

A Multidisciplinary, Comprehensive, Ambulatory Treatment Scheme for Diabetes Mellitus in Children

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A study has been carried out on 262 children with juvenile diabetes and their parents, treated up to 10 yr on an ambulatory basis by a multidisciplinary team composed of pediatric endocrinologist, nurse, dietitian, psychologist, and social worker. Comparison of the findings with those of a study performed before inception of the Counselling Center for Juvenile Diabetics revealed the following positive influences: the degree of control attained was both higher and sustained with greater regularity; there were fewer complications with no episodes of coma, brittle diabetes, or severe ketoacidosis and almost no need for hospitalization; the attitude of the affected child, his parents, and his teachers was found to be considerably improved; there was better understanding of the nature of the disease and its requirements; the child's motivation to maintain the diabetic regimen was greater and conflicts within the family circle were markedly reduced; the child's self-concept was much higher; and both scholastic achievements and social adjustment were greater. We concluded that psychological stability is a basic factor in the control of diabetes, and the value of the multidisciplinary approach in the treatment of this chronic disease is indicated. *DIABETES CARE* 2: 342–348, JULY–AUGUST 1979.

Diabetes mellitus, in its complexity and difficulty of management, constitutes one of the most challenging chronic diseases encountered in childhood.^{1,2} It is also one of the most common, having been reported variously as occurring in from 1 in 600 to 1 in 1200 children under the age of 16.^{3–6} This peculiar disease, or perhaps group of diseases,^{7,8} is both acute and chronic and also falls within the category of a somatopsychic disease.⁹

Many years ago we became aware of the shortcomings of the accepted therapeutic approach, i.e., handling diabetes strictly on a medical basis, and in 1966 we initiated a study on the rehabilitation needs of these patients.¹⁰ We concluded that the treatment of juvenile diabetes is too complex a matter to be handled solely on a medical basis. It became obvious that these youngsters carry a particularly heavy burden. They must not only learn to accept the fact that they are different from their peers, but must coordinate the demands of their social framework (family, school, place of employment) with those of the diabetic regimen (daily insulin administration, maintenance of a diet, and performance of urine examina-

tions). It became clear that the needs of these youngsters might best be met by a multidisciplinary team. This change in approach led to the establishment of the Israel Counselling Center for Juvenile Diabetics.^{2,11–16}

The Center team comprises a pediatrician, a nurse, a dietitian, a social worker, and a psychologist. On the day of admission, the patient and his parents are seen by the physician who evaluates the state, confirms the diagnosis, and outlines the therapeutic approach. On the same day the family is seen by the dietitian, the nurse, and a member of the psychological team. This intervention is performed on an ambulatory basis. Attention is paid to the cultural and educational background of the patient's family and the psychosocial and economic state.

One of the most important factors in the long-term management of diabetes in growing youngsters is the regulation of follow-up. Patients may therefore be seen as often as once a week and at least once every 3 mo, in accordance with need. The staff is available on a 24-h basis. The importance of the urine test as a simple indicator of the degree of control attained is stressed;^{15,16} it is advised that

testing be done three times a day using the two-drop Clinitest method; but it should be noted that, particularly during puberty, there are apt to be periods of refusal to comply with this requirement.

Adherence to an appropriate diet is an important part of the diabetic regimen. The physician, nurse, and dietitian work together to attain an ideal diet, taking into account the amount of physical exercise usually performed, family habits, and ethnic peculiarities. Individuals are taught with plastic models as well as slides. For group teaching, there are food exhibits, a demonstration kitchen, and written materials.¹³⁻¹⁶

Counselling and educational activities play a prominent role in the management of the diabetic youngster and the guidance of his family. At each visit, in addition to the medical check-up, the patient and his parents are counselled by either a psychologist or a social worker. Classes are held three times a week at the clinic. These can be attended while the patient is awaiting examination. There are also monthly meetings and discussion groups: some for both parents and children, and others for youngsters alone, the latter aimed at various age groups.² Genetic counselling and vocational guidance are among other services offered. The staff also meets with school personnel and employers, usually at the Center itself. This provides a system of continuous education.

Parents of a diabetic child who have a positive adjustment to their child's illness may serve as volunteer workers. They are helpful in making contact with new families, giving personal advice, and constituting a connecting link with the Center,¹⁷ particularly for families who have neither a car nor a telephone. In the same way, adolescent patients may counsel younger patients.

Having gained 10 yr of experience with the above system, we have performed a systematic evaluation of the effectiveness of this multidisciplinary approach to the treatment and rehabilitation of youth with diabetes. This report presents part of that review.

SUBJECTS AND METHODS

Prior to the establishment of the Center, we cared for 110 diabetic youths. Subsequently, the number of patients progressively increased. The patients comprise two groups: those who are under our permanent care and those primarily treated elsewhere who occasionally receive specific psychosocial counselling from us. 262 patients (131 females and 131 males) who have been followed regularly and uninterruptedly by our team since their initial referral, have been seen at least once every 3 mo, and have regularly performed urine tests three times daily on most days are summarized in this report.

At each of the follow-up visits, all patients undergo a thorough investigation, which includes a detailed history, physical examination, urinalysis, and two determinations of blood glucose, one in the morning and one at noon.

Neurologic and ophthalmologic examinations, as well as an electroencephalogram, are performed annually. Psychological evaluations are carried out at regular intervals.

In 1966 we performed a psychosocial study of the 110 patients and families treated by us at that time.^{10,18} The research was directed towards the intellectual capacity and emotional adjustment of the diabetic patient himself, his relationship with the family, and the reactions of the family towards the disease. Of these patients, 28 were retested in 1976. In addition, we submitted the same questionnaires to 28 new patients who had been diagnosed and treated for at least 2 yr at the Center by the multidisciplinary team, and to their parents. These patients were matched, according to socioeconomic class, sex, and age at diagnosis, to the 28 patients from the original group retested in 1976.

The criteria for medical control (balance) used in this survey are: "Good": Little or no excretion of sugar, as evidenced by the three daily urine examinations, and 24-h urine sugar excretion of less than 30 g; average blood glucose levels below 200 mg/dl; no episodes of ketosis. "Fair": Same as good but with infrequent episodes of imbalance. "Bad": Daily urine sugar excretion of more than 50 g; average blood glucose above 250 mg/dl. "Very bad": Same as bad but with frequent fluctuations between hyperglycemia, ketosis, and hypoglycemia.

Statistical evaluations were made using Student's *t* test, Fischer's binomial test, and chi-square analysis.¹⁹

RESULTS

Medical Aspects

On the basis of concentrations of blood and urinary glucose and their oscillations, the multidisciplinary approach has generally led to better control. During the past 10 yr we have not encountered a single case of coma or of brittle diabetes (patients oscillating from hypoglycemia to hyperglycemia and difficult to manage), and none of our patients have developed severe ketoacidosis.

Table 1 gives the complications found in the group in relation to duration of the disease. Three patients with unusual forms of diabetes accompanied by eye pathology were not included in the 262 patients selected for this study, since the findings manifested did not appear to have been directly related to the course of the disease. These patients included two male siblings with dwarfism and optic atrophy²¹ and one male with the Prader-Willi syndrome who developed retinopathy after 6 yr of the disease.²² The sex distribution in the nine patients with retinopathy was five male and four female.

From Table 2, which gives the prevalence of complications in the group of 262 patients studied in relation to the degree of control attained, it can be seen that both early and late complications are generally fewer in those with consistently

TABLE 1

Number of patients with complications among 262 diabetic children and adolescents followed at the Israel Counselling Center for Juvenile Diabetics

Complications	Duration of diabetes (yr)				Total
	0-5	5-10	10-15	15	
No. of patients:	122	86	36	18	262
Severe ketoacidosis, coma, brittle diabetes	—	—	—	—	0
Slowing of growth	10 (8.2)	4 (4.6)	1 (2.8)	—	15 (5.7)
Vulvovaginitis*	4 (3.3)	3 (3.5)	—	1 (5.5)	8 (6.0)
Hypertriglyceridemia	3 (2.4)	8 (9.3)	—	1 (5.5)	12 (4.6)
Liver involvement	1 (0.8)	—	—	—	1 (0.4)
Neuropathy	1 (0.8)	3 (3.5)	1 (2.8)	—	5 (1.9)
Dermatologic changes	1 (0.8)	5 (5.8)	2 (5.5)	—	8 (3.0)
Albuminuria†	—	—	—	2 (11.1)	2 (0.8)
Myocardial conduction disturbance	—	—	—	1§ (5.5)	1 (0.4)
Retinopathy	1 (0.8)	—	4 (11.1)	4 (22.2)	9 (3.4)
Hospitalization	5 (4.1)	15 (17.4)	7 (19.4)	3 (16.7)	30 (11.4)

As the multidisciplinary approach was initiated 10 yr ago, only the first two columns include patients treated exclusively at the Center. Numbers in parentheses represent percent of patients.

* Incidence calculated per 131 female patients.

† The presence of albumin in the urine was tested by the sulfosalicylic test.²⁰

§ Transient first degree A-V block and RBBB, with anginal attack.

good control. Among other factors, the infrequent need for hospitalization, an index for the severity of the patients' condition, is striking. Comparing the patients with good and fair control with those with bad control, we found no difference in age, sex, or number of visits to the clinic.

In relation to the degree of control maintained over most years of follow-up, there is a remarkable difference between the children who had received the benefit of the multidisciplinary approach from the very beginning and those who had initially been treated elsewhere by a physician and nurse

TABLE 2

Prevalence of complications in 262 diabetic children and adolescents as related to degree of control

Complications	No. of patients: M/F	Control of diabetes			
		Good	Fair	Bad	Very bad
		99 (37.8)	72 (27.5)	73 (27.9)	18 (6.9)
		50/49	36/36	37/36	12/6
Coma		—	—	—	—
Slowing of growth	15	2 (2.0)*	2 (2.8)	10 (13.7)	1 (5.5)
Vulvovaginitis	9	2 (4.1)	2 (5.5)	5 (13.8)	—
Hypertriglyceridemia	12	4 (4.0)	2 (2.8)	5 (6.8)	1 (5.5)
Liver involvement	1	—	—	—	1 (5.5)
Neuropathy	5	—	—	5 (6.8)	—
Dermatological changes	8	3 (3.0)	2 (2.8)	3 (4.0)	—
Albuminuria	2	1 (1.0)	1 (1.4)	—	—
Myocardial conduction disturbance	1	1 (1.0)	—	—	—
Retinopathy	9	1 (BDR ₁) (1.0)	1 (BDR ₁) (1.4)	6 (4BDR ₁ and 2PDR) (8.2)	1 (PDR) (5.5)
Hospitalization	30	—	2 (2.8)	12 (16.4)	16 (88.9)

M/F, males/females; BDR₁, background diabetic retinopathy without macular edema; PDR, proliferative diabetic retinopathy.

* Numbers in parentheses are percent of patient group.

TABLE 3

Comparison of degree of control attained in patients treated from onset of diabetes by a multidisciplinary team and in patients initially treated strictly on a medical basis (conventional method)

Degree of control maintained after several years of follow-up	No. of patients treated during initial 6–12 months	
	Multidisciplinary method	Physician-nurse alone
Good	57	41
Fair	44	29
Bad	38	53
Total	139	123
$\chi^2 = 7.37$	$P < 0.05$	

alone (conventional method) for periods ranging from 6 to 12 mo. As can be seen from Table 3, out of 139 children treated from the beginning by the multidisciplinary method, 101 (72.5%) maintained good or fair diabetes control; whereas, out of 123 children who had received their initial treatment elsewhere, only 70 (57%) reached the same level of control, despite multidisciplinary treatment after the initial conventional approach.

Psychological Aspects

Analysis of the various psychological aspects also revealed a significant difference between the children who from inception of the disease had been treated within the framework of the multidisciplinary program and those who had not.

TABLE 5

Rank order of 10 aspects of diabetes, rated by the juvenile diabetic patient, mother, and father in terms of "degree of bothersomeness"*

	Treated before establishment of Center and under our care from 1966 to 1976				Treated at Center by multidisciplinary team from onset of diabetes for at least 2 yr		
	1966			1976† Pt.	1976		
	Pt.	M	F		Pt.	M	F
	n = 110 (28)†			28	28	28	28
Injections	1 (1)	2	2	1	2	1	1
Weakness	2 (2)	3	3	3	1	6	8
Fear of future limitations in occupational choice	3 (5)	5	6	6	8	8	6
Feeling of being different from others	4 (4)	6	5	10	10	10	10
Dietetic limitations	5 (3)	4	4	4	6	3	4
Fear of possible complications	6 (6)	1	1	2	5	4	3
Need of meals at regular times	7 (7)	9	9	5	9	9	5
Urine testing	8 (8)	8	8	7	3	2	2
Fear that others know about your diabetes	9 (9)	7	7	9	7	7	9
Having to record results of urine testing	10 (10)	10	10	8	4	5	7

Pt., patient; M, mother; F, father.

* These figures represent the rank order of the calculated means of individual ratings.

† Same patients examined in 1966 and 1976. The group in parentheses is part of the 110 patients.

TABLE 4

Parental evaluations of child's physical, social, and emotional status

	1966 Treated before establishment of Center (n = 110)	1976 Treated at Center by multidisciplinary team from onset of diabetes for at least 2 yr (n = 28)	Statistical significance
Excellent physical health	73%	85%	NS
Excellent social adjustment	57%	86%	$P < 0.01$
Excellent mental health	31%	67%	$P < 0.001$

Evaluating the relationship between the diabetic child and his parents by using a prestructured questionnaire answered by both parents separately,¹⁸ we found an improvement in the intrafamilial relationship. The parents found the child less difficult to manage and less bothersome ($P < 0.001$). There was also a significant improvement of the child's physical, social, and emotional status (Table 4). In this respect, the possible influence of duration of the disease can be excluded, as proved by the fact that the children who from the beginning received psychological counselling consistently showed good scores in their tests, both during the early stages of the disease and subsequently.

A comparison of the way in which the patient and his parents rank the degree of bothersomeness of various aspects

TABLE 6

Comparison of daily habits of diabetic children in 1966 (n = 110) and 1976 (n = 28)

	1966 (%)	1976 (%)	Statistical signif- icance
Urine examinations three times a day	19	68	$P < 0.001$
Carry sugar with them	41	80	$P < 0.01$
Rotate site of injection	61	76	NS

of diabetes gave us another means of evaluating the results obtained (Table 5). This table shows the mean rank order of 10 aspects of diabetes in terms of "degree of bothersomeness" as perceived by the original group of 110 juvenile diabetic patients and their parents investigated in 1966, and 28 of these patients as reevaluated in 1976. For comparative purposes the data of these 28 patients is shown separately for 1966 and a new group of 28 patients treated in 1976 for at least 2 yr by the multidisciplinary method was also investigated. It is noteworthy that the mean rank order in 1966 of the 28 patients subsequently reexamined is almost identical with the mean rank order of the whole group of 110 juveniles. In 1966 the parents of the 110 diabetic children investigated ranked the fear of future complications as no. 1, or the most bothersome, while the children ranked it as no. 6. This illustrates the gap in perception between the far-seeing parents and the child, who was more concerned with day-to-day problems and placed the injection and his fear of hypoglycemia at the top of the list. In 1976, the difference in perception was found to be considerably lessened. Such factors as the fear of possible complications, future limitations in occupational choice, and having others learn of the disease, have all been ranked much lower, both by patients and parents. Particularly striking is the feeling of being different from others, which constitutes the keystone for the child and his parents in their daily coping with the disease. While this in 1966 was ranked quite high on the list, in 1976 it is consistently ranked as the least bothersome by all concerned. This reflects the continuous guidance and counselling given at the Center throughout the years, which has also contributed to eliminating the frequent conflicts previously generated between the patient and his parents.

Of interest is the difference in attitude and sense of responsibility of the children due to the multidisciplinary treatment. This is seen in the fact that, while the injection is almost always ranked first in the degree of bothersomeness, there is no attempt to escape it. Furthermore, as can be seen from Table 6, a much higher percentage are now regularly testing urine, despite the fact that urine testing is now ranked much higher in degree of bothersomeness by both patients and parents.

The achievements in relation to schooling have been remarkable in many ways. In 1966 we found a high incidence of tardiness (46.8% compared with 17.6% in a control group) and of absenteeism (21 or more days per school year, compared with 0.4 days in a control group). In 1976 this was drastically reduced, with almost no tardiness or absenteeism. In 1966 we found that many diabetic children were being prevented from participating in physical activities, including gymnastics, sport competitions, school excursions, etc., due to the fear of hypoglycemia on the part of both the school personnel as well as the patient and parents. Today all the children and adolescents under our care participate in all sport and social activities without limitations. This is the result of the educational program aimed at the school personnel, as well as the capability of the child to detect and manage any deviations in blood glucose levels.

DISCUSSION

There is considerable controversy as to what constitutes acceptable control of diabetes,²³⁻²⁶ but we would propose that it seems to be attained when the following criteria are fulfilled: close to normal levels of blood sugar, avoidance of extreme fluctuations between hyperglycemia and hypoglycemia, avoidance of ketosis, a daily loss of less than 30 g of glucose in the urine, normal concentrations of blood lipids, and normal growth. It is difficult both to achieve these aims and, once attained, to maintain them for long periods of time, particularly during puberty.

Good control of diabetes also means homeostasis of the various hormones influencing carbohydrate metabolism, such as the catecholamines, growth hormone, cortisol and glucagon,²⁷⁻²⁹ all of which are "stress hormones." One of the basic factors in achieving good control is, therefore, the avoidance or lowering of stressful conditions (Figure 1).³⁹

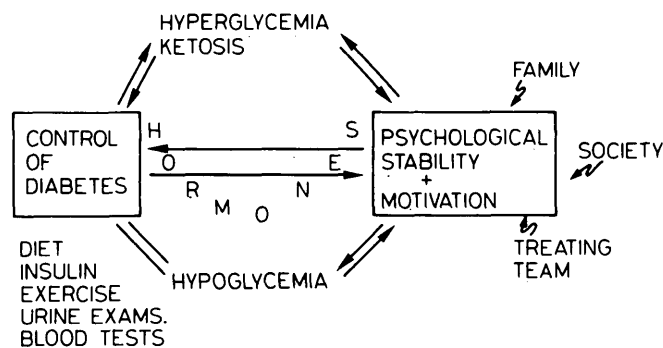


FIG. 1. Balance of control of diabetes. (Reproduced with permission of publisher, from Medical Aspects of Balance of Diabetes in Juveniles, Pediatric and Adolescent Endocrinology, Vol. 2, Laron, Z., Ed. Basel, S. Karger, 1977, p. XV.)

There may be a great deal of stress associated with the daily management of diabetes. One of the major obstacles in achieving and maintaining good control is the psychological problems that develop in both the affected child and his parents following pronouncement of the diagnosis of diabetes. We came to the conclusion that these constituted a challenge that could only be met through a multidisciplinary team. Continuous education of the public and medical personnel¹³⁻¹⁶ has led to early diagnosis, often by parents, and early referral before severe metabolic decompensation.

This study demonstrates the benefits of a multidisciplinary approach. The quality of the care and instruction provided at the initial referral were found to be particularly important in relation to the ultimate results obtained. Here the concept that the diabetic child does not necessarily have to be hospitalized for evaluation is beneficial. The fact that therapy can be applied on an ambulatory basis itself reduces the anxiety of the patient and poses fewer problems for both patient and family.

The control achieved in those children who had been referred to the Center at the onset of their disease was consistently better than in those who were first treated by the conventional medical method. There were no severe complications, such as coma, ketoacidosis, or brittle diabetes. On a long-term basis, these patients seemed to have fewer late vascular complications when compared with patients with a similar duration of follow-up reported in the literature (retinopathy 22% after 15 yr, compared with 38-73% in the literature; proteinuria 11% vs. 16-69% in literature).³⁰⁻³⁷ Hospitalization, which often disrupts family life and school achievements, was almost completely avoided.

The finding that patients who were treated from the onset of diabetes by the multidisciplinary team adjusted better to the requirements of the treatment than those treated initially by a conventional approach is of interest. It may be related to the attitude developed by the patient and his family in the initial stage, of the difficulty to unlearn bad habits associated with the daily care, and/or to a lower motivation of compliance.

From the psychological aspect, both patients and parents showed a better understanding of and adjustment to the problems of management of this chronic disease. The parents' perception of their child and the child's self-concept were improved. Stress levels were lowered, with a positive effect on the degree of control (Figure 2).

Under the supervision and guidance of the multidisciplinary team, the diabetic child is able to lead a normal life in all respects. He is not hampered by the need for frequent and prolonged hospitalization nor by tardiness and absenteeism at school. He is freed of the host of misconceptions, psychological conflicts and fears which all too often burdens the young diabetic, crippling his normal growth and development. His full potential can be realized, which is our ultimate aim.

In addition to the support given to the patient and his

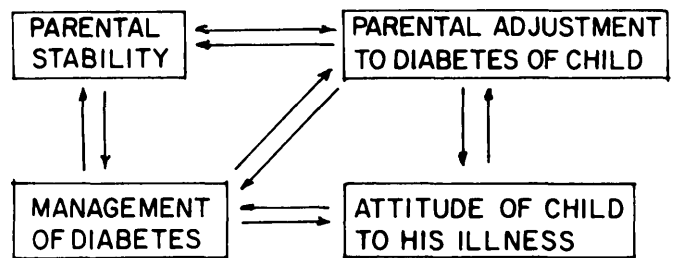


FIG. 2. Influence of parental attitude on the psychological stability and control of the diabetic child. (Reproduced with permission of publisher, from *Psychological Aspects of Balance of Diabetes in Juveniles*, Pediatric and Adolescent Endocrinology, Vol. 3, Laron, Z., Ed. Basel, S. Karger, 1977, pp. XI.)

family by the multidisciplinary team, it is important that the general public be enlightened about diabetes. This may make it easier for the patient to discuss freely his own illness and may contribute to early referral of new cases.

As long as we are unable to effect a cure of diabetes, the importance of the psychological factor in this disease, particularly in affected juveniles, should be given due recognition, and treatment planned accordingly.

ACKNOWLEDGMENTS: The establishment of the Israel Counselling Center for Juvenile Diabetics was made possible by an initial grant of the Social and Rehabilitation Service of the U. S. Department of Health, Education, and Welfare and the continuous support of Kupat Holim, Health Insurance Institution of the General Federation of Labour in Israel.

The authors thank Mrs. Ruth Fradkin for her assistance in the preparation of the manuscript.

Z. Laron is an Established Investigator of the Chief Scientist's Bureau, Ministry of Health.

Presented in part at the 11th Annual Meeting of the German Diabetes Association, Braunlage, 1976.

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