The Possible Existence of a Vitamin A-storing Cell System

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Vitamin A is stored in the liver. Small amounts of vitamin A are also found in the lungs, intestines, eyes and other areas of the body. Cells responsible for vitamin A storage have long been regarded as a part of the reticuloendothelial cell system (RES) (6, 8), e.g., in the liver, Kupffer cells are thought to be the site of vitamin A storage. However, Nakane (7) first noticed in 1963 by fluorescence microscopy that liver vitamin A was found not in the Kupffer cells but in the “fat-storing cell” described by Ito (4) in 1951. Subsequently, Wake (11) and Kobayashi and Takahashi (5) demonstrated by light and electron microscopy that the lipid granules in the fat-storing cell increased markedly when vitamin A was injected into the animal. Furthermore, Wake (11) clearly demonstrated that the cell described by Kupffer in 1876 (9) was the fat-storing cell of Ito. Kupffer in his second paper in 1899 (10), however, modified his original report and described his stellate cell as the phagocytic endothelial cell of the sinusoidal wall. Since then, this stellate cell has been regarded as a part of the RES.

More recently, by means of tritiated vitamin A and electron microscopic radioautography, we showed (1) that vitamin A was incorporated and stored for a considerable period of time in the lipid granules of the liver fat-storing cell. These findings indicated that the fat-storing cell in the liver should be classified as a “vitamin A storing cell” and that vitamin A was not stored in the phagocytic stellate cell described by Kupffer in his second paper.

Further observations in the same series of experiments revealed that the septal cell (12) in the lung alveolar wall had characteristics similar to the liver vitamin A-storing cell (2). Subsequently, the same kind of cell was detected in the adrenal glands and intestines (3). The findings were further substantiated as these cells exhibited the specific transient colour of vitamin A under fluorescence microscopy. The colour response of these cells was previously noted by Kudo (6) and by Popper (8), although these investigators regarded the cells as a part of the RES, as mentioned earlier.

The examined vitamin A-storing cells showed the following features. (a) Cells were irregular in shape and extended slender, often branched, cell processes. (b) Cells possessed several vitamin A-containing lipid granules. The number of granules increased in hypervitaminosis. (c) No basement lamina was found around the cell surface. (d) Well-developed granular endoplasmic reticulum and Golgi apparatus were found, and the former was frequently dilated in cisternal form. (e) Filaments about 50 A diameter were usually seen along the plasma membrane. Microtubules were frequently present, especially in the cell processes. (f) Cells were located in the connective tissue spaces and had a close relationship to both the endothelium of the vascular vessel and various epithelial tissues. Based on these morphological features, the vitamin A-storing cells were easily distinguishable from macrophages or histiocytes found in
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the connective tissue spaces.

These observations led us to propose the existence of a cell system that specializes in vitamin A storage. These vitamin A-storing cells are clearly not RE cells.

The existence of a special storage system for vitamin A throughout the animal body suggests the importance of the vitamin in cellular physiology, although its exact significance is not fully understood.

Explanation of Figures

The micrographs demonstrate the vitamin A-storing cell in the mouse. The bar in each figure represents 1 μm. A, alveolar air space; C, blood capillary; D, adrenomedullary cell; E, endothelial cell; g, lipid granule containing vitamin A; H, hepatocyte; L, lymphatic capillary; n, nucleus of vitamin A-storing cell; V, venule.

Fig. 1. Vitamin A-storing cell in the liver. The cell is located in the perisinusoidal space between the endothelial cell and hepatocyte. Both the number and size of lipid granules were increased by administration of tritiated vitamin A through the alimentary canal. The silver grains indicate the localization of vitamin A in lipid granules. EM-radioautography.

Fig. 2. Vitamin A-storing cell in the intestinal mucosa. The cell is located between the lymphatic capillary and venule.

Fig. 3. Vitamin A-storing cell in the lung. The cell is located in the alveolar septum between the blood capillary and alveolar epithelium.
Fig. 4. Vitamin A-storing cell in the adrenomedulla. The cell is found in the space between the blood capillary and medullary cell.

REFERENCES

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