Pilot Study of Self-Measurement of Blood Glucose Using the Dextrostix-Eyetone System for Juvenile-Onset Diabetes

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Summary. Self-measurement of blood glucose was performed by eight insulin-dependent juvenile-onset diabetics. The patients were well motivated and improved control of diabetes was obtained. The method would seem to be useful for juvenile-onset diabetics, especially of the unstable type and for pregnant diabetics.

Key words: Juvenile-onset diabetes, blood glucose, self-measurement, Dextrostix-Eyetone system, patient education.

Materials and Methods

Subjects comprised 8 insulin-treated juvenile-onset diabetics (male 5, female 3). Table 1 shows their details.

Blood was taken from earlobes or finger-tips by needle puncture. Blood glucose was checked using the Dextrostix-Eyetone System (D-E system) by patients themselves.

After the patients became used to operating the instruments, they started checking their fasting blood glucose (FBG) daily for the first three months and then three times weekly. Occasionally, post prandial blood glucose levels were also measured. Patients visited the Out-Patient Clinic every 2 weeks. Patients and their family, doctors and technicians also met once every three months for discussion.

Diabetic control was evaluated by the mean value of FBG and its standard deviation. $FBG \pm SD$ was calculated at 2 monthly intervals and compared with that of the previous year, which was chosen as a control. Changes of body weight and dosage of insulin were also recorded. The Eyetone instruments were provided by courtesy of Ames Company for 5 patients.

Results

1. The Reliability of D-E System

The accuracy of the D-E system has been reported [1, 2]. We made a comparison between blood glucose Eyetone results and those obtained with the auto-

The Dextrostix-Eyetone System is a simple and reliable method of blood glucose measurement [1]. This study was performed to evaluate the effect of self-measurement on control of diabetes. We started the trial with the view that better control of diabetes would be obtained by giving the responsibility to the patients.

Table 1. Clinical profile of the patients

Patient	Age/Sex	Duration (years)	Hight (cm)	Body weight (kg)	Insulin dose (units/day)	Social status
1.	18/M	3	173	47	Lente 32	Student
2.	24/F	15	148	44	Lente 56, Act 24	College Graduate
3.	20/F	8	156	60	Lente 44, Act 12	College Graduate
4.	46/M	19	158	42	Lente 20, Act 12	Teacher
5.	26/M	12	167	59	Lente 56, Rap 28	Teacher
6.	27/F	5	153	53	Lente 16	House Wife
7.	39/M	11	163	48	Lente 16	Office Worker
8.	24/M	11	165	46	Lente 40	Student

analyzer ferricyanide reduction method [3]. A positive correlation was found ($r = 0.96$). The value measured by the D-E system was slightly higher when it exceeded 200 mg/dl [4].

A second check was also performed: two hours after a meal, blood was taken 3 times consecutively by a technician and blood glucose was measured by autoanalyzer. At the same time, patients took blood and measured glucose with the D-E system. The results are summarized in Table 2. Although the difference between the two methods became slightly greater when the value exceeded 300 mg/dl, the patients' own measurements showed little variation.

2. Self-Measurement of Blood Glucose and Clinical Course of Diabetes

Table 3 shows the mean value and standard deviation of FBG level by D-E system at 2 monthly intervals.

Table 2. The validity of measurement of blood glucose level by the patients using the D-E system and comparison with that by A-A method

Patient	Blood glucose level by D-E system and A-A method				
	Method	3 Measurements (mg/dl)			Average
1.	D-E	350	350	330	343
	A-A	308	317	323	316
2.	D-E	330	350	340	340
	A-A	314	313	322	316
3.	D-E	270	280	280	277
	A-A	264	260	265	263
4.	D-E	240	210	210	220
	A-A	207	201	209	206
5.	D-E	220	220	205	215
	A-A	215	209	217	214
6.	D-E	170	170	150	163
	A-A	146	158	154	153
7.	D-E	120	130	130	127
	A-A	129	131	133	131
8.	D-E	115	130	108	118
	A-A	100	99	100	100

Table 3. Changes of FBG level during the test period

Patient	FBG (mg/dl)						
	pre	2	4	6	8	10	12 months
1.	158± 43	205±37	127±42	120±36	118± 33	113± 23	118±25
2.	386±127	330±96	324±89	311±54	234±111	177±127	181±51
3.	196± 62	145±45	151±50	155±48	131± 42	106± 33	117±28
4.	210± 54	190±86	145±70	114±49	70± 16	118± 28	106±45
5.	159± 49	154±18	149±23	153±24	162± 39	143± 22	149±14
6.	119± 13	135±37	85±10	95± 9	162± 39	120± 24	96±15
7.	108± 14	115±13	125±13	103±23	77± 13	87± 20	90±16
8.	315± 50	214±65	226±66	201±59	228± 58	280± 52	—

The FBG level after 6 months reached the desirable level in 4 of 8 cases. After one year, diabetes was well controlled with FBG of less than 120 mg/dl in 5 of 8 cases. Body weight did not change significantly except in Case 1, who gained 7 kg weight up to 54 kg.

3. Evaluation of Self-Measurement of Blood Glucose

According to the data obtained we have evaluated this method and summarized as follows;

1) Patients were motivated to maintain their blood glucose within normal range by the frequent checking of blood glucose. Consequently, they became eager to regulate their daily life. This positive attitude was observed in all cases.

2) The method encouraged patients to become more involved in dietary control.

3) Since blood glucose and urine glucose level can be checked simultaneously, the relationship between the two became obvious.

4) As they checked blood glucose every day instead of once per fortnight, more information on diabetic control became available which facilitated proper insulin dosage. Adjustment of insulin dosage could be made with confidence.

5) Metabolic disorder could be normalized quickly.

Discussion

Among the various indices available, blood glucose, especially the fasting level, is said to be the most useful indicator of metabolic status even in juvenile onset diabetes. It should be checked more frequently and more accurately. At best in the diabetes clinic, FBG is measured only once each fortnight. Young diabetics, especially unstable cases, cannot be controlled well by this kind of management.

Self-measurement of blood glucose, using the D-E system, gave unexpectedly good results. This might partly be due to the careful selection of the subjects,

choosing patients who were intelligent and skilful in using the instruments. The patients did not become anxious; in fact, the better the control of blood glucose, the happier the patients.

The method would seem to be useful for insulin-dependent juvenile-onset diabetics, especially of the unstable type, and during pregnancy.

Having finished this pilot study of one year, we feel that the development of a more simple and reliable instrument should be pursued, the cost should be lowered and that painless needle puncture should be developed.

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