Diabetic retinopathy in Nigerians

A study of 758 patients

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Diabetes mellitus is a fascinating and challenging disease in African subjects. Certain aspects of the disease in Africans, especially with regard to aetiology, clinical pattern, details of management, and the incidence of some of its complications, show striking differences compared with those in Caucasian patients. Careful study of the disease may provide information not only on the aetiology of the disease, but also on its natural history and the pathogenesis of its complications, which may be of world-wide importance (Tulloch, 1966). Diabetic retinopathy is one such complication.

In the more developed countries such as the United States of America, diabetic retinopathy is rapidly becoming the single most important cause of blindness among the adult population. It accounted for about 18 per cent. of blindness in some states in 1957/8 (Marble, 1965) and the percentage of all blindness due to diabetic retinopathy in the USA is 8.4. There is a similar incidence of diabetic retinopathy as a cause of blindness in the United Kingdom (Winter, 1960). Diabetic retinopathy is not uncommon among the Bantus in South Africa (Jackson, Goldin, and Marine, 1966), whereas among Nigerians it is rare (Kinnear, 1963; Greenwood and Taylor, 1968). This study has been carried out to determine accurately the incidence of retinopathy in Nigerian diabetics and to delineate the various factors which may account for its rarity. It forms part of a study carried out over a period of 2 years (1966–1968) into various aspects of the syndrome of diabetes mellitus in Nigerians.

Material and methods

Of 827 Nigerian patients treated for diabetes mellitus in the University College Hospital (UCH), Ibadan, 758 form the material for this study. The fundi were observed in these 758 patients after dilatation of the pupils with 1 per cent. homatropine. In 69 other diabetic patients, the fundi were not seen either because of cataracts or for some other reason.

Definition of diabetic retinopathy

As hypertension was common in the patients, the example of Jackson and others (1966) was followed in accepting them as cases of diabetic retinopathy only if the following were present:

- (i) Microaneurysms with or without perivenous sheathing and tortuosity of retinal veins.
- (ii) 'Dot' haemorrhages and/or flame-shaped haemorrhages associated with (i).

- (iii) Waxy exudates and cotton wool exudates associated with (i) and (ii).
- (iv) Proliferative retinopathy.

Arterial narrowing, arteriovenous nipping, flame-shaped haemorrhages, and cotton wool exudates without microaneurysms, associated with severe hypertension when encountered occasionally, were regarded as indicative of hypertensive retinopathy rather than as retinal lesions due to diabetes mellitus *per se*. Since Friedenwald (1949) demonstrated retinal microaneurysms in diabetics, they have been regarded and probably overemphasized as the hallmark of diabetic retinopathy (Bloodworth, 1962; Ashton, 1963): when present, however, they are not necessarily pathognomonic of the condition. They occur as isolated findings in non-diabetic persons, in severe hypertension, macroglobulinaemia, sickle cell disease, severe anaemia, Eales's disease, chronic glaucoma and occlusion of the central retinal vein (Fitzgerald, 1967). While we accept the presence of microaneurysms as the minimum for a diagnosis of diabetic retinopathy, the incidence found in this series will represent an overestimation rather than an underestimation of diabetic retinopathy in Nigerians.

A diagnosis of diabetic neuropathy was made when there was clinical evidence of peripheral and/or autonomic neuropathy or diabetic amyotrophy with or without confirmatory electromyography and nerve conduction tests. When a diastolic blood pressure reading of 100 mm. Hg was recorded on at least two visits to the diabetic clinic, hypertension was diagnosed.

Serum cholesterol was determined by the method described by Searcy and Bergquist (1960). Serum urea was determined as described by Varley (1962). Urine was tested for albuminuria using Albustix.

Results

Table I shows the age distribution of the 827 Nigerian patients with diabetes mellitus. The peak incidence of diabetes mellitus in both sexes is in the age group 40 to 49 years, 58 per cent. of Nigerian diabetics being over 40 years of age. In Nigerians, diabetes is less common in childhood and early adult life and occurs with greater frequency in the 4th and 5th decades than among Caucasians (Joslin, Root, White, and Marble, 1959; Tulloch, 1962).

Table I *Diabetes mellitus in Nigerians as seen at University College Hospital, 1957-1968*
Sex and age distribution in 827 patients

Age group (yrs)	0-9	10-19	20-29	30-39	40-49	50-59	60-69	70-79	Total
Sex	Male	3	51	51	135	139	111	44	538
	Female	4	29	33	46	82	62	30	289
Total patients	7	80	84	181	221	173	74	7	827

The classification of diabetes mellitus into various types as defined by Western diabetologists (Lawrence, 1951) does not apply strictly to Africans (Campbell, 1963a, 1963b; Kinnear, 1963). It is not uncommon for the obese maturity-onset diabetics to present with ketonuria and even in diabetic coma. On recovery, such a patient may remain in perfect health on oral drugs. Sometimes diabetes mellitus in non-obese underweight patients under 40 years of age may also be well controlled by oral drugs. Table II shows the aetiological types of diabetes mellitus based on the classical stratification (Lawrence, 1951), and Table III shows the types of treatment. In effect, we have seen virtually every aetiological type of diabetes mellitus in Nigerians. Pancreatic diabetes with pancreatic calcification is common in Nigerians.

Table II *Aetiology of diabetes mellitus in 827 Nigerian patients University College Hospital, Ibadan, 1957-1968*

<i>Patients</i>	<i>No.</i>	<i>Per cent</i>
Onset maturity	632	76.4
juvenile	109	13.2
Pancreatic disease (including two patients with carcinoma of pancreas)	71	8.6
Drug-induced Steroids Thiazide	5 } 6	0.73
"Hepatogenous"	5	0.60
Acromegaly	3	0.36
Haemochromatosis	1	—

Table III *Types of diabetes mellitus (Classified according to treatment)*

<i>Type of diabetes</i>	<i>No. of patients</i>	<i>Per cent.</i>
Insulin-dependent	373	45.1
Oral drugs	434	52.5
Diet alone	20	2.4
Total	827	100

Table IV shows the important features in 35 patients with diabetes mellitus and diabetic retinopathy with or without neuropathy. The two subgroups, with neuropathy and without neuropathy, are remarkably similar except in the incidence of peripheral gangrene or absence of peripheral pulses; this is significantly more common in the patients with neuropathy and retinopathy. It appears, therefore, that neuropathy when associated with diabetic retinopathy predisposes to gangrene. 60 per cent. of the patients belonged

Table IV *Diabetic retinopathy in Nigerians*

<i>No. of diabetics</i>	<i>No. of patients with diabetic retinopathy</i>		<i>Mean age (yrs) (range)</i>	<i>Mean duration of diabetes (yrs) (S.D. and range)</i>	<i>Per cent. with Hypertension (Diastolic BP > 100 mm. Hg)</i>	<i>Albuminuria</i>	<i>Gangrene or absent peripheral pulses</i>	<i>Mean serum cholesterol (S.D. and range in mg./100 ml.)</i>	<i>Mean serum urea (S.D. and range in mg./100 ml.)</i>	<i>Treatment</i>		
	<i>Male</i>	<i>Female</i>								<i>Diet</i>	<i>Oral drugs</i>	<i>Insulin</i>
With neuropathy 353	14	5	51.5 (33-68)	6.9 ± 6 (1-24)	63.5	63.5	31.6	195 ± 74 (104-325)	48.0 ± 5 (23-83)	1	10	8 (mean daily dosage = 76)
Without neuropathy 405	10	6	49.7 (15-75)	5.8 ± 2.8 (1-15)	56.3	56.3	Nil	174.0 ± 49 (121-250)	43.0 ± 9 (21-73)	1	9	6 (mean daily dosage = 77)
Total	24	11	50.7	6.4	60.0	60.0	17.1	186.0	45.8	2	19	14

S.D. = Standard deviation

to the higher social classes: parliamentarians, chiefs, professional men such as doctors, engineers, university teachers, and senior civil servants, and business executives. All the patients with retinopathy suffered from maturity-onset diabetes with the exception of two aged 15 and 17 years. Both of these gave a history of chronic intermittent abdominal pain of several years' duration; pancreatic calcification, raised serum amylase levels, and steatorrhoea were present; diabetes mellitus had been diagnosed and treated for 2 and 3 years respectively. Neither showed any evidence of neuropathy and albuminuria was absent. Most of the patients with retinopathy had moderately raised serum urea levels.

The Figure, the fundus photograph of a patient with diabetic retinopathy, shows that when diabetic retinopathy occurs it can be as severe in a Nigerian as is described in the Caucasian. The patient was a 58-year-old obese female, who presented with a 4-week history of polyuria, polydipsia, and slight loss of weight. She had no clinical evidence of diabetic neuropathy, although motor nerve conduction velocity in the lower limbs was slow. Her blood pressure was 240/150 mm. Hg; there was no albuminuria, serum cholesterol was 179 mg./100 ml.; electrocardiography showed left ventricular hypertrophy.

FIGURE *Fundus in a case of severe diabetic retinopathy*

Table V (overleaf) shows the percentage incidence of retinopathy in relation to duration of diabetes. The longer the duration, the higher the incidence of retinopathy. The difference in the incidence of retinopathy in Nigerian diabetics with neuropathy and in those without is not statistically significant ($P > 0.05$).

Table VI (overleaf) shows the incidence of albuminuria and retinopathy. The longer the duration of diabetes, the higher the incidence of albuminuria and retinopathy. Albuminuria is a much commoner complication of diabetes than retinopathy. It is usually stated that retinopathy is almost always associated with albuminuria (Fitzgerald, 1967). However, in this series, in 36.5 per cent. of patients with diabetic retinopathy associated with neuropathy, and in 43.7 per cent. of those with diabetic retinopathy but without neuropathy, albuminuria was absent. However, the longer the duration of the diabetes mellitus, the higher the incidence of both complications. Albuminuria was

present in all the eleven patients in this series with retinopathy and duration of diabetes over 10 years. In 60 per cent. of patients with retinopathy, hypertension was present.

Table V *Diabetic retinopathy and duration of diabetes*

<i>Duration of diabetes (yrs)</i>	<i>Neuropathy</i>				<i>All diabetics per cent. with retinopathy</i>
	<i>With</i>		<i>Without</i>		
	<i>No.</i>	<i>per cent. with retinopathy</i>	<i>No.</i>	<i>per cent. with retinopathy</i>	
< 5	217	4.6	313	2.9	3.6
> 5	136	6.6	92	7.6	7.0
> 10	43	11.6	17	11.7	11.7
> 15	10	20.0	3	33.3	23.1
> 20	2	50.0			50.0
All durations	353	5.3	405	4.0	(All age groups) 4.6

Table VI *Correlation of retinopathy and albuminuria with duration of diabetes mellitus in Nigerian patients, UCH, Ibadan, 1957-1968*

Duration of diabetes (yrs)	Percentage with albuminuria	Percentage with retinopathy
< 5	15.3 (561)	3.6 (530)
> 5	25.1 (259)	7.0 (228)
> 10	26.5 (83)	11.6 (60)
> 15	38.9 (18)	23.1 (13)
> 20	50.0 (6)	50.0 (2)

Note: Figures in parenthesis represent total patients examined in each group

Table VII *Retinopathy in Bantu and White races in South Africa (Jackson and others, 1966) compared with Nigerians*

Duration of diabetes (yrs)	White		Bantu		Nigerians	
	No.	Retinopathy present (per cent.)	No.	Retinopathy present (per cent.)	No.	Retinopathy present (per cent.)
< 5	81	22	74	18	530	3.6
> 5	194	42.9	26	46	228	7.2
> 10	107	53	6	66	60	11.7
All diabetics	275	34	100	25	758	4.6

Table VII compares the incidence of diabetic retinopathy in Nigerians, South African whites, and Bantus (Jackson and others, 1966). In the three groups, there is a rise in incidence with duration of diabetes mellitus, but the rate of increase and the overall incidence are much lower in the Nigerians.

Diabetic "microangiopathy" is a term used to describe a specific vascular lesion in diabetes mellitus (Goldenberg, Alex, Joshi, and Blumenthal, 1959; Fagerberg, 1959; Fagerberg, 1966). It consists of thickening and hyalinization of the basement membrane due to deposition of periodic acid-Schiff (PAS)-positive colloidal iron-negative material, and enlargement and proliferation of the endothelial cells of the capillaries, sometimes with almost complete occlusion of the lumen. The lesion is widespread, being present in nearly every organ and in the dermal vessels of the skin. It may account for gangrene of the extremities (with or without absence of peripheral pulses), neuropathy, nephropathy, myocardial ischaemia, retinopathy, and small vessel disease in the brain. In the retina associated with microangiopathy, Yanoff (1966) demonstrated loss of the pericytes (Rouget cells, mural cells) which are the supporting cells of the retinal capillaries and help to maintain the tone of the capillaries. Focal degeneration and decrease of the mural cells or pericyte in the capillary wall is probably the initial lesion in the diabetic retina, and results in weakening and focal saccular dilatations, microaneurysms of the capillary wall, and development of capillary shunts (Cogan, Toussaint, and Kuwabara, 1961; Toussaint and Dustin, 1963; Cogan and Kuwabara, 1963; Yanoff, 1966). Thickening of basement membrane and endothelial proliferation and occlusion of the capillaries account for the infarcts, exudates, and haemorrhages (Hausler and Sibay, 1961). If retinopathy is a manifestation of diabetic angiopathy, then other manifestations of angiopathy, such as neuropathy, nephropathy, myocardial ischaemia, peripheral gangrene, and cerebrovascular accidents (Goldenberg and others, 1959; Fagerberg, 1959; Fitzgerald, 1967), will frequently be associated with retinopathy. Hypertension may be the result of nephropathy due to basement membrane thickening and small vessel occlusion, or of renal arterial stenosis known to be commoner in diabetics (Shapiro, Perez-Stable, and Moutsos, 1965). Table VIII shows the incidence of the clinical manifestations of "angiopathy" in Nigerian diabetics.

Table VIII *Clinical evidence of "angiopathy" in Nigerian diabetics*
(Percentages of numbers examined)

<i>Neuro- pathy</i>	<i>No. examined</i>	<i>Diabetic retino- pathy</i>	<i>Hyper- tension</i>	<i>Albu- minuria</i>	<i>Absent peripheral pulses</i>	<i>Peripheral gangrene</i>	<i>Myocardial ischaemia (angina, infarction)</i>	<i>Electrocardio- gram abnor- malities</i>	<i>Cerebro- vascular accidents</i>
Present	400	5.3 (353)*	29.5	18.3	7.8	4	0.8	14 (300)*	5.5
Absent	427	4.0 (405)*	20.1	19.2 (420)*	1.2	1.6	0.2	8.0 (256)*	3.7

*Number examined

400 Diabetic patients with neuropathy and 427 diabetic patients without neuropathy were examined except where otherwise stated and represented by figures in parenthesis.

Neuropathy is very common in Nigerian diabetics (48.3 per cent.). Hypertension and albuminuria are common. Peripheral gangrene, like retinopathy, is uncommon. Myocardial ischaemia is rare in both diabetic and normal Nigerians. In the last 11 years

at the UCH, Ibadan, only four patients with coronary artery disease with myocardial infarction had been seen: three of them were diabetics, and the other suffered from the nephrotic syndrome. Small vessel disease is uncommon in Nigerian diabetics.

Table IX shows the incidence of hypertension in Nigerian diabetics; the low incidence of retinopathy is not due to a low incidence of hypertension.

Table IX Hypertension in Nigerian patients with diabetes mellitus

Neuropathy		Age group (yrs)							
		0-9	10-19	20-29	30-39	40-49	50-59	60-69	70+ All ages
Present	No. of patients	2	34	45	87	118	72	36	400
	Per cent. with hypertension	0	2.9	6.6	10.3	29.7	63.9	58.8	29.5
Absent	No. of patients	5	46	39	94	104	100	37	427
	Per cent. with hypertension	0	0	7.7	7.4	19.2	41	37.8	20.1
Total	Per cent. with hypertension	0	1.3	7.1	8.8	24.8	50.6	48.0	24.7

Table X shows that retinopathy is uncommon in pancreatic diabetes, but this is probably a function of duration of diabetes rather than of the aetiological type of diabetes. The two patients aged 15 and 17 years with pancreatic diabetes who have retinopathy did not show any albuminuria and have no clinical evidence of neuropathy.

Table X Retinopathy and pancreatic diabetes in Nigerians

Neuro-pathy	No. of patients with pancreatic diabetes		Mean age (yrs) (Range)	Duration of diabetes (yrs) $\pm$ S.D.	Per cent. with keton-uria	Per cent. with albumin-uria	Per cent. with retino-pathy	Per cent. with steato-rrhoea	Hyper-tension	Mean serum cholesterol (mg./100 ml.) $\pm$ S.D.	Mean serum urea in (mg./100 ml.) $\pm$ S.D.	Treatment	
	Male	Female										Oral drugs	Insulin
Present*	21	10	27.5	4.5 $\pm$ 3.6	51.6	19.4	Nil	45.2	Nil	136 $\pm$ 61	24 $\pm$ 6.8	1	30†
Absent	29	11	21.0 (4-51)	3.4 $\pm$ 2.9	65.0	20	5	47.5	Nil	116 $\pm$ 37	25.0 $\pm$ 5.5	1	39‡

*Includes one patient aged 36 with carcinoma of pancreas
S.D. = Standard deviation

†Mean insulin daily dosage $\pm$ S.D. = 70.4 $\pm$ 33.0
‡Mean insulin daily dosage $\pm$ S.D. = 83.0 $\pm$ 39.8

Table XI shows serum cholesterol levels in diabetics with retinopathy, diabetics without neuropathy, and normal Nigerians in the upper and middle social classes. The cholesterol level in patients with diabetic retinopathy is significantly higher than in those without ($P < 0.01$).

Table XI Serum cholesterol in diabetic patients with and without retinopathy and normal Nigerians in upper and middle social classes

<i>Series of subjects</i>			<i>No. of patients</i>	<i>Serum cholesterol (mg./100 ml.) $\pm$ S.D.</i>
Diabetics	With retinopathy	(A) With neuropathy	35	190 $\pm$ 60
		(B) Without neuropathy	19	195 $\pm$ 74
			16	174 $\pm$ 49
		Without retinopathy	528	141 $\pm$ 53.9
Normal Nigerians in upper and middle social classes			285	200 $\pm$ 40

S.D. = Standard deviation

Comment

The incidence of diabetic retinopathy in Nigerians correlates with the duration of diabetes mellitus. The incidence of diabetic retinopathy in this series is 4.6 per cent. This low incidence is brought out more vividly when the Nigerian series is compared with the Bantu series with an incidence of 25 per cent. as reported by Jackson and others (1966). Apart from the South African Bantus, diabetic retinopathy seems to be uncommon in the Africans, for the incidence of retinopathy is 4.1 per cent. among diabetics in Southern Rhodesian Africans (Gelfand and Forbes, 1963), 3.3 per cent. among the Congolese (Beheydt and Joris, 1960), and 13.6 per cent. in the Tanzanians (Haddock, 1964). Seftel and Schultz (1961) reported an incidence of diabetic retinopathy as high as 45 per cent. in urbanized South African Bantus. It is also significant that 60 per cent. of our patients with retinopathy belonged to the upper and middle social classes. In Jamaicans, Tulloch (1962) quoted the incidence of retinopathy as 22 per cent. The incidence and severity of diabetes mellitus and the frequency of its complications, however, may be related to the calorie intake and the quality of carbohydrate, such as the amount of sugar consumed per day (Campbell, 1960, 1963b; Cohen, Bauly, and Poznanski, 1961; Gelfand and Carr, 1961; Tulloch, 1966). The Jamaicans eat a great deal of sugar, and in countries such as Uganda (Tulloch, 1966) and in urbanized South African Zulus (Campbell, 1963a) the increasing incidence of diabetes and its complications can be correlated with the recent increase in the daily consumption of sugar. Patients with fasting blood sugar concentration above 150 mg./100 ml., for instance, have a higher level of triglyceride than those with blood sugar levels below 150 mg./100 ml. (Reinheimer, Bliffen, McCoy, Wallace, and Albrink, 1967), and raised serum lipid levels may possibly be important in the aetiopathogenesis of some of the complications of diabetes mellitus. It is, for example, widely held (and rightly so) that atherosclerosis is related to increased levels of cholesterol and/or triglycerides in the blood, with perhaps an added factor of metabolic or mechanical injury to the intima to explain the localization of lesions (Marble, 1967). Campbell (1963) ascribed the differences in the vascular complications of diabetes mellitus in East Indian patients in South Africa (with incidence of retinopathy 26.6 per cent.) and in Zulu diabetics (incidence of retinopathy 9.0 per cent.) to high total fat and low fibrinolysin blood levels in the Indian, and the lower total fat and higher fibrinolysin levels in the Zulu. The rarity of diabetic retinopathy in Africans is probably related to the diet, the blood lipid levels, and the apparent immunity of the Africans to disease of the small vessels. In Nigerians, coronary artery disease is extremely rare. Hypertensive retinopathy is uncommon in Nigerians (Akinkugbe, 1968) and so are collagen diseases and other autoimmune diseases such as myasthenia gravis (Greenwood, 1968). The last raises an interesting possibility of altered immunological response being responsible for the rarity of diabetic retinopathy. It has been suggested that diabetic microangiopathy, the basis of the vascular complications of diabetes, is due to an immune reaction to circulating exogenous insulin, as fluorescent-tagged insulin has been located to the basement membrane of the glomeruli and the capillaries in other organs, presumably deposited as a result of antibody-antigen complexes formed during an immune reaction. (Blumenthal, Alex, and Goldenberg, 1961; Blumenthal, Hirata, Owens, and Berns, 1964.)

Retinopathy is not always associated with proteinuria in our patients. However, in this series, in patients with a duration of diabetes exceeding 10 years, retinopathy and albuminuria were present together. Mild retinopathy may occur without albuminuria. The earliest detectable sign of diabetic retinopathy is the microaneurysm, the histological basis of which is the loss of pericytes or mural cells of the capillary walls; presumably this

may occur without thickening and hyalinization of the basement membrane. However, in cases of severe retinopathy, especially if hypertension is present, nephropathy is invariably present. The findings in this series are similar to those of Seftel and Walker (1966) in that diabetic retinopathy is sometimes present without proteinuria. They found the incidence of diabetic retinopathy to be 11 and 45 per cent. in new and old diabetic Zulu patients: the incidence of proteinuria was 8 and 29 per cent. respectively.

The specific diabetic vascular lesion, diabetic microangiopathy, which is held by many workers to be the basis of such complications as retinopathy, neuropathy, nephropathy, gangrene, and myocardial disease, especially in its severe form, is uncommon in Nigerians (Greenwood and Taylor, 1968). Although hypertension and albuminuria are common in Nigerian diabetics, gangrene is relatively uncommon, with an incidence of 2.8 per cent. compared with 17 per cent. in Great Britain (Beckett and Hobbs, 1961) and 4.1 per cent. in Jamaicans (Tulloch, 1962). Gangrene as well as diabetic retinopathy are uncommon in Southern Rhodesian Africans, the incidence being 4.1 and less than 1 per cent. respectively (Gelfand and Forbes, 1963). Atheroma of the cerebral vessels and aorta is not uncommon in non-diabetic and diabetic Nigerians with hypertension (Osuntokun, Odeku, and Adelaye, 1969). The incidence of peripheral neuropathy in Nigerian diabetics is 48.3 per cent.; this compares favourably with the incidence of 60 per cent. quoted for diabetics in Great Britain by Garland (1960). The pathogenesis of diabetic retinopathy is however controversial and may be unrelated to microangiopathy (Thomas, 1967). Hypertension, peripheral gangrene, and absent peripheral pulses are commoner in Nigerian diabetics with neuropathy than in those without. This may suggest an underlying "microangiopathy" as the explanation, but in this series there is no positive correlation of neuropathy with retinopathy as found by Becker, Maengwyn-Davies, Rosen, Friedenwald, and Winter (1954) and Pirart (1965), who showed that diabetic neuropathy is usually accompanied by diabetic retinopathy. Retinopathy is as common in Nigerian diabetic patients with neuropathy as in those without.

The serum cholesterol in Nigerians with diabetic retinopathy is higher than in those without. It is also significant that a high percentage of the Nigerian diabetics with retinopathy belong to the higher social classes. The level of serum cholesterol in well-fed normal Nigerians in the higher social classes is the same as in patients with diabetic retinopathy. In most low-income Nigerians, whether diabetic or not, the serum cholesterol is low. The normal diet of an average Nigerian includes much unsaturated vegetable fat as well as a liberal quantity of carbohydrate, vegetables, and pulses, but little animal protein. This may account for the low serum cholesterol in most Nigerian diabetics and may apply more generally to Africans. Diet rich in unsaturated vegetable oils, such as corn-oil, will cause a significant improvement in the exudative lesions of diabetic retinopathy and will reduce the total lipid and serum cholesterol levels (King, Dobree, Kok, Foulds, and Dangerfield, 1963). A similar finding has been obtained with Atromid-S (clofibrate), which reduces serum cholesterol and triglyceride levels in diabetic patients with retinopathy (Cullen, Ireland, and Oliver, 1964).

It has been suggested that adrenal function is excessive in diabetics with vascular complications (Rifkin, Solomon, and Lieberman, 1958; Lentle and Thomas, 1964). In a comparative study of Bantus and coloured South Africans suffering from diabetes mellitus, Dancaaster and Jackson (1963) found no evidence of decreased adrenal function in the Bantus, to suggest this as a possible factor in the lower incidence of retinopathy among Bantu diabetics. There was also no evidence of hyperfunction of the adrenal cortex in diabetics with vascular complications.

It has been argued whether retinopathy is due to a different mechanism other than mere lack of insulin. It is known that diabetic microangiopathy is primarily due to a defect in the metabolism of glycoprotein, a metabolism probably independent of insulin (Conn, 1964). Spiro (1959) has suggested that the excessive deposition of glyco-protein in small vessels may be brought about through hexokinase, an enzyme which acts independently of insulin. An alternative explanation other than a lack or relative lack of insulin as the cause of diabetic microangiopathy is further suggested by the finding of diabetic microangiopathy in prediabetics (Fagerberg, 1966), although recent studies in newly-diagnosed diabetics have failed to reveal such lesions (Østerby Hansen, 1965). Moreover, lesions resembling diabetic microangiopathy have been described in non-diabetics (Yodaiken, Seftel, and Rubenstein, 1967). It is possible that the diabetic patient inherits two separate and basically independent traits, one for the metabolic defect and one for vascular disease, which run concurrent and relatively independent courses. Then, perhaps, the trait for the vascular disease is poorly expressed in the Africans. It is also possible that diabetic retinopathy and other manifestations of microangiopathy are commonly found in the hereditary type of diabetes mellitus. For example Reinheimer and others (1967) found that diabetics with microangiopathy have the highest incidence (40 per cent.) of a positive family history of diabetes as compared with diabetic patients with large vessel disease (15 per cent.). The former group has a higher incidence of retinopathy. However, the bulk of the evidence available favours a single trait—that of a metabolic defect reflecting an absolute or relative deficiency of insulin, which favours a vascular disease. Diabetic retinopathy has been found in dogs rendered diabetic with alloxan (Bloodworth, 1965; Engerman and Bloodworth, 1965). It has also been reported in human beings who become diabetic after pancreatectomy (Burton, Kearns, and Rynearson, 1957; Duncan, MacFarlane, and Robson, 1958). Two Nigerian patients with pancreatic calcification, diabetes mellitus, and retinopathy have been previously described. Diabetic retinopathy is therefore probably due to lack or relative deficiency of insulin. Why it is uncommon in Nigerians and most of the African diabetic patients may be explained by their diet, their culture, lower serum lipids, and possibly by increased fibrinolytic activity and altered immunological states. If there are specific morphological differences in the retina of the African, trypsin digestion of the retina may help to delineate this and to demonstrate any difference in the ratio of the pericytes to the endothelial cells of the retinal capillaries. It is possible also that there may be structural and biochemical differences in the ground substance of the basement membrane in Africans and Caucasians. Electron microscopy and histochemistry will therefore be valuable tools in further research on this subject.

Summary

Diabetic retinopathy is an uncommon complication of diabetes mellitus in Nigerian patients. The incidence is 4.6 per cent. in 758 patients. 60 per cent. of the 35 patients seen belong to the higher social classes. All the patients but two had maturity-onset diabetes mellitus. Two young patients had pancreatic calcification and biochemical evidence of exocrine disease of the pancreas.

There is a positive correlation of diabetic retinopathy with duration of diabetes; and with the presence of albuminuria in patients with duration of diabetes mellitus exceeding 10 years. In 40 per cent. of the patients with retinopathy, however, albuminuria was absent. There is no correlation between retinopathy and neuropathy.

Diabetic retinopathy is less common in Nigerian patients than in South African Bantus.

Although hypertension and albuminuria are common in Nigerian patients suffering from diabetes mellitus, peripheral gangrene, absence of peripheral pulses, and myocardial ischaemia are rare. Histological evidence of diabetic microangiopathy is also uncommon.

Serum cholesterol level is raised in Nigerian patients with diabetic retinopathy, compared with those without retinopathy, but is of the same level as in normal Nigerians in the upper and middle social classes.

The various factors which may be responsible for the rarity of diabetic retinopathy in Nigerians and in most African Negroes are commented on.

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