

Ketoacidosis in Ethiopian Diabetics*

Frances T. Lester

Department of Medicine, Yekatit 12 Hospital, Addis Ababa, Ethiopia

Summary. The clinical features of 44 episodes of diabetic ketoacidosis in 34 Ethiopians were similar to those reported from other nations. The mortality was only 9.1%, even though serum potassium, bicarbonate and pH could not be measured. Although 3 patients were new diabetics, and the cause was not found in 7, most cases resulted from omission of insulin (43%) or intercurrent illness (28%). Socioeconomic factors, particularly the cost and unreliability of insulin supplies, are major obstacles to the control of diabetes and the prevention of ketoacidosis in Ethiopian patients.

Key words: Diabetic ketoacidosis, Ethiopia.

About 3% of admissions to medical wards in Ethiopian hospitals are due to diabetes mellitus [1], but no information is available about diabetic ketoacidosis in Ethiopians. In fact, there is little published information about the incidence or outcome of diabetic ketoacidosis in African, Middle Eastern, and Asian countries, and the present study was undertaken to describe the clinical features and prognosis in Ethiopian diabetics.

Patients

Clinical records of patients with diabetic ketoacidosis admitted to the medical wards of Yekatit 12 Hospital, a 300 bed general hospital in Addis Ababa, between early 1976 and mid 1979 were studied. Cases were traced from the records of the author's ward (26 in 2042 admissions) and from the weekly statistics of the Department of Medicine (a further 18 in 3490 admissions). A few

patients had repeated episodes. Thus, 44 episodes of ketoacidosis in 34 patients were studied.

Arterial pH, serum bicarbonate and serum potassium cannot be measured in this hospital. Therefore, diabetic ketoacidosis was defined as an acute illness due to insulin deficiency in a diabetic characterized by hyperglycaemia, impaired consciousness (drowsiness to coma), dehydration, acidotic breathing, and acetone in the urine and on the breath.

About one third of episodes were treated in the 14 bed intensive care unit where there is at least one graduate nurse throughout the 24 hours. The rest were treated in the general medical wards where there are usually one or two nurses for 30 to 40 patients during the day, and only one nurse for half the hospital at night. Laboratory services at nights and on weekends are very limited, and requesting blood glucose determination oftener than twice in 24 hours unreasonable. Dextrostix R (Ames) very expensive in Ethiopia, is usually unavailable, and even Clinitest R (Ames) is often in short supply.

Results

1. Clinical Features of Patients. These are presented in Table 1. Thirteen of the 34 patients had "poverty certificates" allowing free treatment: these usually indicate a total family income of less than U.S. \$15 monthly.

2. Precipitating Factors. Only 3 patients were previously undiagnosed diabetics. A misguided attempt at treatment with oral hypoglycaemic agents preceded 4 episodes, and intercurrent illness was responsible in 15, but no precipitating cause was identified in 7.

In 19 of the 44 episodes (43%) the most important precipitating factor was omission of insulin, the error being chiefly the patient's in 11 instances, the health services' in 7, and due to imprisonment in 1. The commonest reason for omission of insulin was inability to obtain it, either because the patient could not afford it and failed to acquire a poverty certificate, or because the health centre or hospital nearest his home had no insulin.

* Presented at the 15th Annual Conference of the Ethiopian Medical Association, May 1979

Table 1. Clinical features of 34 Ethiopian diabetics admitted in ketoacidosis

Clinical feature	Age			
	Less than 20 years	20-39 years	40-59 years	Over 60 years
Number of patients	15	10	7	2
Male:Female	3:12	7:3	1:6	2:0
Duration of diabetes				
- New	2	0	1	0
- 1-5 years	10	7	3	1
- 6-10 years	1	2	2	1
- More than 10 years	2	1	1	0
Obese	0	0	0	0
Prescribed treatment				
- None	2	0	2	0
- Oral therapy	0	1	3	1
- Insulin	13	9	2	1
Previous episodes of ketoacidosis	8	3	1	0
Complications of diabetes				
- Retinopathy	0	1	1	0
- Neuropathy	0	1	2	1
- Nephropathy	1	1	2	0
- Cataracts	0	0	2	1
- "Diabetic dwarf"	1	0	0	0
Deaths	1	2	0	1

Table 2. Initial findings in 44 episodes of ketoacidosis in Ethiopian diabetics

	Neurological status			
	Drowsy	Confused + restless	Stuporous	Comatose
Number	20	12	6	6
Systolic B.P. < 90 mmHg	1	2	1	2
Mean pulse rate (beats/min)	122	136	133	143
Blood glucose (mg/100 ml)				
- Mean	549	674	580	706
- Range	350-820	440-900	470-880	424-1280
Mean blood urea (mg/100 ml)	17	33 ^a	26	53
Ketoacidosis due to omission of insulin	7	5	3	4
Total dose crystalline insulin in first 24 hr (units)				
- Mean	88	96	117	110
- Range	30-150	36-155	95-160	95-150
Deaths	0	1	1	2

^a excluding one patient with chronic renal failure

3. *Presenting Features.* These, with admission laboratory data, are summarized in Table 2. Serum electrolytes could not be measured.

4. *Treatment.* All patients were treated with crystalline insulin intravenously and subcutaneously, the dose chosen according to the patient's clinical condition and known previous insulin requirement, along the guidelines given by Steinke and Soeldner [2]. Further intravenous and subcutaneous doses of insulin were given four hourly in accordance with the patient's clinical response, and the urine glucose and acetone content. The average dose of insulin given to survivors during the first 24 h was 99 units, ranging from 30 (a 5 year old child) to 160 units.

Initial intravenous fluid for all was normal (0.154 mol/l) saline, followed later by 5% dextrose in water when the patient's clinical condition was improving and the blood glucose level had decreased. Forty mmol potassium, and 50 ml of 7.5% sodium bicarbonate (45 mmol) were added to the first litre, and 20-40 further mmol potassium given during the first 24 h. Patients received 4 to 6 l of intravenous fluid in the first 24 h.

5. *Outcome.* All survivors, except one taken home in poor condition against medical advice, were alert and able to take fluids orally within 24 to 36 h of admission, and the mean duration of hospitalization was 14 days.

There were 4 deaths, a mortality of 9.1%. Two were deeply comatose, and one stuporous, on admission. A 32 year old farmer admitted in deep coma because insulin was unavailable in his local health centre died of bilateral bronchopneumonia. In a 20 year old girl, suspected criminal abortion and profound shock contributed to death in deep ketoacidotic coma. A 64 year old insulin dependent diabetic recovered from his ketoacidosis, but in spite of good control of blood glucose had continued vomiting, abdominal pain, hypotension and a serum amylase of 1300 IU/l: he died in shock presumed due to pancreatitis but, as is usual for cultural reasons when Ethiopians die, autopsy was not obtained. An 18 year old boy stopped insulin for unknown reasons, and died within 12 hours of admission, no other illness except ketoacidosis being found.

Discussion

The clinical features of diabetic ketoacidosis in these Ethiopian diabetics conform to textbook descriptions, and, as expected, there were many more episodes in young diabetics.

The mortality of diabetic ketoacidosis in most centres ranges from 5 to 15% [3], and the Joslin

Clinic estimates that, even with the best of treatment, diabetic ketoacidosis has an irreducible minimum mortality of 3.4% [4]. Biegelman, reporting a 9% mortality in 340 episodes, emphasized that death is more likely when ketoacidosis is complicated by infection, myocardial infarction or pancreatitis [5]. The mortality of 9.1% in this study is within the expected range for developed countries, the same as reported from Thailand [6], and much less than the 36% reported from Jakarta, Indonesia [7]. This mortality rate is unexpectedly low for a small Ethiopian hospital, where modern intensive biochemical monitoring is impossible, probably due to the youth of most patients, and the low incidence of severe complicating illness. It does demonstrate that most episodes of diabetic ketoacidosis, at least in young patients with no other disease, can be managed successfully without the intensive care and frequent biochemical studies considered mandatory in a Western hospital.

In previously reported series, mean insulin requirements in the first 24 hours have been 148 to 1200 units, 540 in one large series [5]. The mean in this group was lower, 99 units, and although the recently described low dose insulin regimes [8] were not used, insulin doses given were conservative because of fear of hypoglycaemia in this setting of understaffed wards and infrequent blood glucose determinations. The low dose continuous intravenous regime [3] is impossible in an Ethiopian hospital because syringe pumps and modern paediatric infusion sets are unavailable. The low dose intramuscular regime has been found simple and effective [3] and warrants a trial in small poorly equipped hospitals.

The most important causes of diabetic ketoacidosis in developed countries are intercurrent illness and omission of insulin [5], as found also in Thailand [6] and in this study. Although some episodes occur in undiagnosed diabetics, or for unidentified or unpredictable reasons, it has been estimated by the Joslin Clinic that two-thirds or more of all episodes are preventable [4].

With this in mind, and noting that 43% of these episodes were directly related to omission of insulin in known diabetics, it is important to note some of the problems facing the Ethiopian diabetic. In overworked, understaffed hospitals, the education of the diabetic is almost certain to be inadequate, and follow-up arrangements are often erratic. Until recently dietary instruction was absent or given by foreigners who did not consider local habits and foods. However, the Ethiopian Nutrition Institute is beginning to develop simple diets and exchange lists based on the

least expensive local foods, and such a diet has already been quite successful with teenage and juvenile diabetics attending Yekatit 12 Hospital Diabetic Clinic [9]. The other major problem facing the Ethiopian diabetic is obtaining insulin, either because of financial difficulties [10], or because insulin is simply not available in rural hospitals and clinics, as noted in Rhodesia [11]. Socioeconomic factors are major obstacles to attaining good control [10], and thus to preventing ketoacidosis, in Ethiopian diabetics. Forty units daily of a long-acting insulin cost twenty to thirty Ethiopian Birr monthly (U.S. \$10 to \$15), most Ethiopians earn less than 100 Birr monthly, but free treatment is usually not granted unless income is below 30 Birr.

References

1. Lester FT, Abdulkadir J, Larson D, Quanaa P (1976) Diabetes mellitus – Clinical features in 404 Ethiopians. *Ethiopian Med J* 14: 185–198
2. Steinke J, Soeldner JS (1977) Diabetes mellitus. In: Thorn GW, Adams RD, Braunwald E, Isselbacher KJ, Petersdorf RG (eds) *Harrison's Principles of internal medicine*, Chap 95. Mc Graw-Hill Kogakusha Ltd, Tokyo
3. Alberti KGMM, Hockaday TDR (1977) Diabetic coma – A reappraisal after five years. *Clin Endocrinol Metab* 6: 421–455
4. Bradley RF (1971) Diabetic ketoacidosis and coma. In: Marble A, White P, Bradley RF, Krall LP (eds) *Joslin's diabetes mellitus*, Chap 14. Lea and Febiger, Philadelphia
5. Biegelman PM (1971) Severe diabetic ketoacidosis (Diabetic "coma"). *Diabetes* 20: 490–500
6. Tandhanand S, Inthuprapa M, Vanasaeng S (1978) Special problems in the management of diabetic ketosis in Asia. In: Bajaj JS (ed) *Diabetes*. Int Congr Ser. Excerpta Medica, Amsterdam
7. Supartondo, Suyono S, Sukatono U (1976) Some aspects of ketoacidosis in a General Hospital in Jakarta. In: Babe S, Got Y, Fukui I, Ebling FSG, Henderson IW (eds) *Diabetes mellitus in Asia*. Excerpta Medica, Amsterdam Oxford
8. Kreisberg RA (1978) Diabetic ketoacidosis – New concepts and trends in pathogenesis and treatment. *Ann Intern Med* 88: 681–695
9. Lester FT (in press) Juvenile diabetes mellitus in Ethiopians. *Trans R Soc Trop Med Hyg*
10. Lester FT, Demissie Y (1977) An assessment of diabetic control in Ethiopians attending a Diabetic Clinic. *Ethiopian Med J* 15: 133–140
11. Levin L, Gelfand M (1974) The risks associated with treatment in the African diabetic. *J Trop Med Hyg* 77: 139–142

Received: July 19, 1979
and in revised form: December 13, 1979

Dr. Frances T. Lester
Box 30432
Addis Ababa
Ethiopia