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VITAMIN C CONTENT OF THE AQUEOUS HUMOR OF LEPROTIC EYES *

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In the last several years much has been published in Japan, especially from the Osaka Imperial University, regarding the vitamin C content of the tissues and tissue fluids. Our interest in this matter was especially aroused by reports by Nishigaki and Yamagami (6-8) concerning vitamin C and tuberculosis. They found that in the lungs of rabbits experimentally infected with tuberculosis, it was present in three and one-half times the normal concentration, whereas in experimental pneumonia of the rabbit the lungs contained less than normal. It was supposed that the increase in tuberculosis had a special relation to that infection. To investigate that possibility they chose the aqueous humor of the rabbit's eye. Contrary to their expectation, they found that in experimental tuberculous rabbits there was a decrease of the vitamin in that fluid. Mizukawa (1) also reported that the vitamin C content is in inverse ratio to that of the albumen in the aqueous humor; and other workers, to be cited, investigated that fluid in various conditions.

The writers, giving consideration to the fact that 70 percent of leprosy patients suffer from leprotic eye lesions, undertook an investigation of the matter in patients with different types of this disease. Besides the vitamin C content, which was determined by the colorometric method of Nishigaki and Yamagami (5), in which wolframic acid is used, the albumen content

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was determined and in most instances examinations were made for the presence of leprosy bacilli.

The material examined consisted of 17 eyes, 2 from two macular cases, 1 from a neural case, and 14 from thirteen lepromatous cases. The types were confirmed by the Mitsuda test. One completely resolved lepromatous case gave a positive Mitsuda reaction.

FINDINGS

The results of these examinations, together with abbreviated data on the conditions existing in each case, are shown in Table 1.

TABLE 1.—*Vitamin C content of the aqueous humor of leprotic eyes.*

Specimen and case				Mitsuda reaction	Duration of disease	Years since eruption	Principal eye symptoms [a]	Vision	Aqueous humor		
Number	Sex	Age	Type						Albumin	Bacilli	VtC, mgm. %
1	M	28	M	2+	10	0	Lagophthalmos (2+); keratitis (+); catarrhal conjunctivitis	1.2	—	—	24.8
2	F	17	M	+	4	0	Trachoma scar.	0.8	—	—	24.8
3	F	40	N2	+	29	0	Lagophthalmos (+); trachoma pannus (+); P.R. (+)	1.0	—	—	27.4
4	F	36	L2	—	9	6	Lagophthalmos (+), trachoma scar; pannus lep.; P.R. (+)	1.5	—	...	24.8
5	F	30	L2	—	11	6	Episcleral leproma, corneal nebecula	1.2	Tr.	—	24.8
6	M	25	L2[b]	+	10	7	Pterygium; P.R.(+)	1.2	—	...	18.4
7	M	31	L2[b]	—	1	2	P.R.(+)	1.2	—	—	17.2
8	M	27	L2	—	10	5	Lagophthalmos (+); episcleral-corneal lepromas with keratitis	0.2	Tr.	...	17.2
9	M	48	L3	—	31	3	Lagophthalmos (+); chr. conjunctivitis; parench. & punct.	0.1	—	—	17.2
10	M	24	L2[c]	—	11	9	Chr. conjunctivitis; P.R. (±)	1.0	—	...	7.2
11	M	45	L3	—	15	10	*Left:* Trachoma scar; pannus leprotica (2+); synech. post.	0.1	2+	—	7.2
12	M	45	L3	—	15	10	*Right:* (Do.)	0.2	2+	...	6.3
13	M	51	L1	—	18	2	Lagophthalmos (2+); pterigium; posterior synechia.	1.0	2+[d]	2+	3.2
14	M	31	L2	—	12	3	Trachoma scar; pannus leprotica (2+); synech. post.; P.R.(±)	0.2	2+[d]	...	2.0
15	F	41	L2	—	21	6	Posterior synechia; secondary cataract	HM	3+	+	Tr.
16	M	43	L1	—	5	5	Pannus lep. (+); post. synech.; secondary cataract; iridectomy	3.5 M/F	3+[d]	...	0
17	M	22	L2[c]	—	9	5	Ac. iridocyclitis; pannus leprotic; lagophthalmos (+)	OL	3+[d]	...	Tr.

[a] Abbreviations: P.R. = pupillary reactions; H.M. = perception of hand before the face; O.L. = perception of light only.

[b] Lesions resorbed.

[c] Erythema nodosum leprosum (lepra reaction in lepromatous-type cases).

[d] Slight yellowish turbidity.

1. It will be seen that the vitamin C content of the eyes from the macular cases (Nos. 1 and 2), and of that from the neural one (No. 3), was almost normal, 24.8 and 27.4 mgm. percent, respectively. The average figure for the lepromatous cases is 10.4 mgm. percent. Case by case, however, there is much variation, and it is necessary to inquire into the cause of that.

The duration of the disease is not found to have much significance in this connection. Usually it is more important to consider the time since the outbreak of the lepromatous eruption, but that factor, too, is found to have no significant correlation here. Serological changes in leprosy are as a rule confined to cases of the lepromatous type and are proportional to the grade of the disease, but as will be seen from the table there is no direct relation between grade of the disease and the vitamin C content of the aqueous humor. Furthermore, though erythema nodosum leprosum—"lepra reaction" of the lepromatous type—usually has much influence on the serological condition, no relation is seen in the present connection.

Elimination of these factors leads to the conclusion that the vitamin C content must be influenced by the eye lesions themselves. To determine whether or not that is so, the analysis shown in Table 2 is made. The lesions that were present are divided into two classes, those that were outside of the eye and those that were inside.

TABLE 2.—*Relation of lesions outside and inside of the eye to the vitamin C content of the aqueous humor.*

Lesions outside of eye	Lesions inside of eye	Iridocyclitis, posterior synechia, etc.		Average
		Marked	Absent	
Pannus leprosa and other leprotic inflammations of cornea and episclera	Marked	V.C.mg.%	24.8 mg.	
		2.0 mg.	17.2	
		7.2	17.2	
		6.3		10.7
		6.3		
		trace		
	Slight	3.2	17.2	
		7.2	24.8	10.1
		0.0	18.4	
		trace		
Average		3.2	19.9	

The lesions outside of the eye, shown in the vertical column, are pannus leprosa, corneal leprotic inflammation, and episcleral

involvement outside of the cornea. These affections are divided into two grades, marked and relatively slight. In the cases with marked changes of this kind the vitamin values average 10.7, and in those with the slight changes the average is 10.1. There is no significant difference between these two figures.

The contrary is true with respect to the lesions inside the eye—iridocyclitis, posterior synechia, etc.—that are shown in the horizontal column of the table. Here there is a very marked difference between the cases with high-grade lesions of this kind and those with none. In the former the average is 3.2, in the latter 19.9. Examples of the latter are cases 4 and 5 of Table 1, with marked lepromatous inflammation of the cornea and episclera but no affection of the iris; in them the findings were practically normal.

It is thus evident that the vitamin C content of the aqueous humor does not vary with the degree of leprotic changes in the body in general, or with those of the cornea, conjunctiva and episclera, but that it depends upon lesions inside the cornea—those of the uvea and lens. Naturally, therefore, there is an inverse ratio between the vitamin content and that of albumen, which increases with the more marked grades of inflammation. It naturally follows that the more marked the decrease of the vitamin, the greater is the diminution of vision.

RELATIONSHIP WITH SECONDARY CATARACT

Secondary cataracts, which result from chronic or repeated iridocyclitis, are often the cause of blindness in leprosy. It has been found by some investigators that vitamin C is decreased in the presence of cataracts. K. Nakamura (3) found that in rabbits there was a direct proportion with the grade of cataracts caused by cystotomy. O. Nakamura (4) and Sai (9) found the same condition when cataracts were produced experimentally with naphthalene. B. Nakamura (2) also found a decrease with senile, traumatic and complicated cataracts, and also in eye diseases which have a tendency to cause cataracta complicata.

Cases 15 and 16 of Table 1 had secondary cataracts, and with them the vitamin C values found were "trace" and none, respectively. This coincides with findings in the presence of other cataracts. Since in leprosy the cataracts are caused by iridocyclitis, this observation confirms the findings of B. Nakamura that vitamin C decreases in those eye diseases which cause secondary cataracts.

CONCLUSIONS

1. The authors have examined the vitamin C content of the aqueous humor in 17 eyes from 16 cases of leprosy by means of colorimetry with wolframic acid.

2. No material departure from normal was found in the material from two macular cases and one neural one, but in the lepromatous cases there was, on the average, a marked decrease.

3. The decrease found in lepromatous cases has no relation with the duration of the disease, or with the time since the outbreak of the lepromatous eruption, or with the degree of changes in the body in general.

4. The decrease is shown to be caused by the leprotic changes inside the eye, as iridocyclitis and cataracts, and not by lesions affecting the outside of the eye, as corneal and episcleral changes. Classified on this basis, the vitamin C content in the cases with changes inside the eye was 3.2 mgm. percent on the average, while in those without such changes it was 19.9.

5. In two cases with secondary cataracts, vitamin C was absent, or only a trace was present.

6. These findings in leprosy are similar to those of B. Nakamura in other eye diseases, namely, that not only in the presence of secondary cataracts but also in the eye conditions which tend to cause them, the vitamin C content of the aqueous humor decreases.

7. In agreement with these facts, the vitamin C decrease is in inverse ratio to the albumen content of the aqueous humor; and the greater that decrease, the more marked is the diminution of vision.

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