaller in the colon, and they contained fewer follicles, which were the same size as those of the small intestine.

It was thus concluded that, as for humans, patches of lymphoid tissue are present in the mouse colon to a significant degree in comparison to the small intestine, and are similar in appearance to, although smaller than, the Peyer's Patches. Since the target tissue for colonic vaccination is present, further colonic immunisation studies can be undertaken using the mouse as the experimental animal.

Yeh P-Y., Ellens H., Smith P.L (1998) *Adv Drug Del Rev* 34, 123-133

Langman J.M, Rowland R. (1986) *J Anat* 194, 189-194

Owen R.L, Piazza A.J., Ermak T.H. (1991) *Am J Anat* 190, 10-18

Table 1 Average Lengths, Numbers of Lymphoid Tissue Patches and Follicles in the Small Intestine, Colon and Caecum of 10 Sox-1 and T/O Mice

	Small Intestine	Colon	Caecum
Length (cm) (Range)	28.43 (24.7-31.9)	7.57 (6.8-9.7)	-
No. of patches (Range)	8.3 (5-12)	6.9 (3-15)	1.4 (1-3)
Total no. of follicles (Range)	51.1 (32-68)	17.2 (8-35)	7(5-13)
No. of follicles per patch	6.4	2.5	5
No. of patches per cm of intestine	0.29	0.9	-