Alcohol: A Cause of Diabetes in Rhodesia

A. C. B. WICKS, R. F. LOWE, J. J. JONES

SUMMARY

Forty-four per cent of newly-diagnosed Black male diabetic patients habitually drank more than 500 ml alcohol per week. This is a far higher proportion than in healthy men matched for age (6 - 12%), and suggests that the abuse of alcohol contributes to the development of diabetes in this population. In diabetic patients a high consumption of alcohol was found to be associated with liver damage, including cirrhosis, and also with iron overload, but not with insulinopenia or steatorrhoea. Twelve of the 98 newly-diagnosed diabetic patients also had cirrhosis, and 14 had a raised serum iron concentration or saturation.

S. Afr. Med. J., **48**, 1115 (1974).

Diabetes mellitus often develops in the chronic alcoholic patient as a consequence of pancreatic[1] or liver damage[2] produced by alcohol *per se*, or by an accompanying over-consumption of iron.[3,4] This study was made to determine the importance of alcohol as a cause of diabetes in the Rhodesian Black population.

PATIENTS AND METHODS

One hundred and seven newly diagnosed diabetic patients were admitted to Harare Hospital in 1971; 9 patients died soon after admission and the remaining 98 (52 men and 46 women, aged 7 - 75 years) were studied in detail. All patients met the diagnostic criteria of the British Diabetic Association.[5] Insulin and growth hormone determinations on these patients have already been reported.[6] Sternal marrow iron[7] was determined in the first 19 diabetic patients and also in a contrast group (C) of 28 previously healthy people killed in road traffic accidents. Investigations included blood glucose (AutoAnalyser ferricyanide method) serum iron,[8] and iron-binding capacity,[9] serum transaminases,[10] cholesterol,[11] bilirubin, alkaline phosphatase and proteins.[12]

A careful history was taken of alcohol consumption (over the past 5 years) from the diabetic patients and also from two healthy contrast groups.

Group A were 52 men and 46 women who exactly matched the diabetic patients in age but not in weight. They were relatives of the hospital patients from a similar socio-economic group and taking a similar diet. Group B were 52 male factory workers who exactly matched the male patients in age, but not in diet, occupation, income or body weight.

A marrow iron grade of 4 or more, an iron saturation of 65% or more, or a serum iron concentration of 1,5 mg/litre or more was considered to be excessive. Increased serum transaminases (SGOT>12 milli-units/ml, SGPT>12 units/ml), alkaline phosphatase (>15 King-Armstrong units), or total bilirubin (>10 mg/litre) concentrations, or a decreased serum albumin concentration (<25 g/litre) were considered to indicate impaired liver function. A pretreatment, fasting blood glucose greater than 130 mg/100 ml was considered to be evidence of manifest diabetes.[2]

RESULTS

Alcohol consumption in the diabetic patient is shown to be significantly higher than in the contrast groups A and B in Table I and in Fig. 1. Although the contrast groups were not random samples from the population, similar proportions in each category for alcohol consumption were recently reported from a strictly random sample of 700 Blacks at Bulawayo.[13] Twenty-six diabetic patients habitually drank more than 500 ml of alcohol per week; 23 of them were men. All of them drank African home-brewed beer containing about 40 ml alcohol, 30 g starch and up to 352 mg iron per litre;[14] 55% of them also occasionally drank municipally-brewed or European beer containing 3 mg or less iron per litre. Before admission to hospital, they had all been drinking beer for many years, but symptoms of diabetes developed only within the previous 4 days to 6 months (median 1 month) before admission. They showed no obvious signs of malnutrition and their average weight for height was no less than for age- and sex-matched diabetic patients who

TABLE I. THE PERCENTAGE OF MEN HABITUALLY DRINKING BEER CONTAINING MORE THAN 500 ml ALCOHOL PER WEEK AND WOMEN DRINKING MORE THAN 150 ml ALCOHOL PER WEEK

	Male	Female
Diabetic patients (%)	**44**	**26**
Contrast group A (%)	**6(a)**	**6(c)**
Contrast group B (%)	**12(b)**	**—**

(a) = $P<0,0001$ against diabetic patients.
(b) = $P<0,01$ against diabetic patients.
(c) = $P<0,01$ against diabetic patients.

Godfrey Huggins School of Medicine, Salisbury, Rhodesia
A. C. B. WICKS,* M.D., M.R.C.P., *Consultant and Senior Lecturer in Medicine*
R. F. LOWE, M.R.C.S., L.R.C.P., D.C.P., D.T.M. & H., *Consultant and Honorary Lecturer in Pathology*
J. J. JONES, PH.D., M.B. B.S., B.SC., M.R.C.S., *Professor of Preclinical Studies*

Date received: 21 November 1973.
*Part of M.D. thesis, Birmingham University.

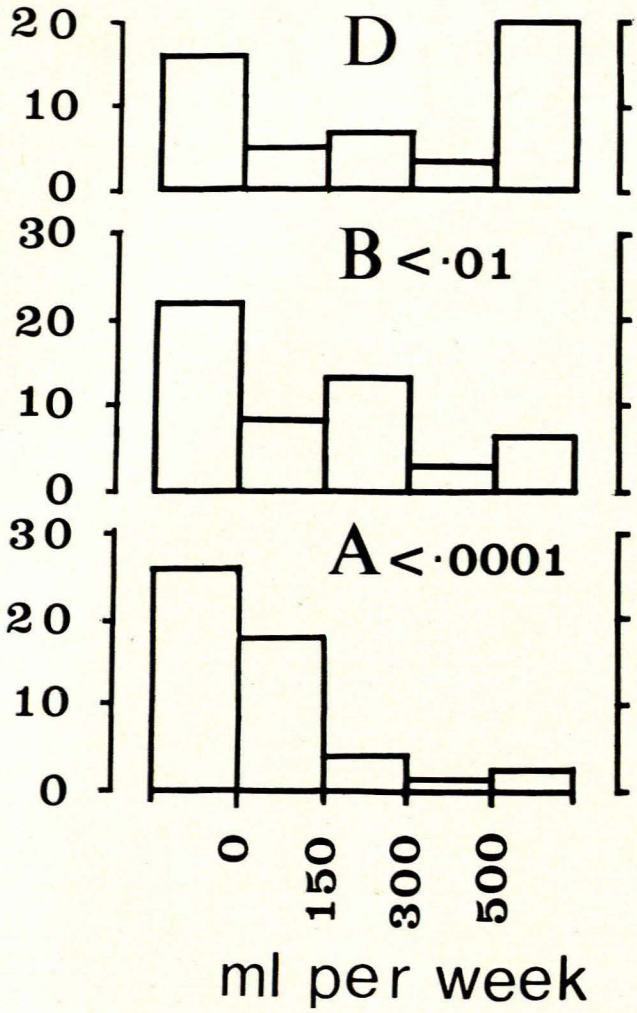

Fig 1. The number of male diabetic patients (D) and men in contrast groups A and B in each category for alcohol consumption from nil to over 500 ml per week.

did not drink alcohol (94% of desirable,[15] 76 - 105% median, 10th and 90th percentiles, compared with 87%, 78 - 117%).

None of the 5 patients with a family history of diabetes in this series drank more than 500 ml alcohol per week.

Table II shows that a high consumption of alcohol was associated with a high grade of bone marrow iron, with impaired liver function tests, with a high pretreatment fasting blood glucose and serum cholesterol[16] concentration, but not with deficient insulin secretion or with a high excretion of faecal fat. The details of the 20 diabetic patients with cirrhosis and/or excessive serum iron concentration or saturation are shown in Table III. Twelve of these patients habitually drank more than 500 ml alcohol per week, and 6 of them had both cirrhosis and an excess of iron, i.e. haemochromatosis. The cirrhotic patients had manifest diabetes mellitus with fasting blood glucose concentrations well over 130 mg/100 ml. Fifty-eight per cent of the diabetic patients had excessively high

TABLE II. CORRELATIONS BETWEEN ALCOHOL CONSUMPTION AND STERNAL MARROW IRON GRADE, ABNORMAL LIVER FUNCTION TESTS, FASTING BLOOD GLUCOSE AND SERUM CHOLESTEROL CONCENTRATIONS, FAECAL FAT EXCRETION, AND THE INCREASE IN SERUM INSULIN CONCENTRATION DURING A 50-g ORAL GLUCOSE TOLERANCE TEST

	r	*P*
Marrow iron	+0,48	<0,05
Liver functions	+0,66	<0,001
Glucose	+0,43	<0,001
Cholesterol	+0,29	<0,01
Faecal fat	+0,18	>0,05
Insulin secretion	+0,29	>0,05

TABLE III. DIABETIC PATIENTS WITH CIRRHOSIS AND/OR IRON OVERLOAD

Sex	Age (years)	Alcohol >500 ml per week	Serum iron (mg/L)	Saturation (%)		
M*	35	+	1,33	41		
M*	49	+	0,73	27		
M*	50	+	0,67	19		
F*	45	+	0,70	23		
F*	49	+	0,91	21		
M*	48	+	2,00	67		Cirrhosis
M*	50	+	2,52	100		
M*	53	+	2,36	72		
M*	66	+	1,66	56		
M*	59	0	2,35	52		
F	60	0	2,67	74		
M	20	+	2,19	85		
M	38	+	1,46	67	Iron Excess	
M	41	+	1,68	42		
M	15	0	1,84	52		No cirrhosis
M	22	0	1,60	76		
F**	9	0	2,00	67		
F	20	0	1,80	73		
F	55	0	1,58	37		
M*	61	0	1,20	40		Cirrhosis

* Porphyria cutanea tarda and impaired liver function.
** Schistosomal hepatic fibrosis.

iron grades (grades 4 - 6)[17] compared with 35% in contrast group C. When the patients were matched with contrast group C for sex and age, the median difference in grade was +3 ($0,05<P<0,1$). The marrow iron grade was significantly higher in male than in female diabetic patients (median grade 5 compared with grade 2, $P<0,01$) and the grade increased significantly with age ($r = +0,59$, $P<0,01$).

DISCUSSION

A far higher proportion of newly diagnosed diabetic patients habitually drank large quantities of alcohol than age- and sex-matched samples from the general population: this suggests that alcohol may be a cause of diabetes in Rhodesian Blacks. Since home-brewed beer contains up to 352 mg iron per litre, diabetes may be

the result of nutritional haemachromatosis,[18] particularly as an excessive iron content in the sternal marrow was found to be associated with high alcohol consumption. Impaired liver function tests and the development of cirrhosis were also related to the consumption of alcohol. Jackson,[19] however, suggests that when diabetes is associated with cirrhosis, it may not be the result of liver damage, but is often produced by concurrent alcoholic pancreatitis: alcohol being the *causa causans* of both diseases.

Porphyria cutanea tarda with characteristic pigmentation, hypertrichosis and heaped nailbeds occurred in all but 1 of the 12 cirrhotic and diabetic patients, giving a frequency of 11%, which is considerably higher than the 4% in Johannesburg Blacks.[20] The high proportion of Rhodesian Black diabetic patients with nutritional haemochromatosis (i.e. both cirrhosis and iron overload[18]) is similar to the frequency reported in both Johannesburg[4] and Ghana,[21] and is in striking contrast to the rarity of this disease in Western populations.[22]

The high fasting blood glucose concentration, which was found to be associated with the excessive consumption of alcohol, may be the result of insulin resistance[23] or of impaired peripheral glucose utilisation.[24]

We thank Dr J. I. Forbes, Professor M. Gelfand, Dr E. Taube, Dr W. M. Buchanan and Mr D. R. Barley for access to their patients and records, and the University of Rhodesia for a generous research grant.

REFERENCES

1. Marks, I. N. and Bank, S. (1963): S. Afr. Med. J., **37**, 1039.
2. Annotation (1967): Lancet, **1**, 35.
3. Seftel, H. C., Isaacson, C. and Bothwell, T. H. (1960): S. Afr. J. Med. Sci., **25**, 89.
4. Seftel, H. C., Keeley, K. J., Isaacson, C. and Bothwell, T. H. (1961): J. Lab. Clin. Med., **58**, 837.
5. FitzGerald, M. G. and Keen, H. (1964): Brit. Med. J., **1**, 1568.
7. Rath, C. E. and Finch, C. A. (1948): J. Lab. Clin. Med., **33**, 81.
6. Wicks, A. C. B. and Jones, J. J. (1973): Brit. Med. J., **1**, 773.
8. London, M. and Marymont, J. H. (1965): Clin. Chim. Acta, **12**, 227.
9. Ramsay, W. N. M. (1957): *Ibid.*, **2**, 221.
10. Reitman, S. and Fraenkel, S. (1957): Amer. J. Clin. Path., **28**, 56.
11. Watson, D. (1960): Clin. Chim. Acta, **5**, 637.
12. Wooton, I. D. P. (1964): *Micro-analysis in Medical Biochemistry*, 4th ed. London: Churchill.
13. May, J. (1970): *Survey of Urban African Drinking Patterns in the Bulawayo Townships*. Occasional paper. Salisbury: University of Rhodesia.
14. Buchanan, W. M. (1967): *Bantu Siderosis with Special Reference to Rhodesian Africans*. Faculty of Medicine Research Lectures Series No. 1. Salisbury: University College of Rhodesia.
15. Diem, K. and Lentner, C. (1970): *Scientific Tables*, 7th ed., p. 712. Basle: Geigy.
16. Grande, F., Hay, L. J., Heupel, H. W. and Amatuzio, D. S. (1960): Circulat. Res., **8**, 810.
17. Finch, S. C. and Finch, C. A. (1955): Medicine, **34**, 381.
18. MacDonald, R. A. (1964): *Hemochromatosis and Hemosiderosis*, 1st ed. Springfield, Ill.: C. C. Thomas.
19. Jackson, W. P. U. (1964): *On Diabetes Mellitus*, 1st ed., p. 81. Springfield, Ill.: C. C. Thomas.
20. Keeley, K. J. (1962): S. Afr. Med. J., **36**, 602.
21. Dodu, S. R. A. (1958): Trans Roy. Soc. Trop. Med. Hyg., **52**, 425.
22. Marble, A. and Bailey, C. C. (1951): Amer. J. Med., **11**, 590.
23. Phillips, G. B. and Safrit, H. F. (1971): J. Amer. Med. Assoc., **217**, 1513.
24. Dornhorst, A. and Ouyang, A. (1971): Lancet, **2**, 957.