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Limited Joint Mobility in 77 Children with Type I Diabetes Mellitus and Correlation to Other Diabetic Complications

Received: May 26, 1996

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Abstract: We investigated limited joint mobility in 77 patients with type I diabetes mellitus. The patients were also assessed for neuropathy, retinopathy and pulmonary complications. The prevalence of limited joint mobility was 47%. Skin changes were present in 87% of patients with diabetes of more than 5 years' duration. No relationship was found between limited joint mobility and metabolic control, but there was a very strong correlation between limited joint

mobility and other diabetic complications such as neuropathy, nephropathy and retinopathy. We did not find any differences in the pulmonary function tests of patients with and without limited joint mobility.

We concluded that limited joint mobility was a simple and reliable indicator of chronic microangiopathic diabetic complications.

Key Words: Diabetes mellitus type I, limited joint mobility.

Introduction

Limited joint mobility (LJM) is considered to be the earliest clinically apparent long-term complication of type I diabetes mellitus (DM). Underlying mechanisms of generalised collagen abnormalities are suggested by association with decreased pulmonary function, retinopathy, nephropathy and neuropathy. LJM has been reported in type I DM with frequencies ranging from 25% to 75% (1, 2, 3).

The aim of this study was to determine the prevalence of LJM and the association between LJM and other complications of DM.

Material and Methods

The study group consisted of 77 patients with type I DM admitted to our pediatric endocrinology clinic.

All patients received insulin injections in the standard treatment regime: two daily injections of a mixture of intermediate and short acting insulin. All subjects were non-obese, nonsmokers with no history of respiratory or other infectious diseases.

Patients were examined for LJM with their hands in the praying position and classified into three groups: group I, no limitation; group II, mild LJM, which indicates involvement of more than two proximal interphalangeal

joints; and group III, moderate LJM, which indicates more serious involvement than group II (Figure). The injection sites were examined carefully for hypertrophic and atrophic lesions.

Blood pressure was measured at each visit and subjects were considered to have a high normal systolic and/or diastolic blood pressure if levels above the 90th centile for age were detected in at least three separate measurements.

Twenty-four-hour urine samples were collected and tested for albumin excretion rate (AER) and albumin concentrations were determined by radioimmunoassay (Pharmacia Uppsala Sweden). Over 30-300 mg/min AER was considered to be microalbuminuria, and over 300 mg/min was considered to be persistent albuminuria.

Direct ophthalmoscopy (with pupils dilated) was performed on all subjects by at least two examiners (one ophthalmologist and one pediatrician), followed by fluorescein angiograms and a slit lamp examination of selected patients. Subjects were classified into three groups based on eye findings: group I, no retinal changes; group II, background retinopathy; and group III, overt retinopathy.

Levels of glycosylated hemoglobin (HbA1c) were determined by latex agglutination (Bayer Diagnostic).

The measurements of pulmonary functions, made by

	LJM(+) (n: 36)	LJM(-) (n: 41)
Sex (F/M)	15/21	17/24
*Mean duration of diabetes (years)	2.8 ± 4.7	5.6 ± 4.1
HbA1c (%)	11.9 ± 2.8	12.5 ± 1.9
ΦBlood pressure (mmHg)	72.4 ± 11.1	63.2 ± 6.7
⊗Microalbuminuria (mg/min)	138.5 ± 132.8	106.1 ± 142.4
Retinopathy	13	2
Neuropathy	13	5
Overt nephropathy	4	---
* p<0.001	Φ p=0.005	⊗ p<0.002

Table 1. The comparison of laboratory data and other diabetic complications in patients with and without LJM.

(% pred)	LJM(+) (n: 36)	LJM(-) (n: 41)
*FEV1	98.4 ± 11.7	97.5 ± 12.7
*FVC	98.3 ± 11.5	98.9 ± 13.9
*FEV 25-75	96.5 ± 23.4	97.3 ± 21.5
*p> 0.05		

Table 2. The pulmonary function test in diabetic patient with and without LJM.

spirometer, included forced vital capacity (FVC), forced expiratory volume in one second (FEV1), and forced expiratory flow between 25% and 75% of vital capacity (FEV25-75).

Electrophysiological measurements were performed by EMG. Motor nerve conduction velocities were evaluated from n. peroneus and n. medianus, and the sensorial latency of these was detected with a Nihon Kohder neuropact 2 device, according to Thompson.

Statistical analyses were performed with commercial software packages (STATGRAFT 5.0). The student-t test was used to compare the differences between groups if parametric suggestions were suitable; otherwise, the Mann Whitney-U test was used. The chi-square test was used for qualitative data.

Results

A total of 77 insulin-dependent diabetic patients were included in this study. The mean age of the patient population was 11.6 ± 3.5 years (2.5 to 17) and the

mean duration of diabetes was 4.6 ± 4.8 years (0 to 12).

Varying degrees of skin involvement were found in 36 (47%) of 77 patients. Skin changes were present in 14 (87%) of 16 patients with diabetes of more than 5 years' duration. LJM was diagnosed earliest in patients with diabetes of 13 months' duration. Only one patient had stage II LJM; all others were diagnosed as mild LJM.

The mean duration of DM was greater in patients with LJM without LJM (p<0.001).

The HbA1c levels of the diabetic patients were between 7.8 to 15 g/dl (mean 12.2 ± 2.9 mg/dl).

Sex distribution and HbA1c levels did not vary according to presence or absence of LJM.

The mean diastolic blood pressure of the patients without LJM was 63.2 ± 6.7 mm Hg, and that of patients with LJM was 72.4 ± 11.1 mmHg. These values varied significantly between the two groups (p=0.005).

The mean AER of patients with LJM was 138.5 ± 132.8 mg/min, and that of patients without LJM was



Figure. Praying position demonstrating diabetic limited joint mobility. Contractures begin typically in the fifth digit and progress to the radial side of the hand.

106.1 ± 142.4 mg/min. The distribution of subjects by AER categories among two groups of LJM was statistically different ($p < 0.002$).

The lipodystrophic changes were found in 34 (45%) diabetic patients. Hypertrophic lesions predominated.

Diabetic retinopathy was found in 15 (19%) of the 77 patients, 13 of them had background retinopathy, in 13 and overt retinopathy in two. All patients but one with retinopathy also had LJM.

Diabetic neuropathy was found in 18 of 77 patients with DM. Thirteen patients suffering from diabetic neuropathy also had LJM.

Four patients diagnosed as having "overt clinical nephropathy" with persistent hypertension, persistent proteinuria and below normal glomerular filtration rate. These four patients also had LJM.

The relationship with diabetic complications and LJM is shown in Table 1. The pulmonary function tests (FEV_1 , FVC and FEV_{25-75}) were within normal limits, as shown in Table 2. There was no statistical difference in values between the two groups.

Discussion

LJM, beginning typically in the fifth finger and moving radially, and affecting interphalangeal, metacarpophalangeal, and large joints, is the earliest clinically apparent complication of diabetes in childhood and adolescence. It is painless and not disabling. LJM is also known as cheiroarthropathy, diabetic contractures, stiff hand syndrome, and diabetic stiff hand. LJM is

diagnosed by careful physical examination by having the patient hold the palms of both hands together in the praying position or by attempting to flatten the fingers and palms against a flat surface. In young patients the importance of this finding has been its relationship to the serious microvascular complications of diabetes, specifically retinopathy and neuropathy (1, 2, 3).

In our patients, there was no correlation between the presence of LJM and sex, chronological age or HbA1c values, but there was a significant relationship between LJM and the duration of DM, as has been indicated in previous reports (1-3, 4, 5, 6).

Lipodystrophy at insulin injection sites was found in 45% of the diabetics, and there were no differences between patients with or without LJM. Although an increased prevalence of soft tissue lesions has been reported with LJM, lipodystrophy at insulin injection sites was thought to be associated with insulin type and injection techniques, and not related to LJM (4, 6).

The diabetic patients were assessed in this study for the following complications: initial and clinical nephropathy, background and proliferative retinopathy, peripheral symmetrical polyneuropathy, and autonomic neuropathy. We found relationships between LJM and raised albumin excretion rates, background retinopathy and incipient neuropathy, as mentioned in previous reports (1, 7, 8). These findings may depend on the duration of diabetes, but two of our patients showed LJM and the other diabetic complications in the initial two years of diabetes mellitus. Since racial differences or genetic abnormalities may influence the initiation and progression of diabetic complications (9, 10), these two

patients were thought to have genetic variations which might lead to different susceptibility to diabetic complications independent from duration and metabolic control of DM.

Pulmonary functional and histopathological abnormalities in diabetic patients have been reported before (11, 12). Collagen is the major connective tissue of the lung parenchyma, and increased nonenzymatic glycosylation of collagen can cause both qualitative and quantitative lung abnormalities. Chronic hyperglycemia may cause restricted pulmonary function, and the reduction of lung function may improve with intensive diabetes treatment programs that result in sustained

near- normoglycemia (12, 13). Pulmonary function tests were within the normal ranges, as has been the case in previous reports (14). We did not observe any differences between patients with LJM and those without LJM, as some other researchers have (15), but not others (16).

We conclude that LJM is a simple and reliable indicator of chronic microangiopathic diabetic complications. All diabetic patients should be examined carefully for LJM, and all patients diagnosed with LJM should be evaluated by sophisticated laboratory methods for other diabetic complications.

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