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Factor analysis to affect muscle characteristics in DM patients: A pilot study

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Objectives

Diabetic polyneuropathy (DPN) is peripheral nerve dysfunction, and one of the major complications with diabetic retinopathy and diabetic nephropathy. DPN in patients with DM is observed in 7% of cases within one year and more than 50% after 25 years. DPN presents with sensory disturbances. Afterward, motor disturbances can be generated in more severe conditions, inducing distal weakness and muscle atrophy of the lower leg and foot. The aims of this study represented correlation between parameters of DM and muscle characteristics measured during isometric contraction using surface electromyography (sEMG) in patients with DPN. Results expected to provide effective exercise program as well as EMG-based methods for quantification in muscle fatigue assessment for patients with DPN.

Methods

Fifteen of twenty-five patients with DM diagnosed DM neuropathy (DPN) with nerve conduction study (NCS) in upper and lower extremities, and calculated composite score (CS) after history taking. They performed laboratory test including HbA1c, fasting plasma glucose (FPG), total cholesterol, HDL, and LDL. Calf circumference (CC) for atrophy and surface EMG for the quantification for strengthening (RMS) and fatigue (MDF and MNF) were used. RMS, MDF, and MNF on medial gastrocnemius (GCM) were measured by isometric maximal voluntary contracture of plantarflexion (Table 1). This study showed the correlation and regression analysis between these parameters and characteristics of muscle.

Results

The duration of DM was not only related to fatigue and CC of muscle, but CS (p<0.01). However, CC or CS did not affected fatigue. CC was associated with HbA1c (p<0.05, Table 2.) Multivariate linear regression analysis depending on duration of DM was a statistically significant in MDF and MNF (p<0.01, Table 3).

Conclusions

We found that the duration of DM affected the fatigue of muscle greatly, and recommend the steady endurance exercise in patients with DM.

Table 1. Clinical characteristics of DM patients with or without DPN. (*p < 0.05, **p<0.01)

Characteristic	DM - DPN (n=10)	DM + DPN (n=15)	P value
Sex, men/women	5/5	8/7	
Age,yr	45.67 ± 11.44	48.00 ± 16.24	0.615
Duration of DM, yr	5.23 ± 5.89	10.43 ± 6.47	0.066
Height, cm	165.63 ±11.24	166.16 ± 8.20	0.897
Weight, kg	76.09 ± 18.88	68.99 ± 19.18	0.394
BMI, kg/m^2	27.62 ± 5.78	24.73 ± 5.33	0.233
Albumin, g/dL	4.52 ± 0.35	4.01 ± 0.425	**0.007****
Creatine, mg/dL	0.96 ± 0.45	2.09 ± 3.35	0.328
HbA1c, %	10.29 ± 2.48	10.35 ± 3.30	0.963
FPG,mg/dL	192.33 ± 61.22	191.57 ± 91.71	0.983
Triglyceride,mg/dL	180.56 ± 70.47	200.50 ± 170.85	0.744
HDL-cholesterol,mg/dL	46.56 ± 8.23	45.71 ± 14.70	0.878
LDL-cholesterol,mg/dL	106.00 ± 38.12	105.38 ± 39.71	0.968
Composite score	0.07 ± 0.10	0.70 ± 0.45	**0.000****
Calf circumference,cm	36.78 ± 3.67	34.96 ± 4.67	0.336
RMS, uV	204.56 ± 104.32	224.39 ± 86.80	0.626
MDF, Hz	187.88 ± 37.95	143.84 ± 45.78	**0.026***
MNF, Hz	203.10 ± 52.20	159.12 ± 44.01	**0.024***

Table 2.The correlation between parameters in patients with DPN. (*p < 0.05, **p<0.01)

		BMI	Creatine	Albumin	CS	FPG	TG	HDL	LDL	CC	HbA1c	Duration	RMS	MDF
BMI	r	-												
Creatine	r	-0.079	-											
Albumin	r	0.128	-0.522	-										
CS	r	-0.334	0.601*	-0.447	-									
FPG	r	-0.198	0.139	-0.350	-0.051	-								
TG	r	0.179	0.134	-0.307	0.072	0.483	-							
HDL	r	0.192	-0.204	0.111	-0.054	-0.525	-0.573*	-						
LDL	r	-0.145	0.522	-0.288	0.164	.575	0.188	-0.222	-					
CC	r	0.550	-0.303	0.318	-0.615*	0.504	0.222	-0.307	0.248	-				
HbA1C	r	-0.209	-0.314	-0.244	-0.287	0.724**	0.248	-0.193	0.266	0.458	-			
Duration	r	-0.238	0.596*	-0.244	0.579*	-0.433	-0.330	0.051	0.007	-0.643*	-0.596*	-		
RMS	r	0.173	0.171	0.263	-0.264	0.180	-0.380	-0.011	0.239	0.425	0.115	0.134	-	
MDF	r	-0.024	-0.423	-0.228	-0.299	0.574*	0.301	-0.166	0.011	0.349	0.665**	-0.791**	-0.303	-
MNF	r	-0.043	-0.418	-0.202	-0.290	0.640*	0.312	-0.128	0.091	0.384	0.670**	-0.811**	-0.282	0.979**

Table 3. Linear regression analysis in patients with DPN. (*p<0.05, **p < 0.01)

Dependent variable	Independent variable	Simple linear regression						Stepwise-Multivariate linear regression					
		R^2	B	S.E	β	t-value	P-value	R^2	B	S.E	β	t-value	P-value
CC	Duration	0.378	-6.393	2.367	-0.615	-2.701	0.019*	0.413	-0.467	0.161	-0.643	-2.905	0.013*
	CS	0.413	-0.467	0.161	-0.643	-2.905	0.013*						
MDF	Duration	0.330	0.306	0.126	0.574	2.431	0.032*	0.626	-5.642	1.26	-0.791	-4.479	0.001**
	FPG	0.443	9.227	2.989	0.665	3.087	0.009**						
	HbA1c	0.626	-5.642	1.260	-0.791	-4.479	0.001**						
MNF	Duration	0.410	0.327	0.113	0.640	2.888	0.014*	0.658	-5.561	1.158	-0.811	-4.803	0.000**
	FPG	0.449	8.940	2.856	0.670	3.130	0.009**						
	HbA1c	0.658	-5.561	1.158	-0.811	-4.803	0.000**						