HISTOGENESIS OF THE PLASMA CELLS IN EXPERIMENTAL Q-FEVER IN GUINEA PIGS

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In the last ten years many papers have appeared indicating the synthesis of antibodies by plasma cells [9, 10, 11]. This has acted as a spur to intensify the study of the origins of the plasma cells [5, 11, 13]. An outstanding monograph on this subject has been published by Burnet and Fenner [8].

Research workers express contradictory opinions on the origin of the plasma cells. Certain authors state that these cells are derived from cells of the reticular tissue [2, 6, 7, 11, 16, 17]. Others [3, 4, 12] consider that plasma cells originate from lymphocytes. Arinkin [1] distinguishes four types of plasma cells depending on their origin: erythroblastic, lymphocytic, myeloblastic and reticuloendothelial. Unna [19] and Pappenheim [15] emphasize that plasma cells are derived from histiocytes. Schridde [18] and Naegeli [14] consider that a myeloblastic genesis of plasma cells is a possibility.

The purpose of the present work was to examine the histogenesis of the plasma cells during experimental Q-fever in guinea pigs.

EXPERIMENTAL METHOD

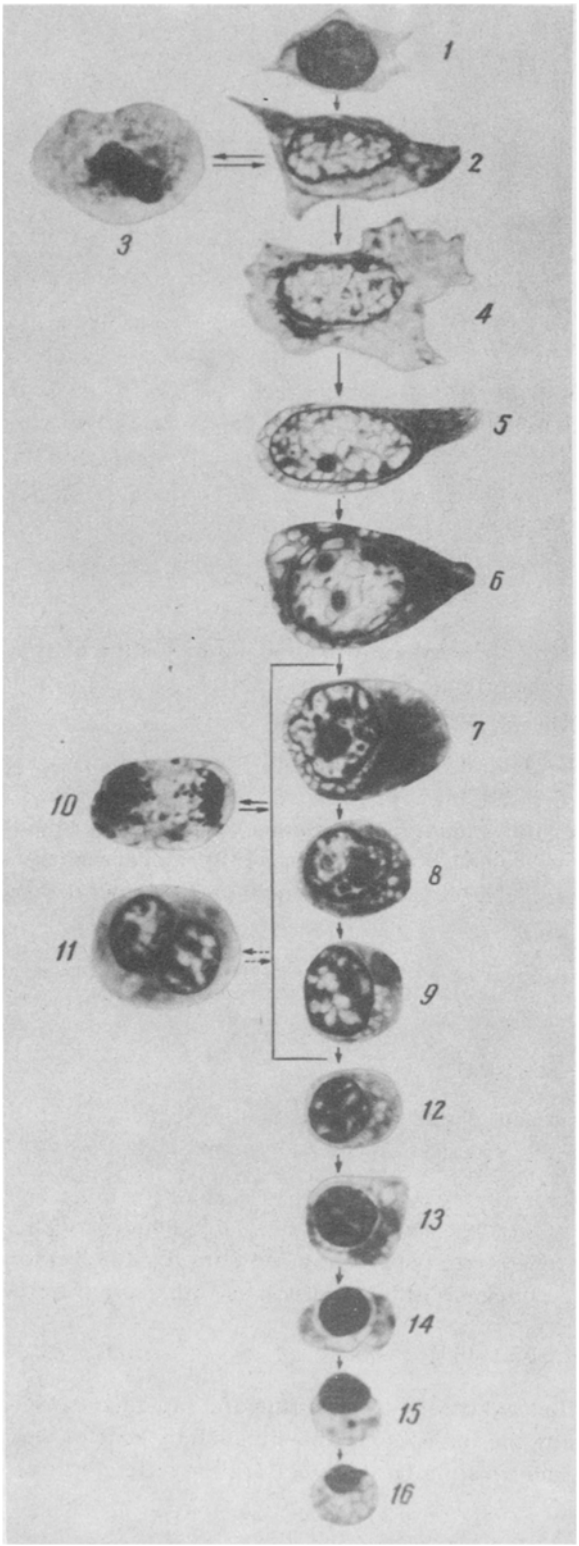
The investigation was carried out on 40 animals inoculated subsutaneously, in the left inguinal region, with a rickettsial suspension (Italo-Greek strain) in a dose of 10,000 infecting doses for guinea pigs.

Material for histological examination was obtained by sacrificing two animals on each of the following days after inoculation: 2nd, 4th, 6th, 8th, 10th, 12th, 14th, 16th, 20th, 25th, 30th, 40th, 50th, 60th and 90th. The spleen, the regional lymphatic glands and the common mesenteric lymphatic gland were fixed in Zenker formol and embedded in paraffin wax. Sections were cut to a thickness of 5 μ and stained with azure II-eosin.

EXPERIMENTAL RESULTS

In the spleen and lymphatic glands a distinctive reaction was observed, consisting of a rapid increase in the number of plasma cells in the red pulp of the spleen and in the fleshy cords of the medullary zone of the lymphatic glands, against a background of marked swelling and hyperplasia of the cells of the reticular tissue and the endothelium of the sinuses.

On the 4th-6th day after inoculation, in the spleen and lymphatic glands there appeared accumulations of cells, characterized by basophilia of their cytoplasm and by a large nucleus, cells poor in chromatin and with one or two large nucleoli. Later (8th-12th day), among these cells appeared an increasing number of typical plasma cells and plasma cells in various intermediate stages of maturation. Between the 12th and 30th days from the moment of inoculation, a dynamic equilibrium was observed between the basophilic cells on the one hand and immature and mature plasma cells on the other. Finally, there was a decrease in the number of basophilic cells with, at the same time, an increase in the typical plasma cells, especially noticeable between 40 and 50 days after the moment of inoculation.



Genesis of plasma cells during experimental Q-fever in guinea pigs. 1) Normal reticular cell; 2) changed reticular cell after inoculation of animal; 3) mitosis in a changed reticular cell; 4, 5) transitional cells; 6) plasmoblast; 7-11) immature plasma cells; 12) mature plasma cell; 13-16) degenerating plasma cells. Stained with azure II-eosin. Assembled from microphotographs. Magnification: ocular 20x, objective 90x.

From the sequence of this reaction it may be supposed that the plasma cells were the differentiated forms of the basophilic cells described above. The question naturally arises of the origin of these basophilic cells. In the early stages it could clearly be seen that the reticular cells increased in size, attaining 12-14 μ in diameter (normally about 8 μ). In shape they were polygonal, often having long processes, and their cytoplasm had a fine cellular structure. The nucleus was oblong in shape, comparatively poor in chromatin, sometimes vesiculiform and with one or two nucleoli, the latter being relatively small in size. A proportion of such cells were in a state of karyokinetic division (see figure, 2 and 3).

The process of differentiation of the plasma cells begins, in the author's opinion, with the appearance of a basophilic cytoplasm in individual reticular cells, mainly around the nucleus (see figure, 4). With increasing basophilia of the cytoplasm, the reticular cell begins to lose its syncitial connection with the other cells and to become round in shape. The nucleus also becomes round in shape (see figure, 5) and under these circumstances there is an increase in the dimensions of the nucleolus. Cells which have lost their syncitial connections and become round in shape, resemble lymphoblast with a mean diameter of 13-14 μ (see figure, 6).

In this way are formed the accumulations of basophilic cells which can be seen at different periods (2, 4, 6 days). This is followed by the process of maturation of the plasma cells (see figure, 7-11). It is characterized by a decrease in the size of the cells of the lymphoblast type, of their nucleus and nucleoli, by an increase in the density of chromatin, by increased basophilia of the cytoplasm and by the appearance of small vacuoles in these cells, around the nuclei. As a rule the nucleus is situated eccentrically. Plasma cells in the stage of maturation are capable of mitotic and, evidently, amitotic division (see figure, 10-11).

The diameter of the cells diminishes from 14 to 8 μ during maturation. The degree of maturation of the plasma cells may be judged not only by dimensions of the cell itself, but by those of the nucleolus, in addition to the signs already mentioned. In the adult plasma cell, the nucleolus is insignificant in size and is often ill-defined in the comparatively dense chromatin of the nucleus (see figure, 12).

Starting on the 16th day, and at later periods, an increasing number of plasma cells with pyknotic nuclei were seen. These were evidently degenerating plasma cells (see figure, 13-16). The process of degeneration of the plasma cells began with an increase

in the density of the nuclear chromatin, with a gradual loss of its visible structure and a decrease in its size. The cytoplasm lost the power of staining intensively.

The whole cell was reduced in size. Some of these cells were engulfed by macrophages, others evidently underwent lysis.

From the morphological findings it may be concluded that plasma cells are derived from the reticular cells of the spleen and lymphatic glands. The individual cells indicated in the figure require a precise nomenclature Fagraeus [11] conventionally divides all the cells into three groups: transitional cells, immature plasma cells and adult plasma cells. This terminology is in agreement with the course of development of these cells, but requires clarification.

The cells which are called transitional by Fagraeus are those which are lying freely, i.e., have lost their syncitial connections. The results obtained show that the name "transitional cells" is best applied to reticular cells which are changed as the result of an increase in the basophilia of the cytoplasm, which are in process of losing their syncitial connections, but have not lost them completely (see figure, 4-5).

When the transitional cell has finally lost its syncitial connection it becomes free, and somewhat resembles a lymphoblast, differing from it by its more extensive and basophilic cytoplasm and its situation. These cells should be called plasmoblasts (see figure, 6). It was these cells that Fagraeus, judging from his description, called transitional cells. By means of the conversions described above, from plasmoblasts were obtained first, immature and then later, mature plasma cells (see figure, 7-12).

Nothing is said about the subsequent fate of the plasma cells in Fagraeus's paper. He merely observes that the decrease in the numbers of mature and immature forms takes place simultaneously, although mature form disappear more slowly than the immature. Fagraeus gives no morphological analysis of this process.

Our findings show that the mature plasma cells subsequently degenerate. Arinkin [1], in puncture material from lymphatic glands, saw basophilic formations which were round or oval in shape, the size of a normocyte or sometimes larger. He considers that they were remnants of plasma cells. Arinkin was unable to follow their subsequent fate.

In developing our point of view on the genesis of plasma cells, we cannot at present, without suitable verification, deny that there are other possible sources from which plasma cells may originate when different factors act on the body.

SUMMARY

The paper deals with the origin of plasma cells in guinea pigs during experimental Q-fever. The author succeeded in demonstrating that plasma cells originate from the reticular cells of the spleen and lymph nodes. The development of plasma cells into reticular ones is distinguished by the following phases: 1) transitional cells, 2) plasmoblasts, 3) immature plasma cells, 4) mature plasma cells and 5) degenerating plasma cells.

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