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Brief report

The evaluation of peripheral neuropathy in youth with type 1 diabetes☆

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ABSTRACT

Of 151 youth with type 1 diabetes who were screened for peripheral neuropathy, and received nerve conduction studies, 11% were diagnosed with Diabetic Peripheral Neuropathy (DPN). DPN can occur in young children, with short diabetes duration, and good diabetes control. National guidelines for screening children for DPN should be developed.

Diabetic Peripheral Neuropathy (DPN) is a devastating, long-term complication of diabetes [1–3]. Although screening tests for DPN have been devised, none are universally accepted as confirmatory. Estimates of DPN in adults vary from 20% [1] to 70% [3] depending on the definition of DPN and the diagnostic techniques used. Because of the paucity of studies in youth, the prevalence of DPN is even more uncertain. Studies outside of the US have estimated the prevalence in youth to be 5–87% [4–12]. DPN has been shown to be associated with HbA1c, diabetes duration, hyperlipidemia, puberty, height, and age [5,6,13,14]. Few studies of DPN in youth in the US have been published. The purpose of this study was to evaluate the prevalence of DPN and factors associated with DPN in our population.

1. Methods

A convenience sample of 151 youth (8–21 year) followed at The Children's Hospital of Philadelphia Diabetes Center for

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Children was recruited. The study was approved by the Institutional Review Board. Two groups of subjects were identified. Group 1 ($n = 143$) was not identified as high risk. Group 2 ($n = 8$) was identified as high risk: ≥13 years, diabetes duration ≥5 years, and HbA1c levels ≥10% on 2 of the previous 4 visits. Patients with significant developmental delays or neurological diagnoses were excluded. All participants completed a modified Michigan Neuropathy Screening Inventory (MNSI) [2] performed by a pediatric nurse practitioner. For the most symptomatic adult subjects, the sensitivity for the MNSI was 79% and the specificity was 65% [2]. The MNSI, designed to screen adults, was simplified. Three questions, inappropriate for youth, were eliminated. A few of the questions were rephrased to increase clarity for our subjects. The physical examination included a foot inspection, ankle reflex testing, monofilament (10 g) testing, and tuning fork testing.

Those subjects who tested positive on either the questionnaire or physical exam in Group 1, or were high risk (Group 2) regardless of the results of the screening, were referred to the pediatric neurologist for nerve conduction studies (NCS). Positive NCS were considered diagnostic of DPN. The association of DPN and HbA1c, diabetes duration, age, height, puberty, and cholesterol level were analyzed.

The prevalence of positive DPN screens by each screening method were calculated and stratified by risk group. The subsequent positive predictive value of each screening method was calculated based on the neurologist's DPN determination. Differences between subjects who screened positive and negative were compared using Fisher's exact, χ^2 or Mann–Whitney *U*-tests, as appropriate. Similar methods were used to compare subjects who had a positive versus negative DPN exam performed by the neurologist.

2. Results

Of the 151 youth who were screened for DPN, 39 (26%) had a positive screen (Table 1). In Group 1, 33/143 subjects (23%) screened positive and were referred to the pediatric neurologist. Twenty four of the 33 followed up on the recommendation for further evaluation. Of those 24 subjects, 11 (46%) were diagnosed with DPN. In Groups 2 and 6 (75%) of the 8 high risk subjects screened positive. All 8 were referred to the pediatric neurologist. Five were evaluated (four who screened positive, one who screened negative) and all were diagnosed with DPN (Fig. 1).

Of the total 41 subjects who screened positive and the high risk subject who screened negative, 29 subjects received further evaluation – 16 (55.2%) (8M, 8F) of whom were diagnosed with DPN. None of the variables analyzed were associated with DPN. The average age was 16.2 years (13.6–19.5), and the average HbA1c was 8.7% (7–12.5%). Of note, the HbA1c of 7 subjects was ≤8%. Although the average duration of diabetes was 6.4 years (3 months–12 years), two subjects had been diagnosed less than 1 year.

3. Discussion

Although there are no national screening guidelines for DPN in youth in the US, our data suggest that DPN warrants recognition as a complication of diabetes that occurs in youth. In our population, 26% screened positive, higher than the 14% positive screening prevalence shown by Weintrob et al. [4]. Of the subjects who screened positive and received further evaluation, 55.2% or 11% of our total sample, were diagnosed with DPN. Insofar as only subjects who screened positive were referred for NCS, and 12 subjects (29%) did not follow up, it is

Table 1 – Comparison of sample characteristics by positive or negative screen for DPN.

Characteristic n (%) or mean ± sd	Group 1			Group 2		
	−Screening ($n = 109$)	+Screening ($n = 33$)	p-Value[a]	−Screening ($n = 2$)	+Screening ($n = 6$)	p-Value[a]
Age			0.536			n/a
<13	42 (38.2)	10 (30.3)		0 (0.0)	0 (0.0)	
≥13	68 (61.8)	23 (25.3)		2 (100.0)	6 (100.0)	
Race			0.169			>0.999
Caucasian	96 (90.6)	27 (81.8)		2 (100.0)	5 (83.3)	
AA/Hispanic	10 (9.4)	6 (18.2)		0 (0.0)	1 (16.7)	
Gender			0.241			0.464
Male	66 (60.0)	16 (48.5)		1 (50.0)	1 (16.7)	
Female	44 (40.0)	17 (51.5)		1 (50.0)	5 (83.3)	
Duration of DM			0.074			>0.999
<5	59 (54.1)	12 (36.4)		0 (0.0)	1 (16.7)	
≥5	50 (45.9)	21 (63.6)		2 (100.0)	5 (83.3)	
Tanner stage			0.389			n/a
1	35 (32.1)	8 (24.2)		0 (0.0)	0 (0.0)	
2–5	74 (67.9)	25 (75.8)		2 (100.0)	6 (100.0)	
Mean HbA1c	8.1 ± 1.4	8.5 ± 1.4	0.114	11.4 ± 1.3	11.6 ± 1.2	0.739

[a] Comparisons between ±screening within group by Fisher's exact, χ^2 or Mann–Whitney *U*-test.