A STUDY OF THE CEREBROSIDES IN SOME NEUROECTODERMAL TUMORS OF THE HUMAN BRAIN

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Various workers have investigated the cerebrosides contained in the grey and white matter in different areas of the human brain [2, 3, 7]. Information is also available concerning changes in the cerebroside content of nerve tissue in various pathological conditions. For instance, Klenk [4], at a symposium on neurochemistry in 1954, reported that there is an increase in the content of cerebrosides in brain tissue in Gaucher's disease and Niemann-Pick disease. An increase in the cerebroside content in the neurolipidoses has also been described by Thannhauser [6]. In 1952, Sloane-Stanley [5] reported cases in which the cerebroside content of the brain was decreased in insulin coma in human subjects. M. Sh. Promyslov [1] observed a decrease in the cerebroside content of the brain in rabbits after administration of tetanus and gas gangrene toxins.

In the present research we investigated the cerebroside content of several neuroectodermal tumors of the human brain.

EXPERIMENTAL METHOD

The material used in the investigation consisted of glial tumors obtained in the course of neurosurgical operations: oligodendrogliomas and a group of tumors of the astrocyte series, including typical benign astrocytomas, astrocytomas with signs of malignant transformation (dedifferentiating astrocytomas), and spongioblastoma multiforme, a highly malignant tumor.

The tumor was freed from blood clots, washed with water, and ground with 10% trichloroacetic acid. The residue of proteins and lipids was removed by centrifugation and the lipids were extracted in a Soxhlet apparatus successively for 12 hours each with acetone, ether, and a 1:1 mixture of chloroform and methanol. After evaporation to dryness, the extracted lipids were hydrolyzed with 10% H_2SO_4 for 2 hours on a boiling water bath. The galactose in the hydrolyzate was determined by the anthrone method. The cerebrosides were calculated as percentages of galactose per dry protein residue. The protein-bound cerebrosides in the dry protein residue were determined by hydrolysis of the lipoprotein complexes followed by extraction with 1% sulfuric acid in ethyl alcohol. After evaporation of the alcohol the lipids were hydrolyzed with 10% H_2SO_4 for 2 hours on a boiling water bath, and the galactose in the hydrolyzate was determined.

By the same methods a parallel investigation was made of the cerebroside content of the grey and white matter of the cerebral hemispheres of patients dying from accidental causes.

EXPERIMENTAL RESULTS

The results of the investigation of the cerebrosides in the tumors are given in Table 1, from which it may be seen that the content of free cerebrosides in the tumors of the astrocyte series varied between 0.37 and 0.9%, and the content of combined cerebrosides between 0.98 and 2.2% (in 2 cases, 2.62 and 3.57%).

The ratio of free cerebrosides to combined was 0.22-0.63. The results of these determinations thus show that the cerebroside content is not dependent on the degree of dedifferentiation, and is the same in the typical astrocytomas, the dedifferentiating astrocytomas, and even in spongioblastoma multiforme.

The oligodendroglia contained 0.6-0.98% of free and 1.3-1.58% of combined cerebrosides, the ratio between these forms being 0.41-0.65. In Table 1 we also show figures of the cerebroside content of an oligoastrocytoma. These

TABLE 1. Cerebroside Content of Neuroectodermal Tumors of the Human Brain (in % galactose per dry protein residue)

Histological diagnosis of tumor	Free	Combined	Ratio of free to combined
Astrocytoma fibrillare	0.37	0.98	0.37
Astrocytoma	0.66	1.70	0.39
"	0.79	3.57	0.22
"	0.83	2.62	0.31
Astrocytoma. Collections of polymorphic nuclei	0.76	1.20	0.63
Astrocytoma with areas of nuclear polymorphism	0.60	1.66	0.36
Astrocytoma of mixed composition with areas of dedifferentiation	0.78	1.42	0.55
Astrocytoma with areas of dedifferentiation	0.90	2.20	0.40
Dedifferentiating astrocytoma	0.51	1.24	0.41
" "	0.38	1.60	0.24
Highly dedifferentiated astrocytoma	0.51	1.00	0.51
Spongioblastoma multiforme	0.53	1.88	0.28
" "	0.47	1.37	0.34
Mean	0.64	1.72	0.38
Oligodendroglioma	0.60	Not determined	
"	0.80	1.30	0.62
"	0.77	1.42	0.54
"	0.98	1.50	0.65
"	0.65	1.58	0.41
Oligoastrocytoma	0.54	1.27	0.42
Mean	0.72	1.41	0.51

figures are very close to the corresponding figures for the oligodendroglioma and astrocytoma. It must be pointed out that by comparison with the astrocytomas, characterized by considerable variation in the cerebroside content, the oligodendrogliomas gave figures which were closer together.

During investigation of the human brain tissue, the grey matter contained on the average 2.56% of free and 1.95% of combined cerebrosides, and the ratio of free to combined was 1.3; the white matter contained on the average 10.1% of free and 2.8% of combined cerebrosides, and the ratio of free to fixed was 3.5. Whereas the free cerebroside content in the white matter was much greater than that in the grey matter, the difference in relation to the combined cerebrosides was not so great. Hence the ratio of free cerebrosides to combined was much higher in the white matter than in the grey.

Our results showing the content of free cerebrosides in the human brain thus agree with those in the literature [2, 3, 7]. It was found that the content of free cerebrosides in the tumors was lower than that in the grey matter of the brain, and lower still than that in the white matter. The content of combined cerebrosides in the tumors was in most cases slightly lower than that in the normal brain tissues, but the difference was smaller than in the case of the free cerebrosides. The ratio of free to combined cerebrosides in the tumors was also smaller than that in the grey and white matter of the brain, on account of the lower content of free cerebrosides than in the brain.

To sum up, it must be emphasized that the cerebroside content of all the tumors we investigated was very similar, and that the degree of malignant change in the tumor did not affect its cerebroside content. Consequently, the figures obtained for the glial tumors may evidently be regarded as characteristic of the cerebroside content of the glial cells – the astrocytes and oligodendrocytes – a matter of particular interest.

LITERATURE CITED

1. M. Sh. Promyslov, Biochemistry of the Nervous System [in Russian], p. 323, Kiev, 1957.
2. S. E. Hansen and C. M. Plum, Acta psychiat. scand., v. 35, suppl. 141 (1960).

3. E. Klenk, Z. Hoppe-Seylers, physiol. chem., Bd. 145, S. 244 (1925).
4. Idem. Biochemistry of the Developing Nervous System, New York, p. 397 (1955).
5. G. H. B. Sloane–Stanley, in: Biochemical Society Symposia N 8. Gambridge, (1952), p. 44.
6. S. J. Thannhauser, Lipidoses: Diseases of the Cellular Lipid Metabolism. London, 1940.
7. J. L. Thudichum, Physiological Chemistry of the Brain [Russian translation], Khar'kov, 1885-6.

All abbreviations of periodicals in the above bibliography are letter-by-letter transliterations of the abbreviations as given in the original Russian journal. *Some or all of this periodical literature may well be available in English translation.* A complete list of the cover-to-cover English translations appears at the back of this issue.
