

Trachoma and increased intraocular pressure

M. M. O. BEIRAM

Department of Communicable Eye Diseases and Filariasis, Ministry of Health, Khartoum, Sudan

In trachomatous areas a large percentage of patients with glaucoma also show signs of trachoma. The WHO (1956) defined trachoma as a specific communicable keratoconjunctivitis, usually of chronic evolution, characterized by the formation of follicles, papillary hyperplasia, and pannus, and typically leading to scar formation. Contradictory reports have appeared in the literature regarding the relationship between trachoma and glaucoma. Müller (1900), DeWecker (1900), Cuénod and Nataf (1930), MacCallan (1936), Adamantiadis (1937), Sédan (1939), and Boles Carenini and Cambiaggi (1957) reported a higher frequency of glaucoma among trachomatous than among non-trachomatous subjects. On the other hand, Bailliart (1928), Terson (1928), Trantas (1937), and Pasino (1957) stated that the two conditions were independent.

This paper attempts to correlate these two diseases with reference to data extracted from a survey carried out in two villages in Northern Sudan.

Northern Sudan

The northern province of the Sudan extends between lat. 16° and 22·5° N and long. 25° and 34° E. The territory is an almost rainless desert region which suffers extremes of hot dry weather in summer and cold dry weather in winter. Sand storms prevail throughout the year but are more frequent in summer. The population, approximately one million, occupies cultivated areas separated by sparsely populated rocky and sandy areas. Atbara, the largest town in the province, is situated in lat. 17·40° N. and long. 33·59° E.

Material and methods

In 1968 the area lying between Berber town (23 miles north of Atbara) and Abuhamed town (130 miles north of Berber) became the site of a mass treatment campaign against trachoma. For assessment of the programme two villages were selected at random, Kadabas (referred to as Village A) on the western side of the river and Hafab (referred to as Village B) on the eastern side of the river. The inhabitants of both villages were examined clinically by the same ophthalmologist for signs of trachoma. All those in the age group 10 years and over were given a tonometric examination, and alternate subjects were examined by the Maklakov tonometer and the Schiötz tonometer. Only those with corneal lesions or severe inflammation and those who were very uncooperative were excluded from the tonometric examination. Cocaine 2 per cent. eye drops were used as a local anaesthetic, and patients were examined in the recumbent position. The weights used for tonometry were 10 g. in the case of the Maklakov and 7·5 g. in the case of the Schiötz tonometer. The findings were registered on special cards supplied by UNICEF. The classification recommended by WHO (1962) for trachoma diagnosis was adopted.

In Village A 1,143 persons and in Village B 639 were examined, and there were 759 and 412 in the age group 10 years and over in Villages A and B respectively. Tonometric examination was carried out in 318 cases in Village A and in 174 cases in Village B with the Maklakov, and 341 in Village A and 211 in Village B with the Schiötz tonometer.

Results

Trachoma was significantly more prevalent in Village B than in Village A—90·8 and 68·1 per cent. (Table I). Village B maintained this higher rate in the three age groups 10–29, 30–39, and over 40 years, the rates being 87·0, 91·2, and 95·1 per cent. respectively; the corresponding rates for Village A were 64·1, 68·9, and 74·4 per cent.

Table I *Trachoma prevalence rates in Kadabas (A) and Hafab (B) villages, by age*

Age (yrs)	Village	Total examined	Trachoma					
			Active		Healed		Total	
			No.	Per cent.	No.	Per cent.	No.	Per cent.
10–29	A	393	23	5·9	229	58·3	252	64·1
	B	177	16	9·0	138	78·0	154	87·0
30–39	A	132	2	1·5	89	67·4	91	68·9
	B	91	0	0·0	83	91·2	83	91·2
40 and over	A	234	1	0·4	173	73·9	174	74·4
	B	144	0	0·0	137	95·1	137	95·1
Total	A	759	26	3·4	491	64·7	517	68·1
	B	412	16	3·9	358	86·9	374	90·8

Trachoma IV cases (Table II, opposite) showed an average degree of cicatrization of 1·3 with a score of 2·1 in Village A, while Village B showed 1·5 with a score of 2·6. The percentage of cases with third degree scarring (C_3) was found to be higher in Village B in all three age groups, the rate being 8·7, 15·7, and 15·3 per cent., compared with 3·5, 0·0, and 6·4 per cent. in Village A.

The mean ocular tension by age, sex, trachoma incidence, and degree of cicatrization is shown in Table III (opposite). With the Schiötz tonometer the actual reading and not the supposed equivalent in mm. Hg was recorded (Smith, 1915).

STANDARDS OF OCULAR TENSION

The generally accepted standards of ocular tension are as follows:

Maklakov

18 to 21 mm. Hg within normal,
21·1 to 24 mm. Hg suspicious,
24·1 mm. Hg pathological.

Schiötz 7·5 weight

6·5 within normal,
5·5 suspicious,
less than 5 pathological.

Table II Degree of cicatrization of Trachoma IV cases in Kadabas (A) and Hafab (B) villages, by age

Age (yrs)	Village	Total examined	Cicatrization						Average	Score
			C ₁		C ₂		C ₃			
			No.	Per cent.	No.	Per cent.	No.	Per cent.		
10-29	A	229	154	67.2	67	29.3	8	3.5	1.4	2.2
	B	138	94	68.1	32	23.2	12	8.7	1.4	2.4
30-39	A	89	70	78.7	19	21.3	-	-	1.2	1.6
	B	83	59	71.1	11	13.3	13	15.7	1.4	2.7
40 and over	A	173	119	68.8	43	24.9	11	6.4	1.4	2.3
	B	137	86	62.8	30	21.9	21	15.3	1.5	2.9
Total	A	491	343	69.9	129	26.3	19	3.9	1.3	2.1
	B	358	239	66.8	73	20.5	46	12.8	1.5	2.6

Note: In calculating the average degree of cicatrization C₁, C₂, and C₃ were considered to be equal to 1, 2, and 3 units respectively. The score is the deviation of the observed from the mean in terms of standard deviation.

Table III Mean ocular tension

Tonometer			Malakov				Schiotz			
Village			A		B		A		B	
			No. examined	Mean tension	No. examined	Mean tension	No. examined	Mean tension	No. examined	Mean tension
Total population			318	20.9 S.D. = 2.41	174	22.1 S.D. = 2.16	341	7.00 S.D. = 1.57	211	5.5 S.D. = 1.95
Characteristics	Sex	Male	150	20.7	74	21.4	118	7.20	85	5.90
		Female	168	21.1	100	22.9	223	6.80	126	5.30
	Age (yrs)	10-29	155	20.9	73	22.3	174	6.90	79	5.70
		30-39	64	20.6	37	21.9	59	7.00	53	5.70
		40 and over	99	21.2	64	22.0	108	6.90	79	5.20
Trachoma	O		98	20.8	22	22.4	109	7.00	16	5.50
		IV	220	21.0	152	22.2	232	6.90	195	5.50
Degree of cicatrization in Tr IV cases	C ₁		158	20.8	102	21.9	159	6.9	132	5.6
		C ₂	55	21.3	36	23.2	53	7.1	33	5.8
		C ₃	7	23.3*	14	22.6	20	6.8	30	5.0

*One patient aged 75 years gave ocular tensions 31 and 35 for the right and left eyes; excluding this case the mean tension would have been 20.9

In the Sudan the mean ocular tension has not been studied before. It was found in this survey that the mean tension with the Maklakov tonometer was 20.9 mm. Hg (standard deviation ± 2.41) in Village A and 22.1 mm. Hg (S.D. ± 2.16) in Village B. The difference is significant, being 5.7 times the standard error (S.E. ± 0.21).

Using the Schiötz tonometer, Village A had a mean reading of 7.00, equivalent to 20.2 mg. Hg (standard deviation ± 1.57). Village B had a mean reading of 5.5, equivalent to 25.3 mm. Hg (standard deviation ± 1.95). Again the difference is significant, being 9.5 times the standard error (S.E. ± 0.16).

Taking each village separately, the mean tension did not vary with age or trachoma incidence.

The females in the two villages showed a slightly higher tension than the males; this tendency was more marked in Village B: 21.4 mm. Hg for males and 22.9 mm. Hg for females, the corresponding Schiötz readings being 5.9 (=24.5 mm. Hg) and 5.3 (=27 mm. Hg).

The females in the two villages also showed a higher prevalence of trachoma, again more marked in Village B. The rates were 57.8 per cent. in Village A and 60.6 per cent. in Village B for females, and 42.2 and 39.4 per cent. respectively for males.

The mean ocular tension was studied in relation to the degree of cicatrization in TR IV cases, and it was found that cases with third degree cicatrization (C_3) exhibited a higher mean than those with first degree (C_1); this too was more apparent in Village B (Table III).

In this survey all our measurements are on the high side, which is probably due to the fact that we used cocaine drops as a local anaesthetic and measured the tension while the patient was in the recumbent position. Cases with an increased tension in both villages were tabulated according to the generally accepted standards of ocular tension: over 24 mm. Hg with the Maklakov tonometer and less than 5 with the Schiötz tonometer (Table IV, cols 4 and 5), and also those with a pathologically high tension: over 28 mm. Hg and less than 3 (Table IV, cols 6 and 7). The findings all follow the same pattern. The percentage of cases with a pathologically high tension was 1.1 per cent. in trachoma-free cases and 4.1 per cent. in persons with trachoma, while a moderately high tension was observed in 7.1 and 18.5 per cent. respectively. The incidence of high tension increased with age, the increase being statistically more significant in persons with trachoma.

Table IV Incidence of high and pathologically high ocular tension in persons examined in both villages

Trachoma stage	Age (yrs)	Total examined	Persons with high tension			
			Over 24 mm. Hg or less than 5		Over 28 mm. Hg or less than 3	
			No.	Per cent.	No.	Per cent.
O	10-29	164	9	5.5	1	0.6
	30-39	49	5	10.2	0	0.0
	40+	67	6	9.0	2	3.0
	Total	280	20	7.1	3	1.1
IV	10-29	367	51	13.9	5	1.3
	30-39	172	32	18.6	10	5.8
	40+	310	74	23.9	20	6.5
	Total	849	157	18.5	35	4.1

These observations may be summarized as follows:

- (1) Trachoma was more prevalent in Village B.
- (2) The mean tension was higher in Village B.
- (3) Females showed a higher trachoma rate and a higher mean tension than males.

- (4) The degree of cicatrization was greater in Village B.
- (5) The mean tension was higher in those with third degree than in those with first degree cicatrization.
- (6) Pathologically high tension was mainly associated with the presence of trachoma.

Discussion

The villages in the Northern Sudan and their inhabitants all look very much alike in almost every respect. One village may differ from another only in its proximity to the river and hence in the ease of obtaining water. This will naturally have an effect on the incidence and severity of trachoma. In this survey both trachoma and the mean ocular tension was significantly more prevalent in Village B.

Cuénod and Nataf (1928) found that at least 75 per cent. of glaucomatous patients in Tunisia exhibited signs of trachoma. Nema, Saiduzzafar, Nath, and Shukla (1964) found a significantly higher mean ocular tension in trachomatous than in non-trachomatous subjects. The higher mean ocular tension found in Village B in all age groups and in both sexes as compared to Village A is very striking, especially as Village B also has the higher trachoma index. Cuénod and Nataf (1930) found that the frequency of glaucoma was 3 per cent. among trachomatous cases and only 1 per cent. among non-trachomatous cases. Boles Carenini and Cambiaggi (1957) found that the incidence of glaucoma was nearly 10 per cent. among trachoma-free patients. Sie Boen Lian (1956) found 17 per cent. with pathologically raised tension. In this survey the incidence of glaucoma was 4.1 per cent. among trachomatous cases and 1.1 per cent. among non-trachomatous cases.

The trachoma index, taking both villages together, was 76.1 per cent., but among glaucoma cases it was 92.1 per cent. Casanovas and Mawas (1961) believed that, where many cases of glaucoma show signs of trachoma, the latter can be considered as one of causative factors.

Not a single case of acute glaucoma was observed in this series. In South Tunisia, an area with a high trachoma index, Kolin (1965) remarked upon the predominance of open-angle glaucoma over closed-angle glaucoma (5.5 and 1.0 per cent. respectively). It is generally accepted that the trachoma agent as such does not cause a rise in ocular tension, and therefore if glaucoma occurs it would be the result of cicatrization. Ashton (1960) observed that structural changes in the trabecular meshwork were of possible importance in the pathogenesis of primary glaucoma. Blatt (1961) found glaucoma in subjects in the later stages of trachoma.

It was not possible under field conditions for us to study the aqueous veins, but Boles Carenini and Cambiaggi (1957) saw fewer aqueous veins in eyes affected by trachomatous pannus and concluded that this was an indication of obliteration of the limbal and pre-limbal vessels. Luntz and Smith (1960) found fibrosis of the episcleral tissue around the limbus leading to obliteration of the episcleral veins in four Negroes.

It seems that trachoma causes a rise in ocular tension only in special cases in which there is obliteration of the pre-limbal and scleral outlets (Sie Boen Lian, 1965). Re-infection with trachoma is common and with each attack further cicatrization may be expected. This explains the higher incidence of glaucoma among trachomatous cases with advancing age; 1.3, 5.8, and 6.5 per cent. in the age groups 10-29, 30-39, and over 40 years respectively. Kamel (1963) incriminated repeated re-infections as an aetiological factor in the causation of primary glaucoma, and suggested that once cicatrization of the lid was complete re-infection tended to involve the bulbar conjunctiva.

It is true, of course, that primary glaucoma is a disease of the older age groups. According to Luntz, Sevel, and Lloyd (1965), high intraocular pressures are not often found below the age of 50 years. Kamel (1963) observed the comparatively very early age at which glaucoma occurs in the United Arab Republic where the trachoma index is high. We have found pathologically high intraocular pressures in the age group 30–39 years and even at 10 to 29 years in trachoma patients, whereas the non-trachomatous glaucoma cases all occurred in the age group 40 years and over (except one case in Village B recorded in a youth aged 19 years).

Summary

A survey of glaucoma and trachoma in the Northern Sudan suggests that trachoma may cause the intraocular pressure to rise as a result of cicatrization.

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