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Morphological structure of accessory spleen in Chinese hamsters

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To attempt a rigorous definition of the structure of the accessory spleen (AS) in the Chinese hamster, we examined twenty-one animals, and found AS in 5 animals (23.8%), which were over 7-month-old. The AS had no connection with the main spleen and was seen as a dark red oval organ (0.7 mm × 1.5 mm), which was embedded in the adipose tissue near the tail of the pancreas. It was demarcated from the adipose tissue and some pancreatic tissue. The organ was encapsulated by thin collagenous connective tissue and smooth muscle fibers, and contained lymphatic nodules, reticular fibers, nodular central arterioles, macrophages and megakaryocytes. Notably the incidence of AS appeared to increase with age in the Chinese hamsters.

Key words: accessory spleen, chinese hamster, histology

Introduction

There have been many reports on the incidence and histology of the accessory spleen (AS) in humans [1-4], rabbits [5, 6], chickens [7], mice [8], apes [9] and pigs [10], but these are rarely found in the Chinese hamster. Although Isegawa et al [11] have observed AS in the golden hamster(APA), the morphological structures were not described.

It would appear that the AS probably represents a type of developmental failure [12]. Although it has been recognised that certain congenital malformations of the spleen are frequently associated with other congenital malformations of body system, it has not been previously shown that the presence of an AS is a marker for the occurrence of another malformation [1].

It is recognized that the occurrence of human ASs is substantially increased in the presence of certain hematological diseases [13]. Development anomalies of the spleen are generally thought to occur infrequently in animals, and include splenomata, duplications, absence of the spleen (alienia), multiple small spleens, displacements (ectopia), and the presence of one or more ASs [5]. ASs are regarded as the most common of the splenic anomalies [14].

The AS has neither been described in detail in the hamster nor frequently been recognized as a functional organ which has genetic background.

To obtain a better understanding of the structures based on morphologic criteria, we studied the distribution and characterization of AS in the Chinese hamster.

Materials & Methods

Animals

Animals were maintained on a commercial laboratory diet (Shinchon feeds, Korea), received water ad libitum, and were housed in a 12 h light/12 h dark cycle for the duration of this study. Room temperature was 23.2°C, relative humidity was 55.1 %, with 15 air changes per hour. Twenty-one Chinese hamsters were divided into three groups by age (2-5 months, 7-9 months, 10-12 months).

Light microscopy

The abdomen of the Chinese hamster was opened after anesthetizing with ether. The ASs were obtained and observed under the stereomicroscope. They were then fixed in 10 % neutral buffered formalin for 72 h. The tissues were rinsed in water, dehydrated in alcohol, processed for routine paraffin sectioning. Serial paraffin embedded sections were prepared cutting at 3-4 μm and stained using hematoxylin & eosin, Masson's trichrome and Gomori's reticulum methods.

Results

Twenty-one Chinese hamsters were examined, and ASs

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Table 1. Incidence of accessory spleens in chinese hamsters.

Age (months) / Total incidence	2 5	7 9	10-12	Total incidence
Incidence in each age Group	0/2 (0%)	2/9 (22%)	3/10 (30%)	5/21 (23.8%)

were found in 5 animals (23.8%) aged more than 7 months (Table 1).

Macroscopically, no AS was connected with the main spleen. AS was seen as a dark red oval organ (0.7 mm × 1.5 mm) embedded in the adipose tissues near the tail of the pancreas (Fig. 1).

On the histological examination, AS was demarcated from the adipose tissue. The organ was encapsulated by thin collagenous connective tissue and smooth muscle fibers, and was supported by reticular cells and fibers (Figs. 2, 3).

The accumulation of lymphocytes was distinct, but few nodules were present. The whole of the AS was generally filled with red blood cells (Fig. 2). The accessory splenic parenchyma was composed of red and white pulps resembling those of the spleen (Figs. 4, 5). Most of the accessory splenic red pulp was red in color, owing to the large amount of blood held within the reticular network (Figs. 2, 3, 5) which was, however, poorly developed. The white pulp was composed of lymphatic tissue distributed throughout the AS as typical lymphatic nodules and diffuse lymphatic tissues. The nodules may or may not have germinal centers, depending on their functional state(Fig. 4). The diffuse lymphatic tissue contained many macrophages that digested erythrocytes and granulocytes (Fig. 5). The AS also contained a few megakaryocytes and nodular central arterioles (Figs. 4, 6), and general basic structure of the organ was poorly developed in the Chinese hamster.

Table 1 demonstrates that the incidence of AS appeared to increase with age.

Discussion

Harris [15] reported that the ectopic splenic tissue could be divided into two categories : splenosis due to autoplantation of splenic tissue, usually after splenectomy: and AS, which was described as a congenital duplication of splenic tissue in an ectopic location. AS is structurally identical to the spleen. In this study, we identified AS by examining blood from the abdominal aorta and examining the main spleen. According to Arey [12], the human spleen originates from the mesenchymal primordia adjacent to those of the pancreas in the embryonic dorsal mesogastrium. As the primitive splenic masses increase in size, their hillocks above the omental surface slowly merge. The spleen is sometimes partially subdivided, or

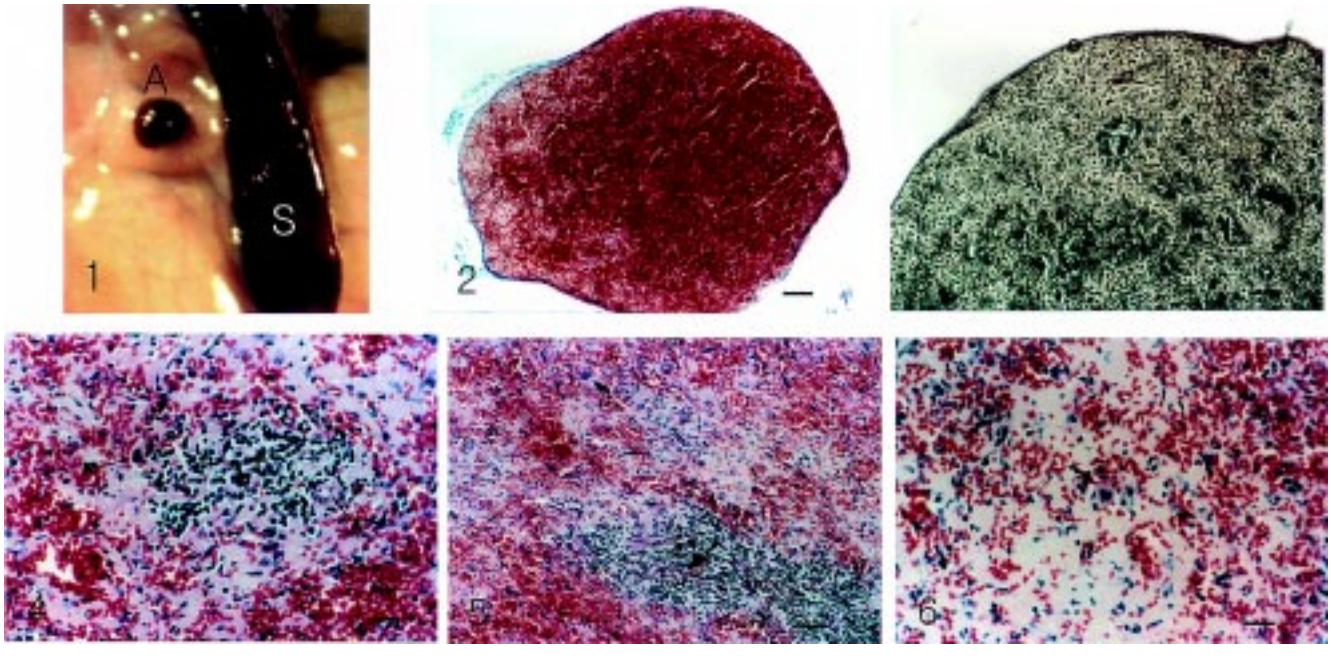

Fig. 1. 1. Accessory spleen (A) near the spleen (S) in the Chinese hamster. Scale bar = 500 μm. 2. General appearance of the accessory spleen embedded in adipose tissues. Masson's trichrome. Scale bar = 50 μm. 3. Capsule (C) and fine reticular fibers (R) in the accessory spleen of the Chinese hamster. Gomori method. Scale bar = 25 μm. 4. A nodular arteriole (A) in the lymphatic nodule (F) and megakaryocytes (M) are shown in the accessory spleen. Hematoxylin & Eosin. Scale bar = 12.5 μm. 5. Macrophages (arrowhead) with deposits of the hemosiderine and megakaryocytes (arrow) are scattered throughout the accessory spleen. Hematoxylin & Eosin. Scale bar = 25 μm. 6. Megakaryocyte (arrow) and erythrocytes (red color) are scattered in the accessory spleen of the Chinese hamster. Hematoxylin & Eosin. Scale bar = 12.5 μm.

even mutiply divided during the developmental stage. Smaller ASs also commonly occur during human development. These types result either from the continuance of the early multiple hillocks or from an exaggeration of temporary incisures that appear during the third and fourth months.

In the present report, however, evidence of AS structure is provided in the Chinese hamster. With regard to the incidence of AS, it is reported that approximately 23.8% of Chinese hamsters, 10% of humans [1], 27% of golden hamsters [11], 8.9% of rabbits [5], and 51% of New Hampshires pigs [10] have ASs.

The AS of the rabbit [5] was found in various locations of the abdomen, all were found to be final derivatives of the embryonic dorsal mesogastrium. In descending order of incidence the organ also occurs in the splenic hilus, the tail of the pancreas, gastrosplenic ligament, phrenicosplenic ligament, main body of the pancreas, and the pararenal and paraovarian sites. It has been estimated that more than 98% of ASs occur near the spleen. ASs of the Chinese and the golden hamsters [11] are embedded in the adipose tissues near the tail of the pancreas. AS was observed cranial, adjacent and caudal to the spleen in the chicken [7], and on the tail of the pancreas in the capuchin monkey [9].

AS in the Chinese hamster was observed near the tail of the pancreas, however, multiple AS is uncommon. The frequency of occurrence of AS was not related to body size or level of inbreeding but increased consistently with age [5].

The average size of AS in the Chinese hamster was 0.7 mm × 1.5 mm, and similar to that observed in the golden hamster [11], in which some large sized (2 mm × 2 mm) and some small sized organs(less than 1 mm × 1 mm) were also observed. AS in the rabbit [5] is usually 1~3 mm in size, but it was about 0.75 cm in the sow [10].

Lymphatic nodules, reticular fibers, nodular central arterioles, erythrocytes, leukocytes, megakaryocytes and macrophages were observed in the AS of Chinese hamster. AS of the rabbit [5] contained splenic corpuscles, nodular or central arterioles and red pulp. Lymphoid tissue (white pulp) was seen adjacent to an artery in both the AS and the spleen of the chicken [7]. AS of the capuchin monkey [9] was composed of mature splenic tissue.

The location, size, number, and shape of AS are variable in animals. However, its structure is invariably similar to that of the spleen. It appears that the morphological structure of AS in the Chinese hamster is almost same as that of other animal species. AS is morphologically and functionally similar to the spleen, however, it is poorly developed in the Chinese hamster, unlike that of the spleen. The above findings suggest that the AS may take part in hemopoiesis, blood filtration and immune reaction in the animals.

It is noteworthy that incidence of the AS increases with age in Chinese hamsters. However, further studies are needed to clarify the factors, which influence the age- or strain-related differences of AS incidence in hamsters, and to investigate its function.

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