A Comparative study on Prenatal and Postnatal changes in the Histoarchitecture of Mesentric lymph node in Laboratory Animals


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ABSTRACT

A comparative light microscopic study on the mesentric lymph node in prenatal and postnatal age groups of mice, rat and guinea pig was carried out in the present study. The lymph node is a critical cross road for encounters between the antigen presenting cells, antigenic substances from lymph and lymphocytes recruited into lymph nodes from the blood.

The completely formed mesentric lymph node could be observed in the embryos of late pregnancy in guinea pigs. In the postnatal age groups, the mesentric lymph node consisted of a connective tissue capsule which varied in thickness as age advanced. The parenchyma was made up of cortex and medulla in all the age groups of the three species studied. The former had an outer and inner zone. Subcapsular sinuses were well developed. Nodules of different sizes could be observed in the outer cortex in all the species studied. Germinal centres could be recorded in the nodules of 12 month-old animals of all the species. The post capillary venules were observed in the inner cortex.

Key words: Light microscopic changes - mesentric lymph node - laboratory animals

The theme of biomedical research is the elucidation of biological cause, as they pertain to human health. Lab animal models are often used as specific test system for this purpose. Choosing a right species of experimental animal which is closely related to that of human immune system is an important step in biomedical research using lab animal species (Merchant et al., 2011).

Among the laboratory animals, the Guinea pig (Cavia porcellus) is one of the most valuable animal model related to human (Kaiser et al., 2010). Next to guinea pig, mice is the most commonly used lab animal model similar to immune system of human (Guo et al., 2012). In this order, rats are also the most commonly used animal model mainly for long term test, nutritional and cancer research.

The lymph node is a critical cross road for encounters between the antigen presenting cells, antigenic substances from lymph and lymphocytes recruited into lymph nodes from the blood (Gretz et al., 1997). Intestinal wall being the heaviest area of antigenic load, the lymph node associated with the intestine is of special interest (Kutyrev et al., 2008). Hence, priority has been given to study the structure of mesentric lymph node in the present study. A typical mammalian immune system is constantly changing throughout its life (Praham, 2009). Hence, the present study is aimed to observe and compare the developmental changes that takes place in the histoarchitecture of mesentric lymph node of guinea pig, mice and rat during prenatal and postnatal period.

MATERIALS AND METHODS

The mesentric lymph nodes were collected from guinea pig, mice and rats after euthanising as per the standard procedures. Lab animals for the study were procured from the Department of Laboratory Animal Science, Tamil Nadu Veterinary and Animal Sciences University, Chennai. The materials for the prenatal study were collected from embryos of all the three species during mid and late pregnancy. For the postnatal study, the tissue pieces were collected from six animals of two groups viz., pre pubertal (one, three and eight week) and postpubertal (4,8 & 12 months) animals of both sexes.
Tissue pieces were fixed in neutral buffered formalin and Bouin’s fluid and processed by paraffin embedding technique as per Kannan et al. (2015). Tissue sections were cut at 5 micron thickness and used for routine haematoxylin-eosin staining method. Mallory’s phosphotungstic acid-haematoxylin for muscle and collagen and Gomori’s method for reticulin fibres (Bancroft and Stevens, 2007) were also used.

RESULTS AND DISCUSSION

Prenatal

In 12 day-old and 16 day-old embryos of mice, there were no lymph nodes in the mesentry excepting uniform distribution of mesenchymal cells in the matrix (Fig 1) as against the presence of small and medium sized lymphocytes in the mesenchymal condensation of the developing lymph nodes in the mid pregnancy of cat (Van Rees et al., 1990). Similar observation could be possible in the present study in the 14 day-old and 18 day-old embryos of rat where the lymphocytes of various sizes were scattered throughout the mesentry. In the guinea pig, lymphocytes of various sizes in addition to the blast cells were found in 35 day-old embryos as in cat embryos (Ackerman, 1967). However, in 55 day-old embryos, the completely formed lymph nodes was observed with the differentiation of cortex and medulla (Fig-2).

Postnatal

Capsule

In the present study, the capsule consisted of collagen, elastic and smooth muscle fibres in all the age groups of mice and rats (Fig 3). In guinea pig, reticular fibres were found instead of smooth muscle fibres as in mammals (Nicander et al., 1993). The thickness of the capsule increased as age advanced immaterial of the species due to increased amount of connective tissue components as in mammals (Pahlavani et al., 1987; Sapin and Etingen, 1996). However, the relative connective tissue components in the mesentric lymph node of terrestrial mammals does not exceed 7-10 percent (Marinkina and Ovsyanko, 2000; Taniguchi et al., 2004).

The lymph nodes are said to lie in fat tissue and some fat adheres to the capsule of the lymph node (Ham, 1957) which occurs in the present study too as all mesenteric lymph nodes were found surrounded by adipose tissue in the post pubertal mice, rats and guinea pigs (Fig 4). The subcapsular sinuses were well developed in all the age groups of all the three species studied.

Parenchyma

In one week-old mice and guinea pigs, a foci of lymphocytic aggregation were seen without any outer limitations (Fig 5). The cortex and medulla could not be differentiated in the parenchyma of the lymph node, as in rats of similar age groups studied. There were no nodules found in the cortex of the rat. However, the presence of nodules were discernible in one week-old guinea pig as described in mammals (Leeson et al., 1988). The germinal centres were absent in one week-old guinea pigs as referred by Maximow and Bloom (1957) where cortical nodules lack the germinal centres in the first month after birth in mammals. These structural differentiation of the lymph nodes of the mice and rat of one week age group has no identical comparison with higher mammals.

The lymph nodes of mice consisted of an outer and inner cortex and the cortical nodules in the outer cortex had germinal centres. However, the prepubertal age groups of mice except that of one week and post pubertal age groups, pre and post pubertal age groups of rats and guinea pigs consisted of an outer cortex with nodules and an inner cortex with diffused lymphocytes. The germinal centres which consisted of lymphoblasts, a few reticular cells, macrophages and plasma cells were present only in 12 month old animals of all the species studied similar to the reports of Maximow and Bloom (1957) where it is reported that the germinal centres develop only after a month (Fig 6).

In the present study, the number of nodules was recorded to be reduced in all the species of the present study as in mammals (Bevelander, 1965). This reflects the attenuation of the lymphopoietic function of mesentric lymph nodes (Kutyrev et al., 2008).

The observed peculiarity is the cuboidal epithelium lining the post capillary venule for an important function of the migration of T lymphocytes from the germinal centre into the parenchyma by virtue of their attraction towards the lining cuboidal cells (Leeson et al., 1988).

The medulla of the lymph node consisted of medullary sinuses and medullary cords in all the postpubertal age groups in the present study (Fig 7) as reported in mammals (Bevelander, 1965). The anastamosis of medullary cords were found to be very common in 8 and 12 month-old mice and found to be more as age advanced in rats (Fig-8) and anastamosis was not recorded in guinea pigs. The number of medullary cords was less as age advanced in the rats.

Plasma cells and macrophages were the major cellular population of the medulla of the mesenteric lymph node in all the species of the present study.

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REFERENCES


Fig. 4 Photomicrograph of mesenteric lymph node of 12 month old male mouse showing adipose encapsulation and the afferent lymphatic vessel in the cortex. Ad- Adipose tissue, A- Afferent vessel H&E x500

Fig. 5 Photomicrograph of mesenteric lymph node of an one week old male mouse showing lymphatic infiltration in the mesenchymal aggregation (arrows). H&Ex80

Fig. 6 Photomicrograph of mesenteric lymph node of 12 months old male mouse showing germinal center in a nodule. G- Germinial center, L- Lymphoblast, M- Macrophage H&Ex500

Fig. 7 Photomicrograph of mesenteric lymph node of 8 week old female rat showing the distribution of reticular fibres (arrows). Gomori’s method x500

Fig. 8 Photomicrograph of mesenteric lymph node of 12 month old male rat showing sinusoidal anastomosis (arrows). H&Ex500