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Histopathological Changes in the Intracranial Portion of the Optic Nerves in Cerebral Atherosclerosis

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Summary. The histopathological findings in the optic nerves and chiasm in relation to atherosclerosis of the circle of Willis are reported. The material was derived from 101 autopsy cases, in which 58 showed various degrees of atherosclerosis, estimated by the method of Baker *et al.* In 6 cases without atherosclerosis of the circle of Willis histopathological changes in the optic nerves were also found. Fibrous thickening of the leptomeninges, fibrous thickening of the walls of intraneural blood vessels and perivascular atrophy of neural tissue were observed most frequently.

Zusammenfassung. Es werden die histopathologischen Befunde in den Nervi optici und im Chiasma in bezug auf die Atherosclerose des Circulus Willisii berichtet. Das Material wurde von 101 Autopsiefällen gesammelt, von denen 58 Atherosclerose verschiedenen Grades nach Auswertung mit der Methode von Baker et al. zeigten. 6 Fälle ohne Atherosclerose zeigten in den Nervi optici ebenfalls Veränderungen. Fibröse Verdickung der Leptomeningen, sowie der intraneuralen Blutgefäße und perivasculäre Atrophie des neuralen Gewebes wurden am häufigsten beobachtet.

Key-Words: Optic Nerve — Atherosclerosis — Circle of Willis — Optic Chiasm.

The histopathological changes of the intracranial portions of the optic nerves in systemic diseases have been little investigated. Optic neuritis or atrophy, which has been found in various general diseases, is reported in a small number of mainly clinical papers.

Recently, Doron and Behar (1968) reported the histopathological changes which they found in the optic nerves in a series of autopsy cases with arteriosclerotic cardiovascular disease, hypertensive cardiovascular disease and liver parenchymal damage. They found that there was a strong association between arteriosclerotic cardiovascular disease and thickening of the walls of leptomeningeal and intraneural blood vessels, fibrous thickening of the leptomeninges of the optic nerves and fibrosis of the reticular spaces around intraneural blood vessels. There was also a strong association between liver parenchymal damage and a slight to moderate proliferation of glial cells, with the presence of abnormal forms, in the optic nerves and chiasm.

In the present study the histopathological changes of the optic nerves and chiasm in 101 autopsy cases are reported. The purpose of this work was to find out if any changes could be correlated with cerebral atherosclerosis, various degrees of which was found in 58 cases.

Material and Methods

The material in this investigation was derived from 101 necropsies performed at the University of Thessaloniki Medical School in Greece. The patients' ages ranged from 3 to 90 years. In each case the circle of Willis of the fixed brain was dissected out as one unit, including the anterior, middle and posterior cerebral anteries, the posterior inferior and superior cerebellar arteries, the basilar and vertebral arteries and the anterior and posterior communicating arteries. The method of Baker *et al.* was used for grading of the atherosclerotic lesions.

By this method the greatest degree of atherosclerosis possible is 88 points.

The intracranial portions of the optic nerves and the chiasm were taken out and embedded in paraffin, after they had been cut along the midhorizontal plane. Transverse sections of the optic nerves in each case were also prepared. The following stains were used: Nissl, Hematoxylin-eosin, Holzer (for glial fibers), Lillie's method for myelin, v. Gieson for connective tissue, and Gomori for reticulin fibers. Silver methods (Kelemen's for axis-cylinders and Cajal's in frozen sections for astrocytes) were also used.

Results

In the 101 cases atherosclerosis was found in 58, amongst which 15 did not show any alteration in the optic nerves or chiasm. In the 43 cases without cerebral atherosclerosis 6 showed one or more alterations in the optic nerves similar to those observed in the cases with atherosclerosis.

The histopathological changes in the optic nerves and chiasm found in our cases are as follows:

1. Fibrous thickening of the leptomeninges around the optic nerve and of the perivascular spaces surrounding intraneural blood vessels.
2. Fibrous thickening of the walls of intraneural blood vessels.
3. Perivascular proliferation of glial fibers.
4. Perivascular atrophy of neural tissue.
5. Microhaemorrhages in the optic nerve or chiasm.
6. Ischemic necrosis.
7. Thickenings (swellings) of myelin sheaths (this alteration was found mainly deep to the leptomeninges).
8. Perivascular gliosis.
9. Astrocytic proliferation (mainly around ischemic or in dystrophic lesions).
10. Thickenings of axis-cylinder and fragmentation.
11. Arteriosclerotic convolute.
12. Newformed capillaries (mainly subpial).

Table 1 shows the occurence the of the above listed pathological changes in the optic nerves and chiasm in each of the 58 cases with atherosclerosis and the 6 ones without atherosclerosis of the circle of Willis.

The Table 2 shows the age distribution of the histopathological changes of the optic nerves a) in the cases with atherosclerosis and b) in the cases without atherosclerosis of the circle of Willis.

The graphs 1 to 3, corresponding to Table 2a, show the percentage incidence of the histopathological changes in relation to the age of the patients.

A comparison between the cases with or without atherosclerosis of the circle of Willis in relation to the changes in the optic nerves is given in the Table 3 (see Fig. 1 also).

Table 1

Grade of Atherosc.	Age	Form (type) of histopathological changes												
		1	2	3	4	5	6	7	8	9	10	11	12	Sum
63	45	+	+		+		+	+		+	+			7
55	64	+	+	+	+		+	+	+	+	+	+	+	11
54	70		+		+			+	+		+			5
53	80	+	+		+									3
52	65	+				+								2
48	75		+	+	+			+						4
48	78	+	+					+						3
45	58	+	+		+		+							4
41	78	+	+		+			+	+	+	+			7
40	70		+		+				+		+			4
37	60	+	+									+		3
37	70		+	+	+	+		+	+					6
37	85	+			+		+	+			+			5
36	30		+								+			2
33	70	+		+	+			+			+			5
33	75	+	+	+	+			+	+	+	+		+	9
32	72	+	+										+	3
31	27			+										1
29	65	+	+											2
29	65		+		+			+			+	+		5
29	70	+			+									2
28	65	+				+			+					3
28	70	+		+	+			+						4
28	75	+	+		+									3
27	65		+											1
25	90	+			+								+	3
25	70	+	+		+			+	+	+			+	7
24	50													0
24	60	+												1
24	60	+	+											2
21	70		+											1
21	80	+	+		+									3

Table 1. (Continued)

Grade of Atheroscl.	Age	Form (type) of histopathological changes												
		1	2	3	4	5	6	7	8	9	10	11	12	Sum
20	60	+												1
20	60	+	+		+			+			+			5
18	48													0
16	70	+												1
16	75													0
14	50	+												1
14	58													0
13	58													0
12	50													0
11	58	+	+											2
10	65	+												1
9	78		+		+									2
8	50													0
8	40													0
6	75	+				+								2
6	67													0
6	50													0
6	50													0
6	55		+											1
4	52													0
4	80	+	+		+									3
2	50													0
2	35													0
2	68	+												1
2	60													0
2	85	+									+			2
0	48							+						1
0	50											+		1
0	52				+									1
0	60		+		+									2
0	60					+								1
0	68	+	+							+				3
Summ. of changes		32	30	7	24	5	4	15	8	6	12	4	5	

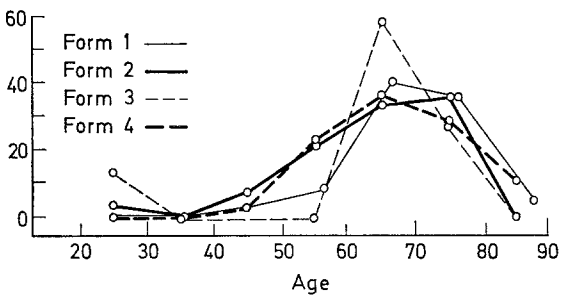
Table 2

a) with atherosclerosis (43 cases)

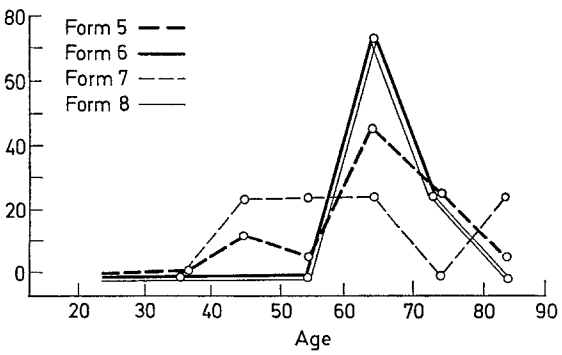
Age	Form of histopathological changes											
	1	2	3	4	5	6	7	8	9	10	11	12
20—20		1	1									
31—40												
41—50	1	2		1		1	2		1	1		
51—60	7	6		2		1	1			1	1	
61—70	11	9	4	9	3	1	7	6	2	5	2	2
71—80	9	10	2	8	1		4	2	2	3		2
81—90	3			2		1	1			2		1

b) without atherosclerosis (6 cases)

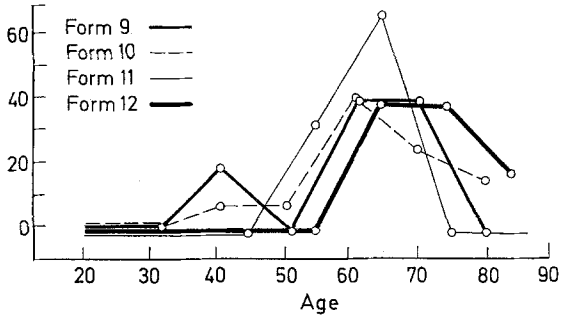
20—30												
31—40						1						
41—50											1	
51—60		1		2		1			1			
61—70	1	1										
71—80												
81—90												



Graph 1



Graph 2



Graph 3

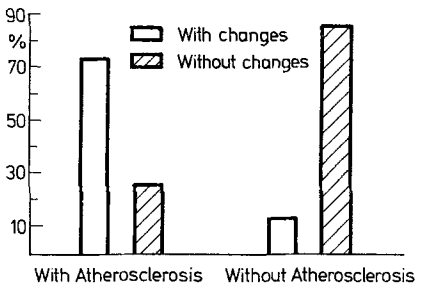


Fig. 1

Table 3

	with changes in the optic nerves		without changes in the optic nerves		Total
with atherosclerosis	43	(74%)	15	(26%)	58 cases
without atherosclerosis	6	(14%)	37	(86%)	43 cases

In the statistical analysis of the above Table ($x^2 = 33.44$, $p = < 0.0005$) there is evidence of a significant increase of histopathological changes in the optic nerves in the case with atherosclerosis of the circle of Willis in comparison with the cases without atherosclerosis.

As far as the incidence of the various forms of change in the optic nerves is concerned, fibrous thickening of the leptomeninges including fibrosis of the perivascular spaces (26%), fibrous thickening of the walls of intraneural blood vessels (25%) and perivascular atrophy of neural tissue (20%) were observed most frequently.

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