THE PROCESS OF CRYSTAL-FORMATION IN FIBRILLARY ASTROCYTOMA

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Recently, with the introduction of the electron microscopy method of investigation, it has become possible to detect organic crystalline formations in certain tumours. H. F. Shipkey, P. H. Liberman, E. W. Foote, F. W. Stewart (cited by 2) made a description of the ultra-structure of the protein-carbohydrate crystals within the cytoplasm of the alveolar sarcoma cells. Similar crystalline formations were established by the authors of the paper in the cytoplasm of the multiform glioblastoma (3) and jointly with A. S. Shubin — in the cytoplasm of the fibrillary astrocytoma.

In the present work, we would like to draw the attention on the problem regarding the process of crystal-formation in the fibrillary astrocytoma, referring to the ultra-microscope finding in two cases of fibrillary astrocytoma.

Material and Method

The material for electron microscopic investigation was obtained during surgical intervention on the patients. Immediately thereafter, it was immerged in osmic tetroxide fixator after Shostrand and was cut in small particles, measuring about 1 cu. mm, and thereby kept for fixation in the same fixator at 4° C for two hours. After dehydration in serial ascending ethyl-alcohol concentration, it was included in butyl-methyl metacrylate at a ratio 4 : 1 with addition of 1% benzoyl peroxide for 48 hours at 56°C. The sections were made prepared on LKB ultratome and following contrast visualization with uranyl acetate, they were investigated with electron microscope EM-6 at the laboratory of the Institute of Experimental and Clinical Oncology in Moscow.

Finding

In the cellular cytoplasm of the two fibrillary astrocytomas, wherein crystalline formations of organic nature were found, two crystals (one apiece) were furthermore discovered, which, in the author's opinion are worth of special attention, for a peculiar, differentiated corpuscle was also established, closely connected with them.

One of them, for which a clearer photograph is available, will be discussed in detail. The crystal proper exhibited irregular, rhomboid form with a narrower band at one end. The periodicity of dark and cleared bands was about 60 Å, the dark ones being about 20 Å wide, and the bright ones — about 40 Å. At one end, perpendicular to these well arranged bands, an elliptical corpuscle was established, separated from the crystal and from the

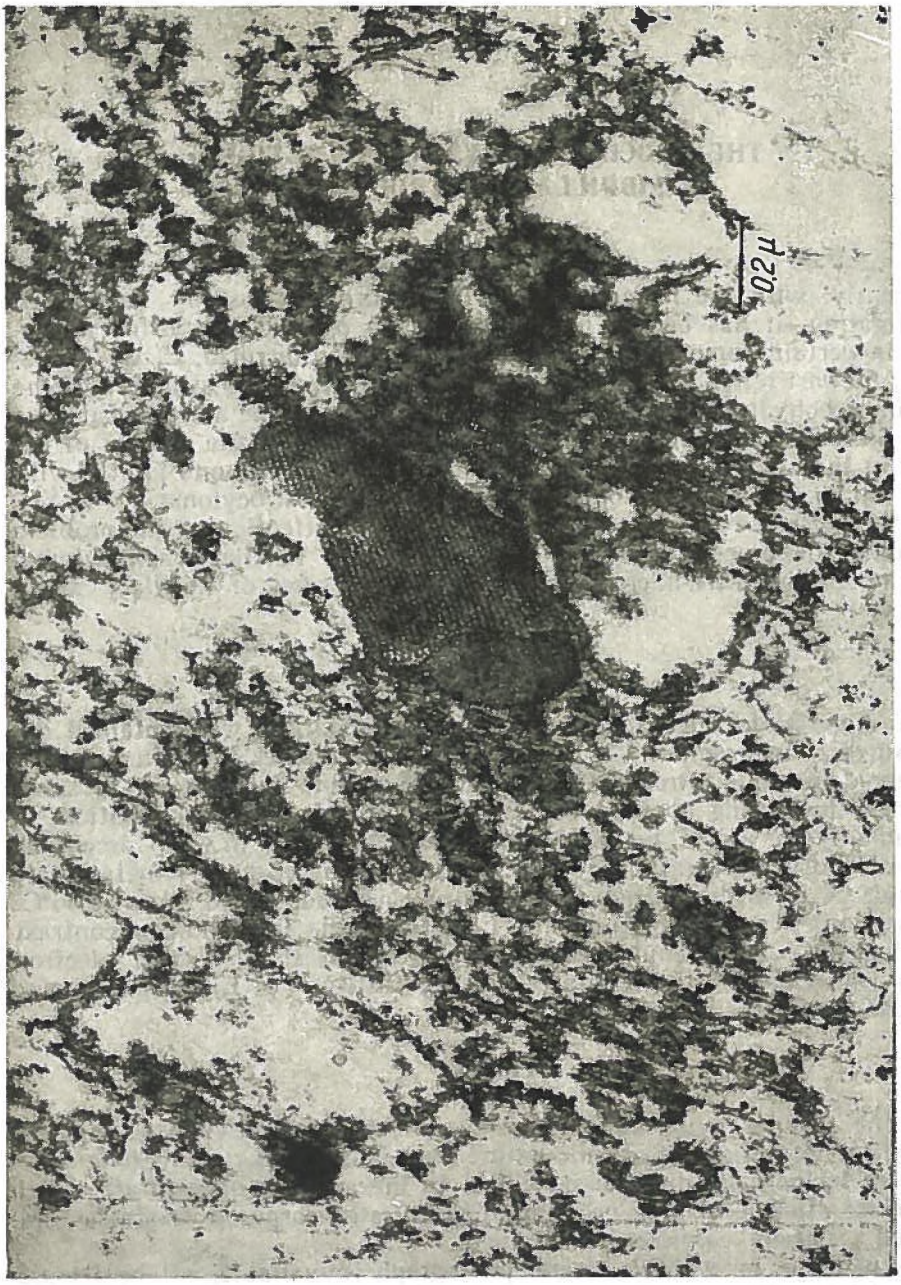

Fig. 1. Complex: lentil — lentil corpuscle — organic crystal.

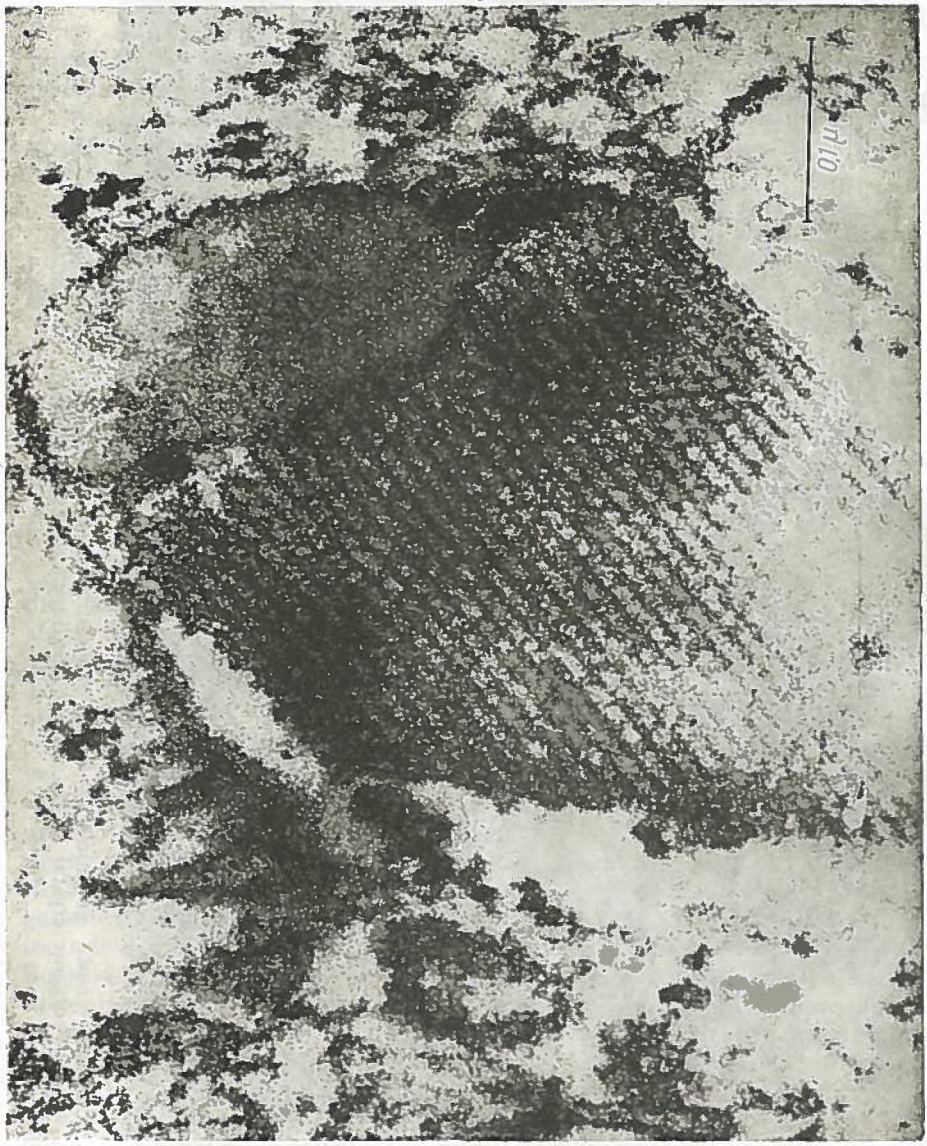

Fig. 2. The same complex as in Fig. 1 with larger magnification — 336 000

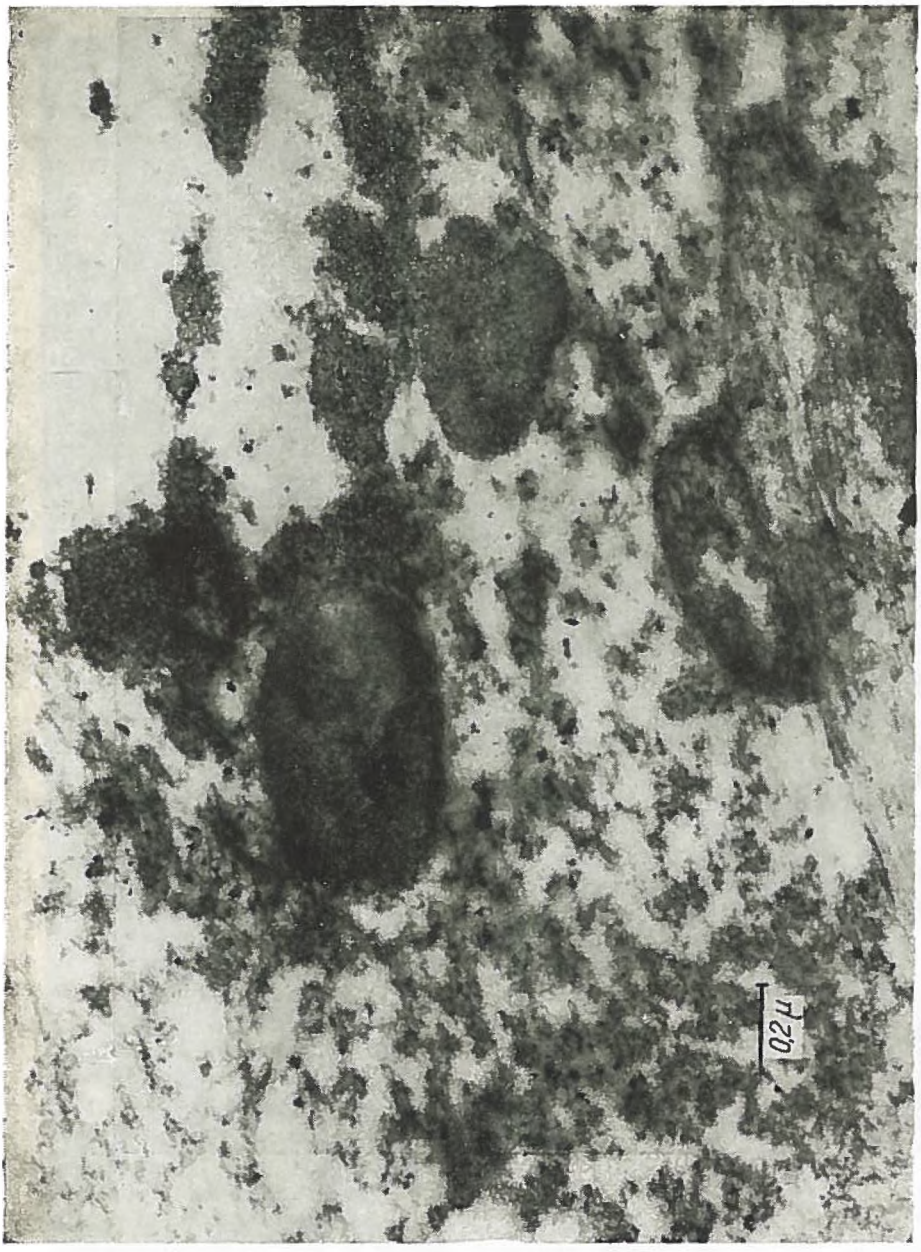

Fig. 3. Complex: lentil corpuscle — organic crystal and second complex: lentil corpuscle — not shaped organic crystal in the second fibrillary astrocytoma. Magnif. — 80 000.

surrounding cytoplasm by a membrane, which apparently extended and was converted into the membrane surrounding the crystalline formation. Thus, the impression was had that the crystals and the ellipsoid corpuscle built up a single unit. The internal content of the corpuscle was homogeneous and slightly granular. It measured about 130/260 m. μ. (Figs. 1 and 2).

It is rather difficult to conceive this corpuscle in three dimensions but however, it might be assumed that in all likelihood, it has the form of lentils.

In the crystal discovered in one of the cells of the second tumour, a similar corpuscle was established, displaying lesser brightness in the crystal proper, as well as a second one which was in close contact with another formation whose crystalline structure was hardly outlined (Fig. 3).

Discussion

The fact of finding organic crystals in the cytoplasms of a tumorous cell poses two distinct problems. First, which is the underlying cause substantiating their formation and second, what is exactly the mechanism of their production.

In answering the first question — what causes the production of organic crystals — two possibilities might be considered: the first is that they are due to certain vira by analogy with the adenovira produced organic crystals. Secondly, it might be assumed that the crystals are the product of an enhanced capacity of protein production on behalf of the tumorous cell. These two probabilities hold true also for the organic crystals found by the authors, although no definitive data are available for the timebeing which could help resolving the problem in favour of one of the hypothesis. However, the fact that viral particles were not disclosed in these tumours warrants the assumption that these crystals are the result of an enhanced autoproduction capability of the tumorous cells, that is, that they are the product of the basic neoplastic-formation process. Hence, it might be assumed that they are formed by the ribonucleic acid containing cytoplasmic organelles — namely, endoplasmic reticulum and ribosomes (polyribosomes included). The fact that N. M. Shestopalova, V. N. Reingold and V. M. Borisova found needle-shaped crystals in the endoplasmic reticulum of the epithelial cells of the rats' intestinal mucosa proves that the endoplasmic reticulum is capable of producing organic crystals. On the other hand, the organic crystals described by H. F. Shipkey and al., are enveloped in a simple membrane similar to that of the Golgi complex, which serves merely for the condensation of the cytoplasmic protein produced by the ribosomes. A similar possibility for crystalline protein production was likewise recognized in the corpuscles, disclosed by the author in the multiform glioblastoma. In the fibrillary astrocytoma, however, the picture is rather different: the organic crystal is found closely attached to the elliptic corpuscle described, which could hardly be identified with the well known cellular organelles. It resembles neither a formation of the endoplasmic reticulum, nor that of the Golgi complex. It is filled up of certain material and the protein compound molecules are arranged in a crystalline pattern along one of its convex surfaces. This fashion of production differs

equally from that of the endoplasmic reticulum, where the crystals are established within the lumen, and from that of the Golgi apparatus, where the condensation product is present in the lumen too. Although a definitive statement could not be made in terms of the origin and characteristic feature of this corpuscle, it is certain that its membranes have an essential bearing on crystal-production. Furthermore, the fact that such a relationship is not isolated, but found in two tumours, warrants the assumption that a causality in this case is by no means concerned. It rather concerns certain regularity, drawing attention to which was considered worthwhile.

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О ПРОЦЕССЕ КРИСТАЛЛООБРАЗОВАНИЯ ПРИ ФИБРИЛЛЯРНОЙ АСТРОЦИТОМЕ

Р. Койнов

РЕЗЮМЕ

На основании использования электронно-микроскопического метода, автор сообщает оригинальную находку в цитоплазме клеток от двух фибриллярных астроцитом. Находка состоит из своеобразного комплекса из чечевицеобразного тельца, на одной из конвексных поверхностей устанавливается кристаллическое расположение органических молекул. Это тельце нельзя идентифицировать с известными органеллами цитоплазмы нормальной клетки.