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Histological studies on the spleen of large white Yorkshire Pig (*Sus scrofa*)

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Abstract

The microscopic studies of 6 spleens showed that the capsule was composed of smooth muscle, collagenous and elastic fibers. Trabeculae were emerged from the capsule and entered into parenchyma and subdivided it into smaller compartments by forming a net like framework. Splenic parenchyma was composed of white and red pulps. White pulp was lymphoreticular tissue consisted of lymphatic nodule and peri-arterial lymphatic sheath. Peri-arterial lymphatic sheath and Splenic nodules were abundant in pig spleen. Ellipsoids (pericapillary macrophage sheath) were especially large and abundant in the marginal zone, the region between the red and white pulp. Red pulp was consisted of pulp arterioles, sheathed capillaries, terminal capillaries, splenic sinusoids and splenic cords. The splenic sinusoids were less abundant and poorly developed.

Keywords: Spleen, White Yorkshire Pig, histology

1. Introduction

Pigs are domesticated animals, of the genus *Sus* and of the family Suidae, that are raised for food all over the world. The present study has been planned to study the gross structure of the spleen (the largest lymphoid organ) to justify its importance and essentiality in the body. The spleen is more complex than other lymphoid tissues and is an important reservoir of blood. Its capsule contains large amount of smooth muscle fibers controlled by sympathetic nervous system. It performs various functions like hematogenesis, metabolizes iron, blood filtration, red blood cell destruction and immune response.

2. Materials and Methods

For the histological examination the small pieces of tissues (2mm size) were collected from 6 spleens. From each spleen, the tissues were collected from seven fixed anatomical regions to explore the regional differences if any. The tissues were preserved in 10% formal saline, Bouin's fluid and Zenker's fluid for 48hrs, 15hrs and 18hrs respectively and processed for light microscopy by using paraffin of melting point of 58-60 °C. The paraffin blocks were sectioned to obtain 5-6µm thick sections which were stained with the following routine histological stains to demonstrate different components of spleen.

1. Ehrlich's Haematoxylin and Eosin stain for routine observation (Singh and Sulochana 1997).
2. Gomori's method for reticulum (Luna, 1968).
3. Verhoeff's elastin stain for connective tissue fibers (Singh and Sulochana, 1997).
4. Van Gieson stain for collagen fibers (Singh and Sulochana, 1997).
5. Masson's trichrome method for collagen fibers (Singh and Sulochana, 1997).
6. Silver impregnation for reticular, elastic and collagen fibers (Singh and Sulochana, 1997).
7. Crossman's Modification of Mallory's Triple stain elastic and collagen fibers (Singh and Sulochana, 1997).

3. Results and Discussion

The spleen was covered by thick fibro-elastico-muscular capsule invested by the serous peritoneal covering. The capsule was composed of collagenous, elastic and reticular fibres along with smooth muscle fibres. Branching trabeculae emerged from the capsule. These entered into the splenic parenchyma and subdivided it into smaller compartments by forming a net like framework. The splenic parenchyma or stroma was composed of white pulp and red pulp.

White pulp of spleen was lymphoreticular tissue consisting of lymphocytes, plasma cells and macrophages enmeshed in reticular network. The white pulp was composed of two components called as splenic nodules or Malphigian corpuscles or lymphatic nodule and peri-arterial lymphatic sheath. Peri-arterial lymphatic sheath and Splenic nodules were abundant in pig spleen. Splenic nodules were composed of aggregation of the lymphatic tissue along the course of small pulp artery. The splenic nodules generally occurred aggregation of two or three nodules. Eccentrically situated arteries were observed in the splenic nodules, the nodular artery or central artery. The germinal centre of the nodule was light stained, where the lymphocytes were loosely arranged. Ellipsoids (pericapillary macrophage sheath) were especially large and abundant in the marginal zone, the region between the red and white pulp. Each consists of macrophages and reticular fibers that surround a capillary. The red pulp filled the spaces between the white pulp and trabeculae. It consisted of pulp arterioles, sheathed capillaries, terminal capillaries, splenic sinusoids and splenic cords. The splenic sinusoids were less abundant and poorly developed. Numerous splenic cords were observed between the sinusoids. The framework of splenic cords was formed by loosely arranged reticular fibres and it contained numerous erythrocytes, reticular cells, lymphocytes, macrophages and plasma cells. The spleen was covered by moderately thick fibro-elastic and muscular capsule (Fig. 1 and 2) as was also reported by Dellmann and Brown [5] in pig. The capsule was invested by serous peritoneal covering, which was in accordance with the observation of Dellmann and Brown [5] in pig, Trautmann and Fiebiger [20] in domestic animals, Getty [9] in horse, Panchal *et al.* [16] in Marwari sheep and devi [7] in Marwari goat. Simple squamous mesothelial cells of peritoneal covering were irregular in shape with centrally placed spherical nucleus and attenuated strands of cytoplasm (Fig.1) in present study. Similar finding was observed by Bajpai [3] in goat. The smooth muscle fibers were arranged in three layers; outer, middle and inner (Fig.2). The fibers were parallel to the surface in outer and inner layer and oblique in middle layer. These findings were consonance with the finding of Dellmann and Brown [5] in pig, Bajpai [3] in goat, Thanvi [19] in sheep and devi [7] in Marwari goat. Branching trabeculae emerged from capsule and entered in to the interior of the splenic parenchyma, which concurred, with the findings of Raghavan [17] in ox, Getty [9] in horse and Bajpai [3] in goat. The reticular fibers of inner most part of capsule extended into trabeculae; (Fig. 1 and 2) similar observations were made by Dellmann and Brown [3] in pig, Panchal [16] *et al.* in Marwari sheep, devi [7] in Marwari goat, Ikpegbu *et al.* [10] in African palm squirrel and Maina [12] *et al.* in camel. In present study the fibers were vertically arranged in trabeculae and became progressively finer in the terminal branches. The collagenous, elastic and muscle fibers were oriented parallel to the trabecular direction. The characteristic arrangement of elastic fibres and smooth muscles fibres in the capsule and trabeculae help in changing the volume of spleen and pumping out the excess blood in circulation. This simulated the finding of Banks (1981) in domestic animals that elastic fibres allowed large volume changes, whereas the contractions of smooth muscles fibres discharged the blood from the organ. The white pulp of lympho-reticular tissue consisting of lymphocytes, plasma cells and macrophages as was also observed by Raghavan (1964) in ox, Banks (1981) in domestic animals, Morphol

(2006) in Little Hairy Armidillo and Kannan *et al.* (2015) in chicken. The white pulp was composed of two components, which were splenic nodules or Malphigian corpuscles or lymphatic nodules and peri-arterial lymphatic sheath (Fig. 4), findings are similar to Nicander *et al.* (1993) in domestic animal and Sinha *et al.* (2013) in Black Bengal goats. The pig spleen was abundant lymphatic tissue which was similar findings of Dellmann and Brown (1987) in same species.

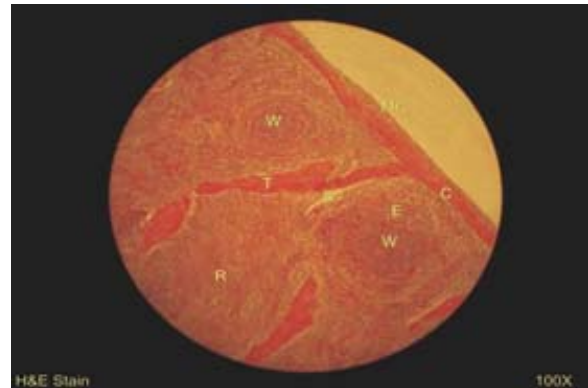


Fig 1: Cross Section of the Spleen. (C) Capsule, (MC) Mesothelial cells, (T) Trabeculae (R) Red Pulp, (W) White pulp, (S) Sinusoid, (E) Ellipsoids.

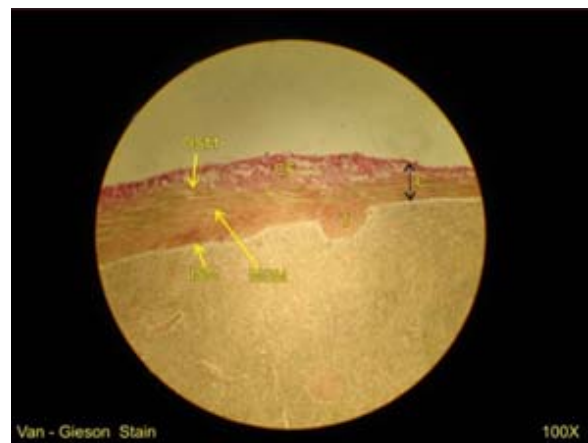


Fig 2: Cross Section of the Spleen. (C) Capsule, (T) Trabeculae, (CF) Collagen Fibers, (ISM) Inner Smooth muscle fibers, (MSM) Middle smooth muscle fibers, (OSM) Outer smooth muscle fibers.

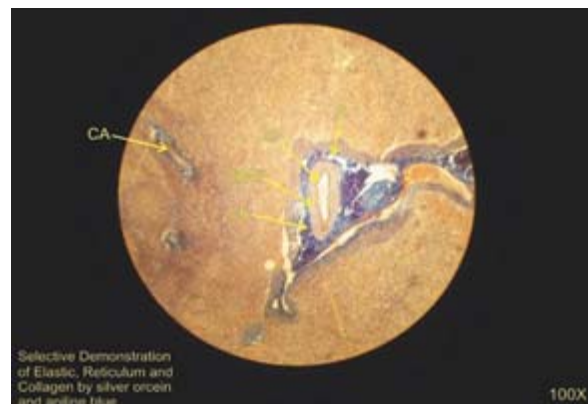


Fig 3: Cross Section of the Spleen. (T) trabeculae, (A) Artery, (V) Vein, (EF) Elastic fibers, (CF) Collagen fibers, (SMF) Smooth muscle fibers, (CA) Central artery.

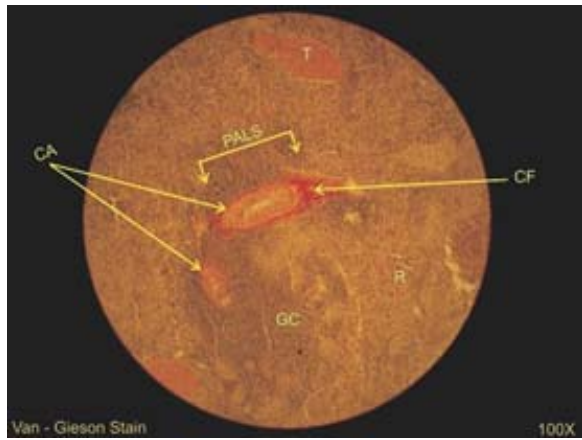


Fig 4: Cross Section of the spleen, (CA) Central artery, (PALS) Periarterial Lymphatic sheath, (G) Germinal center, (W) White pulp, (R) Red pulp, (CF) Collagen fibers

In the present study, splenic nodules of various sizes were observed as an ovoid mass. The nodule was composed of aggregations of the lymphatic tissue along the course of small pulp artery as was previously described by Nickel^[15] *et al.* in domestic animals. It was also confirmed by the findings of Awal^[2] *et al.* in indigenous cattle that the splenic corpuscles were ovoid mass of compact lymphatic tissue and had a fine meshwork of reticular connective tissue containing mainly lymphocytes of various sizes. Spleen was abundant in lymphatic nodules, generally occurred aggregations of two to three nodules and occasionally singly was observed. This finding was in harmony with Dellmann and Brown^[5] in same species. Eccentrically situated arteries, the nodular artery or central artery were observed in the nodule (Fig. 3 and 4). This concurred with the findings of Dellmann and Brown^[5] in pig and Firdous *et al.*^[8] in fox that each splenic corpuscle contained a small artery of variable position, falsely called as central artery. Dellmann and Brown^[5] mentioned in pig that Ellipsoids (pericapillary macrophage sheath) were especially large and abundant in the marginal zone, the region between the red and white pulp (Fig. 1). Each consists of macrophages and reticular fibers that surround a capillary. Similar findings were also observed in the present investigation. Trautmann and Fiebiger^[20] in domestic animals and devi^[7] in Marwari goat reported that the space between the white pulp and trabeculae were occupied by the red pulp. Similar findings were observed in the present study. Red pulp consisted of pulp arterioles, sheathed capillaries, terminal capillaries, splenic nodules and splenic cords which was concurred with the findings of Banks^[4] and Dellmann and Brown^[5] in domestic animals, Ikpegbu^[10] *et al.* in African palm squirrel and Kannan^[11] *et al.* in chicken. The splenic sinusoids were less abundant and poorly developed, similar observations were evidenced by Sinha *et al.*^[18] in horse, cow, and pig.

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