



Microscopic Appearance of Human Spleen at Different Gestational Age Groups: A Fetal Histological Study

Farklı Gestasyonel Aşama Gruplarında İnsan Dalağının Mikroskopik Görüntüsü: Fetal Histolojik Çalışma

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ABSTRACT

Purpose: Spleen is concerned with phagocytosis and immune response. Microscopically the spleen has a capsule and parenchyma. The parenchymal tissue of the spleen consists of white pulp and red pulp. The present study is an attempt to reveal the detailed microscopic appearance of spleen in fetuses at various gestational ages.

Material and Methods: The present study was carried out on 15 human fetuses) of known gestational age (GA) in the department of Anatomy, Kasturba Medical College, Manipal. The sections of the spleen were stained using Hematoxylin and Eosin and were observed under light microscope.

Results: The microscopic anatomy of the spleen was observed at different gestational age. At first trimester the spleen was covered with a capsule. The lymphoid aggregations were observed throughout the spleen without any well differentiated red pulp. At second trimester the lymphoid aggregations started differentiating around the central arteriole forming the periarteriolar lymphoid sheath by 20 weeks. The red pulp was distinctly observed containing the RBCs and sinusoids and the white pulp containing lymphoid follicles were observed by 23rd week. At third trimester distinct red and white pulp was observed. By 30th week well developed lymphoid follicles with central arteriole were seen. At 36 weeks the central arteriole was seen at the periphery of the lymphoid follicle.

Conclusion: A detailed description of the development of parenchymal and vascular components is essential in understanding the normal development of spleen.

Key words: Spleen, red pulp, white pulp, central arteriole, histogenesis.

ÖZET

Amaç: Dalak fagositöz ve immün cevap ile ilgili bir organdır. Mikroskopik olarak dalağın kapsül ve parankim yapıları vardır. Dalağın parankimal dokusu beyaz ve kırmızı pulpa kısımlarından oluşur. Bu çalışmada farklı gestasyonel aşamalarda, fetüs dalağının detaylı mikroskopik görüntüsünü ortaya çıkarmak amaçlanmaktadır.

Materyal ve Metod: Bu çalışma, Manipal, Kasturba tıp fakültesi anatomi bölümünde, gestasyonel aşaması (GA) bilinen 15 insan fetüsü ile gerçekleştirilmiştir. Dalak kesitleri hematoxilen ve eosin ile boyanmış ve ışık mikroskopunda görüntülenmiştir.

Bulgular: Dalağın mikroskopik anatomisi farklı gestasyonel aşamalarda incelenmiştir. İlk trimesterdeki dalak kapsül ile çevrilidir. Lenfoid agregasyonlar herhangi bir kırmızı pulpa farklılaşması olmadan tüm dalak boyunca gözlenmiştir. İkinci trimesterde lenfoid agregasyonlar 20. haftadan itibaren periarteriolar lenfoid kılıf oluşturmak üzere merkezi arteriolar etrafında farklılaşmaya başlamıştır. Kırmızı pulpada açıkça KKH'leri ve sinüzoidler, beyaz pulpada ise 23. haftadan itibaren lenfoid foliküller görülmektedir. Üçüncü trimesterde kırmızı ve beyaz pulpa açıkça görülmektedir. 30. Haftadan

itibaren merkezi arteriol ile iyi gelişmiş lenfoid foliküller görülmektedir. 36. Haftada merkezi arteriol, lenfoid folikülün periferinde görülmektedir.

Sonuç: Dalağın normal gelişiminin anlaşılmasında, parenkimal ve vasküler bileşenlerin gelişiminin detaylı tanımlanması önemlidir.

Anahtar kelimeler: Dalak, kırmızı pulpa, beyaz pulpa, merkezi arteriol, doku oluşumu

INTRODUCTION

Spleen is concerned with phagocytosis and immune response. In fetal life it is also an important site for hemopoiesis. Microscopically the spleen has a capsule and parenchyma. The capsule is made up of collagen fibers. Numerous trabeculae extend from the capsule into the substance of the spleen. The parenchymal tissue of the spleen consists of two major components. They are white pulp and red pulp named on the basis of their appearance when a fresh spleen is transected. The white pulp is composed of lymphoid tissue in which B and T lymphocytes mature and proliferate under antigenic stimulation. In the white pulp T cell surrounds the central arterioles to form periarteriolar lymphatic sheath. The red pulp is a unique filtration device that enables the spleen to clear the particulate material from the blood. Splenic parenchyma is permeated by an interconnected network of sinuses^{1,2}.

The spleen appears about sixth week of gestation as localized thickening of coelomic epithelium of dorsal mesogastrium. The proliferating cells invade the underlining angiogenetic mesenchyme which becomes condensed and vascularized. The process occurs simultaneously in several adjoining areas which soon fuse to form lobulated spleen. The mesenchymal cells differentiate into reticular cells that provide the splenic reticular stroma³. Vascular reticulum is well developed at 8-9 weeks gestational age and contains immature reticulocyte and numerous closely packed thin walled vascular loops⁴. The specialization into red and white pulps seems to be depended upon the development and distribution of vascular channels. The lymphoid tissue appears early and by 6 months of fetal life the splenic corpuscles form nodules around arteries⁵.

Histogenesis of the spleen has attracted relatively little attention. The present study is an attempt to reveal the detailed microscopic appearance of spleen in fetuses at various gestational ages.

MATERIAL and METHODS

The present study was carried out on 15 human fetuses (3 first trimester, 6 second trimester and 6 third trimester) of known gestational age (GA) in the department of Anatomy, Kasturba Medical College, Manipal. The spontaneously aborted and stillborn fetuses were procured from the department of Obstetrics and Gynecology, Kasturba Hospital Manipal for museum specimen preparation. The GA of first trimester fetuses ranged from 10 to 12 weeks whereas it ranged 16 to 24 weeks and 28 to 36 weeks for the second and third trimesters respectively. Fetuses with any external deformity were excluded from the study. The spleen was resected from the abdomen. The section was taken adjacent to the hilum. The tissues were processed for histological observations. The sections were stained using Hematoxylin and Eosin and were observed under light microscope.

RESULTS

The microscopic anatomy of the spleen was observed at different gestational age (GA) and the changes were observed. The sections were observed both under low and higher magnifications to explain the various components of the spleen.

First trimester: (10 to 12 weeks)

When observed under 10X the spleen was covered with a capsule made up of connective tissue. The substance of the spleen appeared to

be incompletely subdivided by the trabeculae. The lymphoid aggregations were observed throughout the spleen without any well differentiated red pulp. The blood vessels were observed in the trabeculae (Figure 1a).

The capsule and the trabeculae appeared cellular rather than fibrous. The fibroblasts were observed in the capsule when observed under 40X (Figure 1b). The lymphocytes were scattered

throughout and aggregations were observed at some places by 10 weeks. The sinusoids appeared by 12th week and the RBCs were scattered without distinct formation of red pulp. No central arterioles were seen till 12th week of gestation. The details of reticular framework could not be elaborated as they usually don't stain with routine histological preparation.

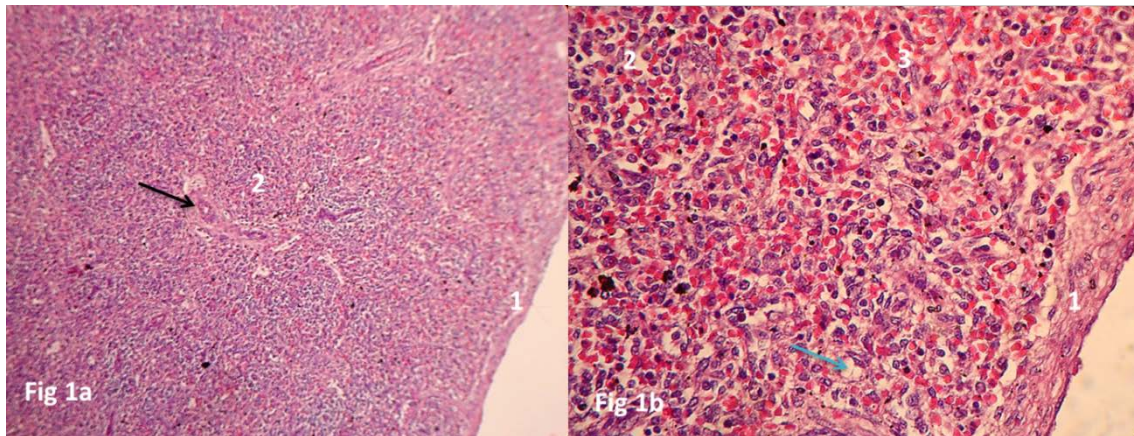


Figure 1. Fetal spleen at first trimester (Hematoxylin and Eosin)

Figure 1a shows the fetal spleen at 10X and **Figure 1b** shows fetal spleen at 40X

Capsule, 2- lymphoid aggregation, 3- hemopoietic cells, trabeculae with blood vessels (black arrow), sinusoid lined by flattened cells (blue arrow)

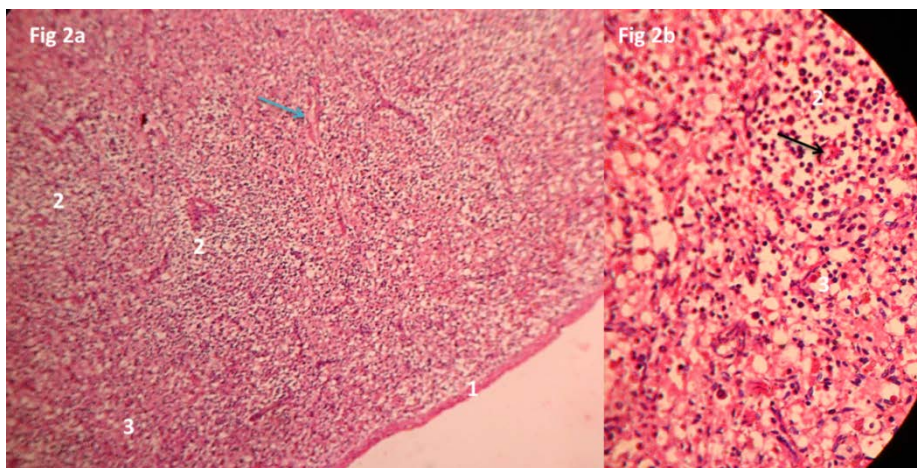


Figure 2. Fetal spleen at second trimester (Hematoxylin and Eosin)

Figure 2a shows the fetal spleen at 10X and **Figure 2b** shows fetal spleen at 40X

1-Capsule, 2- lymphoid aggregation, 3- red pulp containing RBCs, trabeculae with blood vessels (blue arrow), centrally placed central arteriole (black arrow)

Second trimester: (16 to 24 weeks)

When observed under 10X a thin capsule was observed surrounding the spleen and the trabeculae with well differentiated blood vessels were dispersed in its substance. The lymphoid aggregations started differentiating around the

central arteriole forming the periarteriolar lymphoid sheath (PALS) by 20 weeks. The red pulp was distinctly observed containing the RBCs and sinusoids and the white pulp containing lymphoid follicles were observed by 23rd week (Figure 2a and 2b).

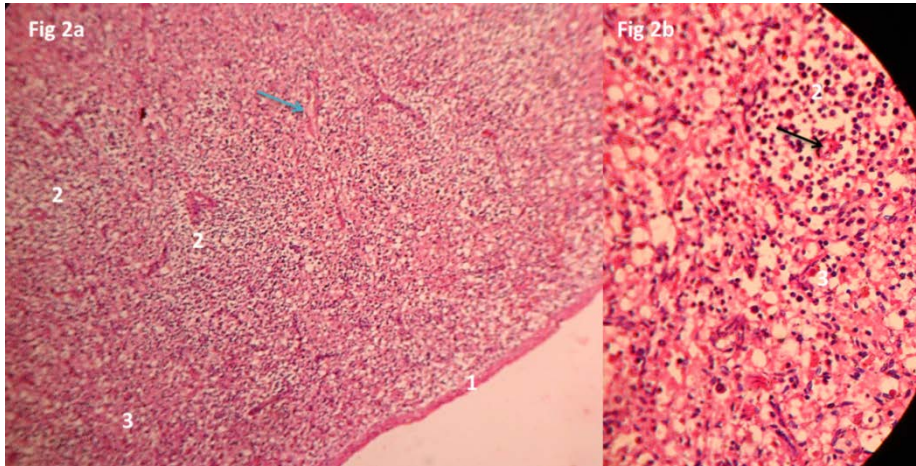


Figure 2. Fetal spleen at second trimester (Hematoxylin and Eosin)

Figure 2a shows the fetal spleen at 10X and **Figure 2b** shows fetal spleen at 40X

1-Capsule, 2- lymphoid aggregation, 3- red pulp containing RBCs, trabeculae with blood vessels (blue arrow), centrally placed central arteriole (black arrow)

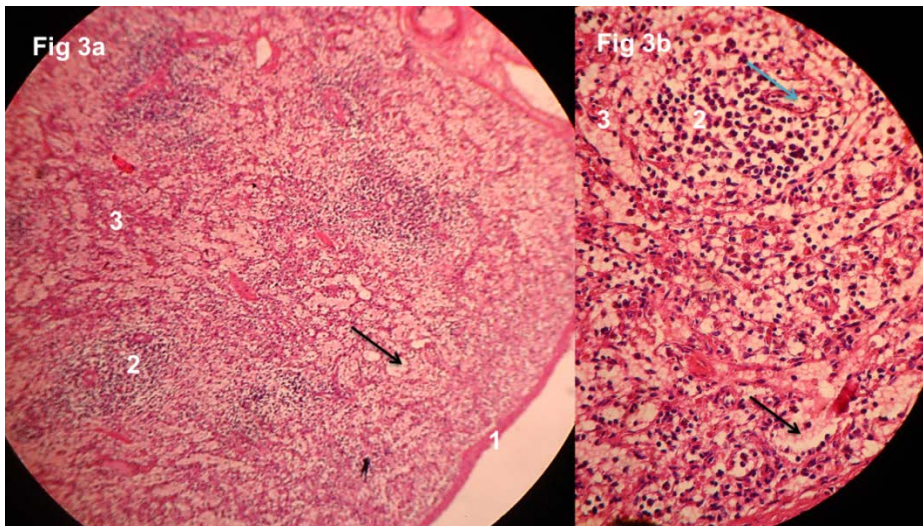


Figure 3: Fetal spleen at third trimester (Hematoxylin and Eosin)

Figure 3a shows the fetal spleen at 10X and **Figure 3b** shows fetal spleen at 40X

1- Capsule, 2- white pulp showing lymphatic nodule, 3- red pulp containing RBCs, sinusoid lined by flattened cells (black arrow) , peripherally placed central arteriole (blue arrow)

Third trimester: (28 to 36 weeks)

Under 10X the spleen was observed to have distinct red and white pulp. By 30th week well developed lymphoid follicles with central arteriole were seen. At 36 weeks the central arteriole was seen at the periphery of the lymphoid follicle.

DISCUSSION

According to Vellguth et al, at 14th gestational week numerous erythrocytes, normoblasts and macrophages are seen among a network of mesenchymal cells. Splenic lobules begin to form during the 15th to 17th week of gestation. They consist of a central artery, surrounded by a sheath of lightly stained cells which resemble myofibroblasts. The development of the white pulp starts around the 18th gestation week. An accumulation of lymphocytes around the central arteries was recognized during the 20th week of gestation. Around 23rd week the primary follicles were arranged at the periphery of the PALS⁶. In the present study by 10th week the lymphocytes were scattered throughout and aggregations were observed at some places. The distinct red and white pulps were observed by 23rd week of gestation.

According to Radhika et al, by 11th week only lymphocytic aggregation was seen. By 20th week developing lymphoid follicles observed. By 32 weeks well developed lymphoid follicles with central arteriole was observed⁷. At 36 weeks mature lymphoid follicles with peripherally placed arteriole was seen. The above findings are in agreement with the present study.

Pal et al used Masson's trichrome stain to describe the connective tissue components. The spleen up to 13th week was composed of collagen fibers with fibroblast cells, fibrocytes and reticular cells. From 14th week onward RBCs were observed in the interstitial tissue with few lymphocytes. Reticular cells could be detected till 20th week of gestation. The proper aggregation of lymphocytes could be observed from 24th week

Numerous sinusoids were observed in the red pulp. The reticular framework was also well differentiated by 32 weeks. The capsule appeared predominantly fibrous than cellular (Figure 3a and 3b).

onwards, but the well-defined lymphoid follicle or white pulp could be observed from 31st week⁸. In the present study the reticular framework was not appreciated in up to 12 weeks but it was distinctly observed by 32 weeks.

Sinusoids, capillaries with thin endothelial lining were observed from the earliest gestational period. By 15 weeks the blood vessels lined by interrupted endothelial cells could be detected [8]. In the present study the sinusoids were observed by 12 weeks and their differentiation continued up to the second trimester.

According to Satoh, the spleen of the 17th gestational week showed, alpha-smooth muscle actin positive reticulum cells which were scattered around the arterioles. From the 23rd week, they increased in number and began to form a reticular framework. An accumulation of T and B lymphocytes occurred within the framework, and a primitive white pulp was observed around the arterioles⁹. In the present study the authors could not distinctly observe the appearance of the reticular framework as it was not stained with routine preparation which could be considered as one of the limitations of the present work.

The present study was a preliminary attempt to explain the histogenesis of the spleen. All the components of the spleen were analyzed but the finer details of the reticular framework and capsule could not be described which needs further consideration using special stains.

The present study is a preliminary attempt to explain the histogenesis of the human spleen at different gestational age. A detailed description of

the development of parenchymal and vascular components is essential in understanding the normal development of spleen.

Conflict of interest: None

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