

## LYMPHATICS IN RELATION TO PEYER'S PATCHES IN INDIAN BUFFALO CALVES (*Bubalus bubalis*)\*

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Ileum of Indian buffaloes was described to have both dome projections of lymphoid follicles of PP's of submucosa into mucous membrane and non-dome areas (Lalitha, 1993). Non-dome areas of ileal mucosa were represented by typical villi with associated lamina propria where lymphatics commence as lacteals (Trautmann and Fiebiger, 1957; Dellman, 1981). There is paucity of literature on the distribution of lymphatics in the dome areas. The distribution of lymphatics in dome areas is necessary to understand the transfer of self and nonself antigens absorbed through the follicle associated epithelium (FAE) of dome areas, which serves as part of local immune system of gastro intestinal tract. Hence a study was done to elucidate the same as the first of its kind in Indian Buffaloes.

### Materials and methods

Ileum from 24 buffalo calves aged upto one month were collected in buffered formalin for paraffin blocks. 4mm sections were cut and stained by haematoxylin and eosin and silver orcein staining for reticulin fibres (Humason and Lushbaugh, 1960).

Two newborn calves were fed with 5% lithium carmine. Eight hours later they were sacrificed and samples of ileum were procured and processed by routine method for paraffin embedding; 6mm sections were cut and stained by haematoxylin and eosin.

### Results

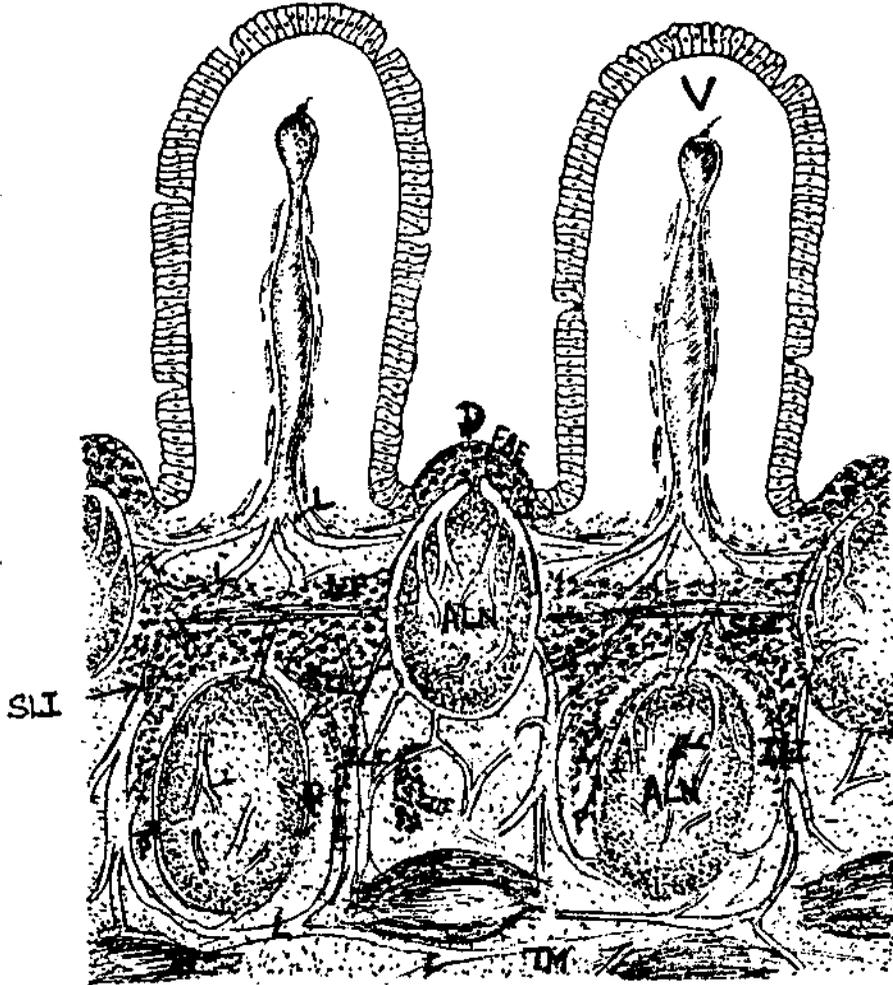
The presence of domes in the mucous membrane of ileum, contributed to the significant variations in the pattern of distribution of lymphatics of mucosa. The mucous membrane of ileum consisted of both dome, which appeared as a blunt projection of lymphatic nodules of peyer's patches, devoid of villi and non-dome areas comprising of villi. Non-dome areas had typical lacteals forming the central core of the villi. The domes were associated with submucosal peyer's patches. The lamina propria of domes had dense lymphoid tissue and was lined by a specialised layer of epithelium called follicle associated Epithelium (FAE). In the lamina propria of dome, a net work of lymphatic capillaries was present. A few lymphatic capillaries were running parallel to the surface epithelium closely following the indistinct basement membrane (Fig.).

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**Fig.** Schematic drawing of section of ileum-Villi (V) with lacteals, Dome (D) line by FAE (Follicle associated epithelium). Lymphoid tissue of Peyer's Patches (ALN) forming lamina propria of D. Lymphatics of Villi (L) dome, Laminapropria (LP), Submucosal infiltration (SLI), interfollicular lymphoid tissue (ILI) Aggregated lymphoid nodules (ALN), perifollicular lymphatics (P) Tunica muscularis (TM).

Lacteals were absent in domes. The lymphatic capillaries from lamina propria of dome reached submucosa establishing communication with PPs, submucosal lymphocytic infiltration (SLI) and lymph vessels of submucosa and interfollicular lymphocytic infiltration (ILI).

The submucosa of ileum due to the presence of PPs in the antimesenteric wall and absence of PPs at the mesenteric attachment, revealed a

peculiar arrangement in the distribution of lymphatics.

In the antimesenteric submucosa of ileum of buffalo calves, lymphoid tissue presented three types of arrangements, (1) a continuous sheet of Submucosal Lymphocytic Infiltration (SLI), (2) Aggregated Lymphoid Nodules (ALN) forming PP, (3) Interfollicular Lymphocytic Infiltration (ILI). Due to this peculiar arrangement, lymphatics coursing

through SLI, PPs and interfollicular zone, were observed and described at appropriate sites.

### **Submucosal Lymphocytic Infiltration (SLI)**

A thick zone of SLI formed a continuous sheet, subjacent to muscularis mucosae in the submucosa. In the dome areas as the lymphoid follicles of PPs were in continuation with the dome, muscularis mucosa was absent. In the absence of muscularis mucosae the SLI merged with the PPs wherever domes were present. Thus muscularis mucosae formed demarcation between lymphocytic infiltration of mucous membrane and submucosa in non-dome areas. SLI reported in this study formed arches with the concavity facing towards tunica muscularis. The junction of arches, at certain sites, projected into the interfollicular zone and were in continuation with ILL. Lymphatic capillaries were abundant in SLI. The lymphatic vessels arising from dome traversed SLI forming a rich network of lymph vessels. From the tips of arches of SLI, large lymphatic vessels were seen extending into the interfollicular zone, communicating with lymphatic capillaries of dome, lacteals, SLI and of ALN.

### **Peyer's Patches (PP)**

PP were confined to the submucosa of anti-mesenteric wall. The surface of the lymphoid follicles of pp was closely invested by lymphatic capillaries which can be termed peri-follicular lymph capillaries. The parenchyma of pp had narrow lymph sinuses, which communicated with the perfollicular vessels, with those of SLI and of inter follicular zone. Lymph vessels from dome also entered into the follicles.

### **Interfollicular Lymphocytic Infiltration (ILI)**

The interfollicular zone with ILI had abundant large lymphatic vessels. Lymph vessels arising from SLI, perfollicular vessels and domes communicated with each other and also with large lymphatic vessels in the interfollicular

zone. SLI in most of the areas extended deep into submucosa forming part of ILI in the interfollicular zone. In certain areas the junction of arches of SLI dipped between the follicles. These vessels formed extensive plexus at the base of PPs inner to the tunica muscularis.

At the mesenteric attachment domes were absent as PPs were not present at this site. Submucosa was narrow containing blood and lymph vessels, the latter draining the lacteals.

Tunica muscularis revealed oblique course of lymph vessels and tunica serosa revealed a rich plexus of lymph vessels along with blood vessels.

The red lithium carmine granules ingested were seen adhering to the surface of FAE, within the lymph capillaries of dome, in PP, perfollicular lymph capillaries and also in the blood vessels in the peripheral part of submucosa.

### **Discussion**

The transport of macromolecules or antigen was described to be through the FAE and the intercellular space of lamina propria (Kagnoff, 1987) and same pathway from epithelial cells to the vascular system through the underlying connective tissue (Copanhaber, 1961) for nutrients. Passage of colostral protein has been identified to be through epithelial cells" and lacteals and PP with dome having all the components required to mount an immune response (Tizard, 1987). The course of lymphatic capillaries parallel to the surface of dome and their close association with the indistinct basement membrane reported in this study might be indicative of transport of either antigen or intra, epithelial lymphocyte into the lamina propria and peyer's patches through these lymph capillaries. These might also serve as channels for migrating lymphocyte into FAE. Apart from transport through intercellular space

(Kagnoff; *loc-cit*) lymph capillaries also might play a role in transporting lymphoblasts to dome and antigen from FAE to lamina propria.

Peyer's patches lack afferent in man (Thomas and Jewell, 1979; Shorter *et al.*, 1982). The presence of carmine granules in FAE in the lymphatics of dome and PPs is suggestive of the existence of afferents to PPs, as carmine granules could have reached the PPs only through the afferents in the dome. Some of the lymphatic capillaries extending between dome and PPs might be efferent also, for homing of lymphocytes into the lamina propria after systemic circulation (Tomasi *et al.*, 1980). Homing of sensitised T&B lymphocytes from mesenteric lymphnode and thoracic duct into the gut as immune competent effector cells of both B and T cell types, as previously suggested (Craig and Cebra, 1971; Manuel and Tomkins, 1986).

ALN (Chu *et al.*, 1979) had three main components germinal centres (of PPs) referred to as B-cell region, inter nodular areas known as T cell region and dome areas which may be associated with the immune competent B-cells. The SLI and its extension - ILI into the interfollicular zone reported in this study might be part of inter nodular areas with T cells region (Chu *et al.*, *loc cit*). The presence of a dense zone of SLI which is reported in this study might be due to heavy antigenic load especially in young ruminants.

Further work on the type of lymphatics in close association with lymphocytes in different sites, enumerated in this study on Indian buffalo calves would throw light on the nature and ability of local immune response of gastrointestinal tract to respond to antigenic stimuli and deficiency diseases.

### Summary

Presence of dome, the extension of lymphoid follicles of Peyer's patches (PP), in

the mucous membrane of antimesenteric wall of ileum, contributed to the variations in the pattern of distribution of lymphatics. Lacteals were absent in domes. Lymphatic capillaries closely associated with the basement membrane of dome epithelium, ran parallel to the surface and continued down in the lamina propria, forming a rich plexus of lymphatics along with the continuation of lacteals from adjacent villi. Small vessels emanating from this plexus coursed through muscularis mucosae to form a rich plexus in the dense submucosal lymphocytic infiltration (SLI). Submucosal lymphatics existed as plexus in the SLI, perifollicular lymph capillaries, large lymph vessels in the interfollicular zone and as extensive plexus at the base of follicles. In as much as PP were absent on the mesenteric side, domes were also absent.

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