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Clinical and Pathological Features of Chronic Glaucoma in North-East Ghana

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Summary

Of 34 consecutive patients with chronic glaucoma seen in north-east Ghana, 22 (65%) were male and seven (21%) were aged under 40 years. Only 17% of eyes had a visual acuity better than 6/18 at presentation. Sixteen of 23 patients who underwent gonioscopy had PAS of which 13 had positive skin snips for onchocerciasis, compared with two out of seven patients with positive skin snips who had open angle glaucoma (p=0.003).

Of 22 trabecular meshworks examined by light microscopy ten (45%) showed marked melanin pigmentation which was more common in younger patients but did not correlate with onchocerciasis infection.

There is evidence from the USA and Caribbean countries that chronic glaucoma is a more severe disease in people of African origin than Caucasians. Blindness from chronic glaucoma has been reported to be eight times more common in non-white than white populations, registered blind in the USA.[1,2] The severity of chronic glaucoma and risk of blindness is said to be greater in indigenous Africans but this in itself is a vague statement. Africa consists of many ethnically distinct peoples, and different geographic and climatic environments. Chronic glaucoma appears to vary in its frequency from one part of Africa to another, but generally seems to be a greater problem in West Africa, and the dry areas of East and Southern Africa.

Existing literature on glaucoma blindness in West Africa presents somewhat contradictory evidence. A population based survey of blindness in the Gambia showed chronic glaucoma to be responsible for 2% blindness (best acuity less than 3/60), although visual fields were not examined.[3] Clinic based reports from Zaire, Sierra Leone, Nigeria and Liberia suggest that the disease is more severe, has a younger age of onset, and is responsible for 31%, 20%, 23% and 24% of all blindness respectively.[4-7]

In Rodger's extensive survey of eye disease in West Africa in the 1950s, mention is made of glaucoma which 'appeared in vast numbers in certain restricted areas'. He suggests the possibility of underlying nutritional factors and investigated this, but limited by time and resources was unable to find any obvious association. He commented that the disease was serious and required special thought and that 'every case we saw was totally blind'.[8]

In many parts of West Africa, onchocerciasis is endemic and there appears to be an association between the distribution of these two diseases.[5] However neither the importance of, nor the mechanism by which onchocerciasis may cause secondary glaucoma are defined.[9,10] During a previous visit to Bawku, four patients aged under 20 years with glaucoma required surgery. Similar young patients

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with glaucoma have been seen in the forest areas of Sierra Leone and the savannah of Northern Nigeria, within and outside areas with hyperendemic onchocerciasis.

In order to investigate glaucoma in West Africa, a preliminary study was carried out at Bawku hospital in Northern Ghana where a high prevalence and severity of the disease had been noted. The study was in two parts. The first, a retrospective review of all patients with chronic glaucoma seen at the hospital over an 19 month period; and the second, a detailed assessment of 34 new patients presenting with glaucoma at the hospital. The first is published separately,[14] and the latter is described below.

Patients and Methods

Bawku hospital is situated in the north-eastern corner of Ghana. The area is part of the Sahel region of West Africa with a wet season from June to October (annual rainfall 110 cm/year). Onchocerciasis is endemic in this part of Ghana. The onchocerciasis control programme of the World Health Organisation has been carrying out larviciding as part of the vector control programme since 1976. Bawku hospital with a 50 bed eye ward, a daily outpatient clinic and two operating theatres is supported by the Presbyterian Church of Ghana, the Government of Ghana and Christoffel Blindenmission. Also based at the hospital is a mobile eye unit which visits neighbouring villages referring patients who require treatment to the hospital.

Patients were examined in the clinic, and all those with glaucoma who had navigational vision were admitted for further assessment and treatment. Those who could no longer see to walk around clinic furniture in a fully illuminated room were considered unlikely to benefit from treatment and advised to return home.

All glaucoma admissions were screened for glycosuria and hypertension. Visual acuity by Snellen or E Chart, slit lamp examination of the anterior segment, Goldmann applanation and/or Schiotz indentation tonometry and evaluation of the optic disc by direct ophthalmoscopy were performed on all patients, and Goldmann single mirror gonioscopy on 23 patients. Patients who had not recently had a skin snip for onchocerciasis or whose onchocerciasis status was not clinically apparent had skin snips from the hip and shoulder examined in the hospital laboratory for microfilaria. In some patients (with whom good communication was possible), a family history was taken, and in one case it was possible to visit the home and examine all family members by ophthalmoscopy. Those with a cup:disc ratio of 0.6 or greater came to the clinic for further assessment.

Thirty four glaucoma patients were admitted and underwent trabeculectomy during the study. Out of 30 trabeculectomy specimens taken 22 included trabecular tissue. The specimens were fixed in formalin or paraformaldehyde, and later embedded in paraffin and sectioned for light microscopy at the Institute of Ophthalmology in London.

During a visit by the mobile unit to an outlying village of approximately 4000 population, the causes of visual loss were documented. Ninety attenders were examined by one ophthalmologist (RW) and evidence of onchocerciasis, disc appearance and intraocular pressure (where indicated) were recorded.

Case Reports

Four patients are presented below to illustrate the heterogeneous nature of chronic glaucoma in this area.

Patient 1

N.S., a 17 year old girl is the daughter of an affluent town dweller. She had never suffered from or been treated for onchocerciasis. Apart from her father who had lost the sight of one eye there was no family history of blindness. She complained of poor sight in her left eye. On examination, best acuity in the left eye was hand movements and right eye 6/24. There was a left afferent pupillary defect. Gonioscopy on the left eye showed a normal open angle. The left optic disc was totally cupped, and the right showed pathological cupping (C:D ratio 0.8). The intraocular pressure was greater than 40 mmHg in the left eye. Her skin snip was negative for microfilaria on two occasions. She had undergone right trabeculectomy the day before our arrival so that the meshwork biopsy was not available.

During a visit to her family home, most members of her large family were examined. Figure 1 illustrates the findings. One known patient and three previously undiagnosed people with glaucoma

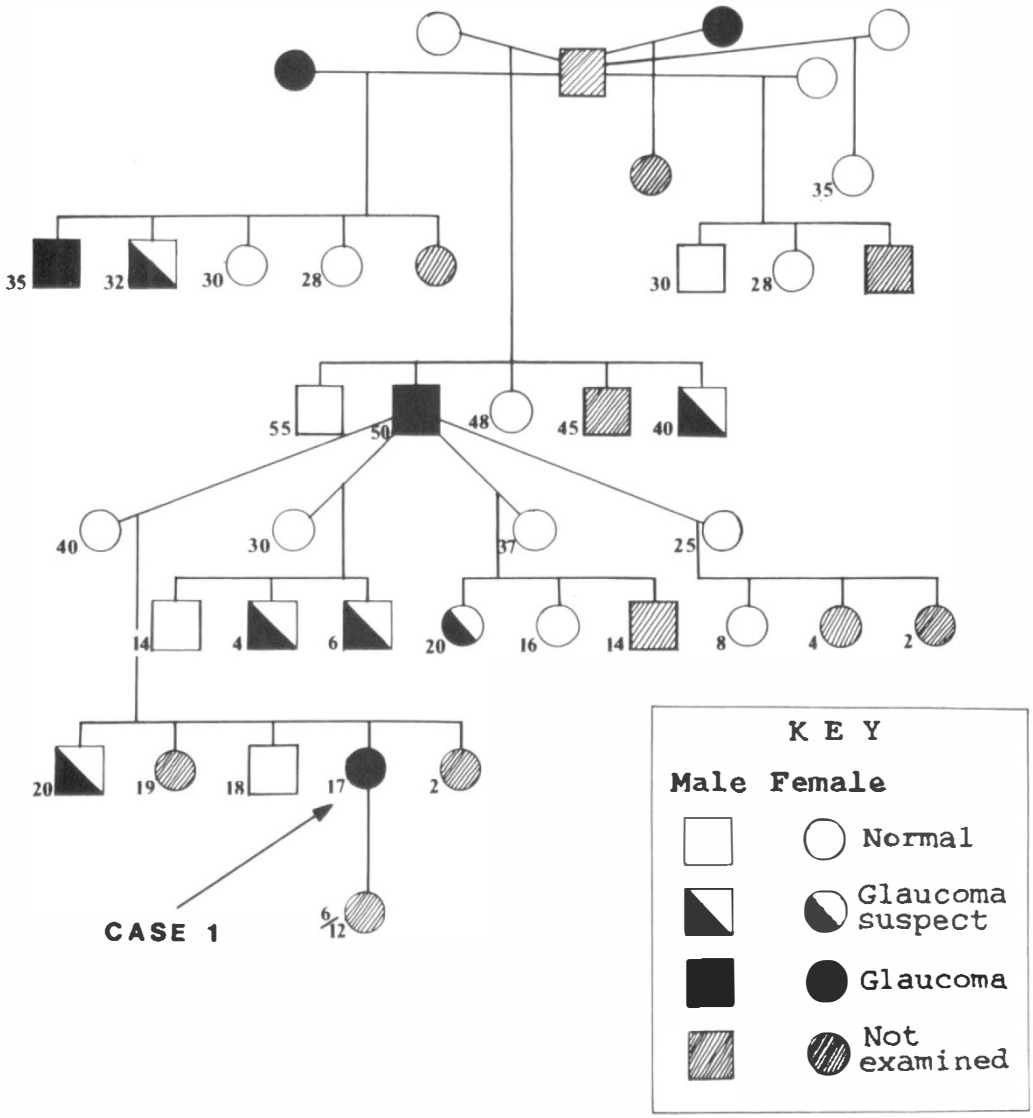

Fig. 1. *Family tree of Case 1.*

were found. Within her own direct family pedigree, her father had glaucoma and one full brother, two half brothers, and one half sister (ages 20, 4, 6 and 20 years respectively) had suspicious optic discs (C:D ratio 0.6 or more) but normal intraocular pressures. This patient had no evidence of onchocerciasis to account for her early onset primary open angle glaucoma.

Patient 2

Y.A., a 29 year old mother of six children, was diagnosed as having glaucoma during a mobile unit visit to her village. She had previously been diagnosed and treated for onchocerciasis. She complained of poor sight in her left eye which could only see hand movements. Her right acuity was 6/6. Intraocular pressures were right, 25 mmHg and left, 40 mmHg. Slit-lamp examination of the anterior segments revealed some sclerosis of the bulbar conjunctiva in the interpalperbral area with migration of limbal pigment into the corneal epithelium in the same distribution. The anterior chambers were quiet, deep and no microfilaria were seen after two minutes in the head down position. The anterior iris stroma was atrophic with extensive pigment fall out, especially from the iris crypts. This appearance

was more marked in the left eye. Gonioscopy revealed abundant peripheral anterior synechiae (PAS) particularly in the left eye. The left optic disc was totally cupped and the cup:disc ratio on the right was 0.7. The patient underwent right trabeculectomy. Histological examination of the meshwork specimen showed sclerosis and pigment encrustation. No microfilaria were seen.

Such extensive iris atrophy in a 28 year old with a positive skin snip suggests that these changes are due to onchocerciasis. It seems likely that her glaucoma was secondary to onchocerciasis and probably due to the development of PAS from chronic inflammation. The only family member we were able to examine was her 14 year old son whose eyes appeared normal. She was unaware of any family history of blindness.

Patient 3

Z.D., a 35 year old male staff nurse working in the hospital, complained of poor vision in his right eye. His visual acuity was 6/36 right and 6/12 left with myopic correction. Anterior chambers were deep and intraocular pressures 32 and 34 mmHg right and left. Both discs were pathologically cupped, the right more than the left (vertical cup:disc ratio 0.9:0.8). He had bilateral pterygia but no ocular signs of onchocerciasis. On gonioscopy there were extensive adhesions from the iris root to Schwalbe's line in both eyes which were felt to be PAS. There was no history of onchocerciasis and several skin snips and a Mazzoti test had been negative in the past. There was no history of uveitis. An aunt had glaucoma and two of his children aged nine and 13 years had cup:disc ratios 0.6 or more. Trabeculectomies were performed on both eyes and the excised meshwork showed marked sclerosis.

The presence of PAS makes one doubt the otherwise straightforward diagnosis of primary glaucoma. Although Mazzoti and skin snip were negative, there must have been some suspicion of onchocerciasis to justify these tests. One cannot be sure in this patient whether the glaucoma is secondary to a previous uveitis (possibly onchocerciasis) although a familial predisposition is also present.

Patient 4

A.A., a 38 year old male, was brought into hospital by the mobile team for glaucoma surgery. His right eye was blind with absolute glaucoma and advanced sclerosing keratitis typical of long standing ocular onchocerciasis. His left eye could see 6/60 with early anterior segment changes due to onchocerciasis. The intraocular pressure in the left eye was 28 mmHg and the optic disc was cupped to a ratio of 0.7. The angle was open on gonioscopy although the anterior iris stroma was atrophied with pigment fall-out. Trabeculectomy was performed and the specimen showed marked melanin impregnation of the meshwork.

Although this man had open angle glaucoma, it is possible that the glaucoma was precipitated by pigment fall out due to onchocerciasis. The advanced changes in the other eye give definite evidence of ocular onchocerciasis. We were not able to obtain an adequate family history from this patient, who illustrates the problems of classification when there are signs of both onchocerciasis and primary open angle glaucoma.

Table I *Gonioscopy appearances in 23 patients compared with presence of onchocerciasis*

	Open angle	*P.A.S*
Oncho. neg.	5	3
Oncho. pos.	2	13
	7 (30%)	16 (70%)

Fisher's exact test
p = 0.0026

Results

(a) Age and sex distribution

Twenty two males (mean age 53, range 28–67) and 12 females (mean age 43, range 17–75) underwent surgery. Seven patients (21%) were under 40 years old.

(b) Visual Acuity

Visual acuity was recorded in 32 patients. Eleven patients had a best acuity of 6/18 or better, and ten of less than 6/60. Only 17% of all eyes had an acuity of 6/18 or better at presentation. However, these figures do not include those patients totally blind in both eyes at presentation, who were not admitted for assessment.

(c) Gonioscopy

Twenty three patients were examined by gonioscopy. Sixteen had peripheral adhesions between the iris and cornea (PAS), of which 13 had positive skin snips for onchocerciasis.

Table II *Onchocerciasis infection by age in 32 patients with chronic glaucoma*

Age	*Oncho. pos.*	*Oncho. neg.*	*Total*
<40 yrs	3	4	7
40–59 yrs	11	3	14
60 yrs +	8	3	11
	22	10	32

Table III *Histological appearances in 22 trabecular meshwork specimens by age*

	<40 yrs	*40–59*	*60+ yrs*	*Total*
Normal or sclerosed meshwork	2	4	6	12
Highly pigmented meshwork	5	4	1	10
	7	8	7	22

This compares with two out of the seven patients with open angles who were positive for onchocerciasis. Table I.

(d) Onchocerciasis

Of the 32 patients with chronic glaucoma examined by skin snips, 22 (69%) had positive skin snips for onchocerciasis infection. Three of seven (43%) aged under 40 years compared with 19 of 25 (76%) aged 40 or over were positive (Table II).

(e) Trabecular Meshwork Biopsies

Of 22 meshworks examined by light microscopy, nine appeared normal, ten showed moderate to marked melanin pigment deposition of which four also showed sclerosis, and three showed meshwork sclerosis alone (Table III). Five of seven patients under the age of 40 years showed heavy meshwork pigmentation compared with four of eight aged 40–59 years, and one of seven aged 60 years or over. The presence or absence of onchocerciasis was not correlated with the degree of melanin pigmentation in meshwork biopsies.

(f) Rural Clinic

The following summarises the findings in 90 patients seen in a village clinic.

(1) Fifty nine patients (66%) had a positive skin snip for onchocerciasis.
(2) Sixteen (18%) of patients had a best visual acuity of less than 6/60.
(3) Fourteen patients were considered to have glaucoma or be glaucoma suspects, of which seven (50%) had onchocerciasis. Fourteen of 24 eyes (58%) with glaucoma had an acuity of less than 6/60.
(4) Thirteen patients had optic atrophy, all of whom were positive for onchocerciasis. Nine of 24 eyes (37%) with optic atrophy had an acuity of less than 6/60.

Discussion

(a) Reasons for more Glaucoma Blindness in Africa

The available evidence including this study

Table IV *Summary of population based glaucoma surveys*

	No. insurvey	*Age range*	*Definition of glaucoma*	*Prevalence %*
Liberia (7)	203	above 40 years	IOP 22 mms Hg or above with pathological cupping or IOP 26 mms Hg or above	4.43
Transvaal (11)	2,427	over 40 years	IOP 21mms Hg or more with pathological cupping and field loss (Friedmann) (low tension glaucoma IOP below 21mms Hg)	POAG 1.1 PXF 1.1 CACG 0.25
Jamaica (2)	574	35–74 years	IOP 21mm Hg or more with pathological cupping and field loss (Globuck)	POAG 1.4
Wales (13)	4,231	40–74 years	IOP 21mms Hg or more with pathological cupping and field loss (low tension glaucoma IOP below 21mms Hg)	POAG 0.43

PXF = glaucoma associated with pseudocapsular exfoliation
POAG = primary open angle glaucoma (includes low tension glaucoma)
CACG = chronic angle closure glaucoma

Table V *Aetilogy of chronic glaucoma in 23 patients at Bawku Hospital*

		No.
1.	Open angle glaucoma	
	A. Early onset (0–39 years)	3
	B. POAG (40 years onward)	3
2.	Closed angle glaucoma (chronic)	
	A. Primary	3
	B. Secondary to ocular onchocerciasis	13

One other patient had POAG and severe ocular onchocerciasis

indicates that chronic glaucoma causes more blindness in Africans than in Caucasians.

The possible reasons for these racial differences in chronic glaucoma[23] are:

(1) increased prevalence of the disease in blacks;
(2) earlier age of onset, and therefore more person-years at risk of developing blindness;
(3) more rapid progression of the disease, resulting in a shorter time from onset to blindness;
(4) later diagnosis because of reduced access to ophthalmic services;
(5) poor response to treatment, either due to poor compliance with medication or increased failure rate with filtration surgery.

However, all these explanations make the assumption that the disease is fundamentally comparable, and this may not be valid.

Population based studies on glaucoma in Africa have been carried out in Liberia[7] and Transvaal.[11] The results are summarised with studies from Jamaica and Ferndale (Wales) in Table IV. It should be pointed out that the populations surveyed are not comparable for age or sex, and that different definitions for glaucoma were used, particularly in the Liberia survey. If this is accepted, the available data suggests that primary glaucoma is more common in ethnic groups from Africa compared with Caucasians.

The present study confirms previous observations[12,14] that glaucoma occurs in young African patients, who are often already blind at presentation. This suggests a more rapid progression of disease in younger patients. It is strange that early and even intermediate stages of the disease are rarely diagnosed in young Africans. This is possibly explained by the reduced access to ophthalmic services in many parts of West Africa which leads to patients presenting and being diagnosed only when there has been severe loss of vision in one or both eyes[14] but also it may be because of the rapid progression of the disease in young people.

Another reason for more glaucoma blindness in Africans is poor response to treatment. There is evidence that medical treatment is unsatisfactory because of poor compliance.[7,14] The results from filtration surgery vary with some authors reporting poor control[12,15,16] and others, results comparable with filtration surgery in Caucasians.[17,18] It is likely that all these different factors have a role to play, with the result that glaucoma causes much more blindness in an African population than in a Caucasian population.

(b) Aetiology of Chronic Glaucoma

The aetiology of chronic glaucoma in this series is mixed. It would appear from the 23 patients in which gonioscopy was performed that there are at least four groups of glaucoma patients in this area. Table V.

(1) The young patient (40 years or under) with open angles and no evidence of onchocerciasis. There were three patients (two males, one female) within this group which represents an 'early-age onset' glaucoma the cause of which is unknown, but as demonstrated by case history one, genetic factors may be important. This genetic influence may also explain variations in glaucoma prevalence between different ethnic groups in Africa.

On reviewing Olurin's data on the anterior chamber depth in Nigerians,[19] she found 17 of 36 (47%) of glaucoma patients under the age of 40 years with anterior chamber depth greater than 3.25 mm compared with 54 of 274 (19.7%) of normal subjects in the same age group. This suggests that deep anterior chambers are a risk factor for early onset glaucoma. Wallace reported that glaucoma in Jamaicans was associated with myopia. One factor which may be involved in early-onset glaucoma in Africans is a gen-

etic predisposition to deep anterior chambers resulting in excessive lens-iris contact causing pigment fall out and a 'pigmentary' glaucoma.[20]

(2) Thirteen patients had glaucoma associated with ocular onchocerciasis infection, demonstrated by a positive skin snip, anterior iris stroma atrophy and PAS. Their age range was 29–67 years. Ten were male and three female. Case history 2 demonstrates this group. It is possible however that some of this group have primary chronic angle closure and that the onchocerciasis is coincidental.[12] This group explains the observation that glaucoma is common in areas with onchocerciasis.[10] Thylefors found that severe ocular onchocerciasis was associated with glaucoma and was more common in males.[9]

(3) The third group have open angles and a later age of onset (over 40 years). They have features typical of chronic open angle glaucoma as seen in a Caucasian population. There were three patients in this group with an age range of 45–57 years. One patient had a positive skin snip but no signs of ocular onchocerciasis.

(4) Three other patients (two male, one female) had negative skin snips for onchocerciasis but the appearances of PAS on gonioscopy (eg case history 3). It is possible that they previously had onchocerciasis which had been treated, or that they actually have open angle glaucoma with heavily pigmented meshworks giving the impression of PAS. The other possibility is that they have primary chronic angle closure glaucoma as documented by Olurin.[12]

One patient had definite ocular onchocerciasis but open angles suggestive of primary open angle glaucoma (case history 4). No patient was seen with glaucoma associated with pseudo-capsular exfoliation as reported from Transvaal[11] and Somalia.[21] Table V summarises these findings. This classification may be useful in trying to follow the natural history of glaucoma and response to treatment in future studies in areas with hyperendemic onchocerciasis.

(c) Trabecular Meshwork Microscopy

The appearances of the trabecular meshwork are interesting. The most significant observation was the degree of melanin pigmentation. Ten of 22 meshworks showed moderate to heavy pigment deposition, and this was most marked in the younger age groups (<40 years, five of seven; 40–59 years, four of eight; 60+ years, one of seven) (Table III). The pigment dispersion may be due to chronic inflammation from onchocerciasis, but this would not explain all the cases. The second possibility is a 'pigmentary' glaucoma which may be a factor in causing the 'early-onset' glaucoma.

(d) Gonioscopy Appearances

In heavily pigmented eyes, particularly of young people it is often difficult to interpret the gonioscopic findings. Iris processes are common in young people and in combination with a heavily pigmented meshwork, these features may be confused with PAS. Nevertheless, we observed similar findings to Thylefors[9] in that onchocerciasis was associated with peripheral anterior synechiae formation presumably due to chronic ocular inflammation.

Conclusion

The available evidence confirms that chronic glaucoma is more common, occurs at a younger age and results in more blindness in populations of African origin than Caucasian.

The aetiology of chronic glaucoma in north-east Ghana is mixed. As well as typical open angle glaucoma, patients are commonly seen with glaucoma secondary to PAS from onchocerciasis. Two other groups of glaucoma patients are an early onset (under 40 years) open angle glaucoma which may be associated with deep anterior chambers and pigment dispersion, and lastly a group with chronic angle closure which is probably not secondary to onchocerciasis.

Further research into the important types of glaucoma in different African settings is warranted. Classification of glaucoma patients according to age and sex, family history of glaucoma, onchocerciasis status, anterior chamber depth, gonioscopic appearances and presence of pseudocapsular exfoli-

ation will enable identification of the most important diagnostic categories in different parts of Africa.

The identification of risk factors for different types of glaucoma, in particular early onset glaucoma, will assist in the recognition of individuals at high risk and lead to earlier diagnosis and treatment.

Medical therapy of glaucoma in Africans is disappointing. This may be due to poor patient compliance or to poor response to therapy, which may vary from one type of glaucoma to another. Studies into the long-term results of filtration surgery in different types of African glaucoma are needed.

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