THE EFFECT OF PRENATAL ASPHYXIA ON THE SIZE OF CEREBRAL NERVE CELLS

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Our previous works [1-4] showed that asphyxia, compatible with life, endured during intrauterine development, finds expression in the postnatal period in an alteration in behavior and an increase in the reactivity of the central nervous system to various irritations of the receptors and to the administration of medicinal substances in doses which do not produce particular reactions in normal animals. The alterative effect of intrauterine asphyxia is also clearly manifested by the fact that the brain of the experimental animals is always seen to be smaller in its measurements and weight than the brain of the control animals.

In the present undertaking we carried out experiments on white rats, undergoing asphyxia at different stages in their intrauterine development, studying its effect on the cerebral nerve cells.

METHOD

In white rats pregancy lasts 21 days. Asphyxia of the pregnant animals was carried out, as in our previous experiments, by placing them in hermetically sealed chamber, the volume of which was 2 times greater than the volume of the animal. The rats were subjected to asphyxia on the 9th, 16th, and 20th day of pregnancy. The brains of the newborn rats, obtained from these animals, and also the brains from the rats surviving for 1 and 2 months after their birth, were investigated histologically.

In each age group were included 5-6 experimental animals and the same number of controls. All the animals were decapitated under the same conditions. The brains were fixed in 10% formalin, imbedded in paraffin, and stained according to the method of Nissal.

In each case, in histological sections of 8 μ, the gigantic pyramid cells of the 4th field of the cerebral cortex were measured, as well as the coarse cells of the nucle us ruber and the cells of Deiter's nucleus. We also measured the dimensions of the cells of the inferior olive, which according to the hypothesis of B. N. Klosovskii [5], are inhibitory cells. For the investigation we took cells in "active condition", in which the section passed through their center, the nuclei thereby being visible and positioned in the center of the cells, and the nucleoli present.

We determined the greatest height and width of the cell body and the axes of their nuclei. We multiplied the height and width of the cell body, thus obtaining the relative area of the contoured field of the nerve cell, expressed in square microns. From the measurements of 50 cells and their nuclei we obtained an average figure for each experimental and control animal. The results were treated by the methods of variation statistics. In each age there were 5 (occasionally 6) animals; thus, from the individual values for the areas of the contoured fields of the nerve cells and their nuclei we determined the average value of the contoured field of the nerve cells and their nuclei. The results obtained were again treated by the methods of variation statistics. The same calculations were carried out for the control animals as well.

The results obtained are presented in Tables 1, 2, and 3.

From the data in Table 1, 2, and 3 it is apparent that asphyxia endured in the embryonal period leads to a considerable decrease in the measurements of the nerve cells and their nuclei (contoured field). This decrease is manifestly clearer in those cases where the fetuses underwent asphyxia in earlier stages of their intrauterine development.

SUMMARY

The author studied the effect of prenatal asphyxia on the size of cerebral cells. Experiments were conducted on white rats which sustained asphyxia on the 9th, 16th, and 20th days of pregnancy. The brain of the newborn ratlings obtained from these animals, as well as the brain of the 1 and 2 months-old rats was subjected to histological examination. Nissl's method was used for the treatment of the preparations. The author measured the greatest height and the width of the cellular body and of the axis of cellular nuclei, the giant pyramids of the 4th field of cerebral cortex, the large cells of the cellular body and of the axis of their nuclei, the giant pyramids of the 4th field of cerebral cortex, the large cells of the nucleus ruber and of the Deiters' nucleus, as well as the cells of the inferior olive. For each experimental and control animal an average figure for 50 measurement of the cells and their nuclei was estimated. The results were processed by the method of variation statistics. There were 5, at

TABLE 1. Decrease in the Measurements of the Nerve Cells and Their Nuclei in Newborn Rats Which Endured Prenatal Asphyxia at Various Intervals During the Pregnancy

No.	Nucleus	Experimental rats. Born 5 days after asphyxia	Standard error	Experimental rats. Born 12 days after asphyxia	Standard error	Control	Standard error
	Product of the height times the width of the nerve cells (contoured field) in μ^2						
1	4th field	146,80	±0,21	146,21	±0,20	221,65	±0,21
2	Nucleus ruber	277,97	±0,17	272,48	±0,21	358,30	±0,27
3	Deiter's nucleus	474,85	±0,31	423,46	±0,28	849,41	±0,44
4	Inferior olives	186,69	±0,21	176,86	±0,21	239,24	±0,22
	Product of the axes of the nuclei (contoured field) in μ^2						
1	4th field	95,09	±0,18	85,75	±0,16	126,22	±0,14
2	Nucleus ruber	162,22	±0,17	142,94	±0,18	215,05	±0,17
3	Deiter's nucleus	208,63	±0,17	170,09	±0,25	319,54	±0,21
4	Inferior olives	114,48	±0,20	109,60	±0,17	150,63	±0,19

TABLE 2. Decrease in the Measurements of the Nerve Cells and Their Nuclei in 1 Month Old Rats Which Endured Prenatal Asphyxia at Various Intervals During the Pregnancy

No.	Nucleus	Experimental rats. Born on the following day after asphyxia	Standard error	Experimental rats. Born 12 days after asphyxia	Standard error	Experimental rats. Born 12 days after asphyxia	Standard error	Control	Standard error
	Product of the height times the width of the nerve cell (contoured field) in μ^2								
1	4th field	541,22	±0,28	395,38	±0,38	296,48	±0,15	622,35	±0,26
2	Nucleus ruber	715,66	±0,33	594,04	±0,29	485,71	±0,34	1083,78	±0,52
3	Deiter's nucleus	1073,74	±0,68	920,69	±0,56	780,78	±0,38	1234,30	±0,65
4	Inferior olives	208,88	±0,25	255,52	±0,14	251,16	±0,14	327,26	±0,38
	Product of the axes of the nuclei contoured field) in μ^2								
1	4th field	180,94	±0,15	165,86	±0,15	105,12	±0,18	254,02	±0,14
2	Nucleus ruber	168,98	±0,20	215,02	±0,13	160,50	±0,15	278,66	±0,15
3	Deiter's nucleus	303,06	±0,23	221,49	±0,21	188,88	±0,16	315,10	±0,19
4	Inferior olives	123,36	±0,17	120,14	±0,14	102,54	±0,14	165,81	±0,16

TABLE 3. Decrease in the Measurements of the Nerve Cells and Their Nuclei in 2 Months Old Rats Which Endured Prenatal Asphyxia at Various Intervals During the Pregnancy

No.	Nucleus	Experimental rats. Born on the following day after asphyxia	Standard error	Experimental rats. Born 12 days after asphyxia	Standard error	Experimental rats Born 16 days after asphyxia	Standard error	Control	Standard error
	Product of the height times the width of the nerve cell (contoured field) in μ^2								
1	4th field	658,69	±0,27	524,26	±0,29	468,62	±0,26	712,30	±0,17
2	Nucleus ruber	870,34	±0,43	866,98	±0,20	760,58	±0,61	1095,48	±0,37
3	Deiter's nucleus	1088,32	±0,33	966,15	±0,27	812,96	±0,48	1257,22	±0,59
4	Inferior olives	298,12	±0,15	289,36	±0,23	263,63	±0,18	340,02	±0,24
	Product of the axes of the nuclei contoured field) in μ^2								
1	4th field	281,60	±0,17	224,56	±0,56	203,48	±0,16	289,39	±0,15
2	Nucleus ruber	265,30	±0,22	232,92	±0,17	226,21	±0,20	291,86	±0,22
3	Deiter's nucleus	306,32	±0,22	248,22	±0,28	233,56	±0,27	321,27	±0,25
4	Inferior olives	145,54	±0,12	120,86	±0,16	108,03	±0,16	183,56	±0,15

times 6 animals of each age and therefore the averages for the cross section area of the nerve cells and their nuclei were estimated from values of individual areas. The results obtained were again processed by the variation statistics method. The same estimations were made in the instance of control animals. The above demonstrated that prenatal asphyxia leads to a considerable decrease in the size of the nerve cells and their nuclei (cross section). This reduction was more clear-cut when the embryo was subjected to asphyxia at the earlier stages of the intrauterine development.

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