Original Research Paper

Volume-9 | Issue-4 | April-2019 | PRINT ISSN No 2249-555X

Pediatrics

MOTOR NERVE CONDUCTION STUDIES IN CHILDREN HAVING TYPE 1 DIABETES MELITUS

Shashi Kant Dhir*	Associate Professor, Department of Pediatrics, Guru Gobind Singh Medical College, Faridkot *Corresponding Author
Meenal Batta	Assistant Professor, Department of Physiology, Guru Gobind Singh Medical College, Faridkot
Naveenta Gupta	Professor, Department of Physiology, Guru Gobind Singh Medical College, Faridkot
Sonia Garg	Professor, Department of Physiology, Guru Gobind Singh Medical College, Faridkot
Rajeev Sharma	Professor and Head, Department of Physiology, Guru Gobind Singh Medical College, Faridkot
Gurmeet Kaur	Professor and Head, Department of Pediatrics, Guru Gobind Singh Medical College, Faridkot

ABSTRACT

Background: Diabetes Mellitus is commonly associated with neuropathic complications. Nerve conduction studies can be helpful in detecting sub clinical type of diabetic neuropathies.

Aims and Objectives: To see the effect of diabetes on MNCV in type 1 diabetes mellitus children.

Methods: This observational study was done on thirty children with type 1 diabetes mellitus for minimum two years. Motor nerve conduction study (MNCV) of peripheral nerves was performed. The onset latencies, amplitude of compound muscle action potential (CMAP) and nerve conduction velocity were recorded and analysed.

Results: The mean onset latencies were significantly increased in all the limbs in cases. The amplitude of CMAP and conduction velocity of peripheral nerves were decreased. No significant difference was seen between the parameters of MNCV in both sides.

Conclusion: Type 1 diabetes mellitus does affect peripheral neural pathways in children. MNCV is helpful in early detection of sub clinical changes in neural pathways.

KEYWORDS : Type 1 Diabetes Mellitus, Children, Motor Nerve Conduction Studies

Introduction

Out of various complications of diabetes, the neuropathy is most common(1). The sensory, motor and autonomic nerves are all included in the neuropathic damage. Molecular as well as vascular level pathogenetic mechanisms have been implicated in the progression of diabetic neuropathy, most common being increased production of advanced glycation end products, increased oxidative stress, activation of protein kinase C and release of cytokines(2). The sub clinical type of diabetic neuropathy can be detected by nerve conduction velocity (NCV)(3). The changes are more commonly observed in lower limbs in children(4,5). It also has additional advantage of being repeatable(6).

This study was planned to see effect of diabetes on nerve conduction in peripheral nerves in children having type 1 diabetes mellitus.

Material and Methods

This observational study was done in Pediatrics and Physiology departments of Guru Gobind Singh Medical College, Faridkot over a period of one year. The study was approved by the institutional ethics committee of the institute. Informed consent was taken from one of the parents of enrolled patients. Confidentiality and privacy of the subjects was maintained.

The children who were admitted in Pediatrics unit wards or had come on OPD basis to Guru Gobind Singh Medical College and having type 1 diabetes mellitus for a period of minimum two years were eligible for enrolment. Definition by WHO was used for classifying diabetes mellitus(7).

The baseline data was obtained from the patient's records and height, weight as well as body mass index were noted. Detailed history including treatment history was taken from the patient or guardian. Details included type of insulin used, duration of diabetes and glycemic status of the child. Primary CNS or neuro-muscular disease was ruled out by thorough physical and neurological examination. All the patients were included irrespective of their glycemic status and mode of insulin therapy.

The patients having established peripheral neuropathy, local site infection, CNS disease were also excluded as they might alter NCVs per se. The children of parents who refused to participate in the study were not enrolled.

Age and gender matched euglycemic hospitalised children for illness other than diabetes mellitus and having normal HbA1c were taken as controls.

For recording motor nerve conduction study (MNCV), surface recording electrodes were placed in belly tendon montage(8). The active electrode was placed close to the motor point and reference electrode to the tendon respectively. The nerve was stimulated at two points along its course with a supramaximal stimulus keeping cathode close to active recording electrode. Surface stimulation having a square wave pulse of 0.1ms duration and intensity of 30-40mA was given. Ground electrode was placed between the stimulating and recording electrodes. The response in the form of a biphasic action potential with initial negativity was recorded. Filter setting for MNCV study was 2 Hz-3kHz and sweep speed was 3 ms/division. The parameters recorded were onset latency (ms) at two points of stimulation, latency difference (ms) between proximal and distal points, amplitude (mV) of compound muscle action potential (CMAP), distance (mm) between two points of stimulation and nerve conduction velocity (m/s).

The MNCVs were recorded in the research laboratory of Physiology department of GGS Medical College, Faridkot using Data Acquisition and Analysis System, Neurostim, (NS4) Medicaid Systems, Chandigarh, India™. For recording median motor nerve conduction study (MNCV) for upper limbs, active recording electrode was placed close to motor point of abductor pollicis brevis and reference electrode at first metacarpophalangeal joint. A supramaximal stimulus at wrist and at elbow (near the volar crease of brachial pulse) was given.For recording tibial motor nerve conduction study for lower limbs, active recording electrode was placed close to motor point of abductor hallucis and reference electrode at first metatarsophalangeal joint. A stimulus was given behind and proximal to medial malleolus and second stimulus in the popliteal fossa along flexor crease of knee slightly lateral to midline.

The data was collected by the investigators and compiled in a pre-designed validated proforma and was statistically analysed by applying student t-test using Microsoft Excel™. The p value less than 0.05 was considered to be statistically significant.

Results

A total of 33 cases were enrolled during this study. Out of these three patients were excluded because of non willingness for taking part in the study. Equal number of controls was taken. The mean age of the children in years was 5.6±0.7 and 5.7±0.7 in cases and controls respectively and was similar in both groups. The baseline variables like age, gender, weight, height and body mass index (BMI) were not statistically significant in the two groups and are given in Table 1. The comparison of various parameters of the MNCV (latencies, conduction velocity and amplitude) between the cases and controls has been shown in Table 2 and 3.

Table 1: Baseline Variables

Variable		Cases N=30	Controls N=30	P value
Gender	Male	18	18	>0.05
	Female	12	12	>0.05
Religion	Hindu	14	14	>0.05
	Sikh	16	16	>0.05
Background	Rural	17	17	>0.05
	Urban	13	13	>0.05

Table 2: Upper Limb Parameters

	Left Median Nerve			Right Median nerve		
Parameter (unit)	cases	controls	P value	cases	controls	P value
Latency 1 ankle(ms)	2.71±0.16	2.45±0.15	HS	2.74±0.15	2.46±0.15	HS
Latency1 pop.fossa (ms)	5.71±0.20	5.25±0.22	HS	5.72±0.21	5.24±0.23	HS
CV (m/s)	50.94±3.12	54.72±1.87	HS	51.37±2.99	55.16±2.02	HS
Amp 1 (mV)	5.34±1.52	9.13±1.11	HS	5.31±1.62	9.14±1.15	HS
Amp 2 (mV)	5.61±1.70	9.20±0.90	HS	5.60±1.67	9.18±0.92	HS

Table 3: Lower Limb Parameters

	Left Posterior Tibial nerve			Right Posterior Tibial nerve		
Parameter (unit)	cases	controls	significance	cases	controls	significance
Latency 1 ankle(ms)	4.29±0.22	4.06±0.26	HS	4.31±0.21	4.05±0.27	HS
Latency1 pop.fossa (ms)	10.11±0.48	9.34±0.40	HS	10.12±0.47	9.32±0.42	HS
CV (m/s)	40.96±1.36	45.28±1.05	HS	40.96±1.14	45.38±1.07	HS
Amp 1 (mV)	6.13±2.26	8.88±1.01	HS	6.06±2.31	8.86±1.02	HS
Amp 2 (mV)	6.41±1.34	9.25±0.99	HS	6.39±1.34	9.26±1.00	HS

The mean onset latencies (ms) of responses of nerve stimulation were found to be significantly increased in both upper and lower limbs in cases. The conduction velocity (m/s) of peripheral nerves in both upper and lower limbs was found to be decreased highly significantly in cases. The amplitude (mV) of the responses in the form of compound muscle action potential (CMAP) on nerve stimulation was also found to be decreased in all the limbs among type 1 diabetic children. There was no significant difference between the values of the parameters of nerve conduction studies (MNCV) on the right and left side of both upper and lower limbs among the cases as well as controls.

Discussion

This cross-sectional case-control study was done to assess the effect of type 1 diabetes mellitus on the nerve conduction in peripheral nerves in children. Our study has shown that there is significant increase in the latencies, decreased amplitude of the responses and decrease in the conduction velocity of the peripheral nerves in patients having diabetes mellitus.

Diabetes does affect the peripheral and the central nervous system and electrophysiologically it manifests as the increased latency and decreased amplitude in various nerve potentials like VEP's and BERA(9).

In the present study, MNCV was found to be decreased in both posterior tibial and median nerves similar to the previous studies(6,10–14). Marcus et al found a positive correlation between duration of diabetes and decrease in motor nerve conduction velocity(15). In addition Cenesiz et al found statistically significant relationships between the glycemic control values and nerve conduction also(16). In our study, amplitude of the responses in the form of CMAP was found to be decreased as reported previously in other studies (6,11,14). Coutinho dos santos et al also have similarly shown that amplitude of responses of MNCV was decreased in diabetic children with or without overt neuropathy(13). In coherence to the present study the increase in latencies of the responses was also depicted in the previous studies(14,16).

Rania refaat et al found a significant positive correlation with duration of disease and the nerve motor latency(12). Although the subset of population is different from our study with variable duration of the disease yet most of the studies have yielded same results.

The lack of correlation between the glycemic status and effect on the therapy on the NCVs, smaller sample size, single point study are few limitations of the study. The nutritional status of the child could have also been a poor confounding factor.

Early interventions for good glycemic control and rehabilitation should be tried in the patients diagnosed to have type 1 diabetes mellitus so that the changes could reverse to some extent.

Further multi-centeric studies are required with adequate sample size along with stratification of various duration of diabetes and glycemic control. The NCVs can also be done during follow up phase to ascertain the reversibility of the changes acquired during the treatment phase. More electrophysiological tests like sensory nerve conduction studies, F-wave, repeated nerve stimulation studies can also be done to have more insight about the electrophysiological changes in the diabetes mellitus.

Conclusion

The type 1 diabetes mellitus does affect the peripheral neural pathways in children as shown by the prolonged latencies and decreased conduction velocity and amplitude in the MNCVs. Nerve Conduction studies are helpful in the detection of early changes in the conduction across the neural pathways in the sub-clinical diseases.

Acknowledgements

Authors would like to thank Mrs. Shinder Pal Kaur, Lab technician and Mrs. Balwinder Kaur, Lab attendant, GGS Medical College, Faridkot for assisting in the conduction of the tests.

Funding: No funding sources
Conflict of interest: None declared

REFERENCES

1. Hirschfeld G, von Glischinski M, Blankenburg M, Zernikow B. Screening for peripheral neuropathies in children with diabetes: a systematic review. Pediatrics. 2014 May;133(5):e1324-1330.
2. Dyck PJ, Giannini C. Pathologic alterations in the diabetic neuropathies of humans: a review. J Neuropathol Exp Neurol. 1996 Dec;55(12):1181–93.
3. Hyllienmark L, Brismar T, Ludvigsson J. Subclinical nerve dysfunction in children and adolescents with IDDM. Diabetologia. 1995 Jun;38(6):685–92.
4. Käär ML, Saukkonen AL, Pitkänen M, Akerblom HK. Peripheral neuropathy in diabetic children and adolescents. A cross-sectional study. Acta Paediatr Scand. 1983 May;72(3):373–8.
5. Ludvigsson J, Johannesson G, Heding L, Häger A, Larsson Y. Sensory nerve conduction velocity and vibratory sensibility in juvenile diabetics. Relationship to endogenous insulin. Acta Paediatr Scand. 1979 Sep;68(5):739–43.
6. Lee S-S, Han H-S, Kim H. A 5-yr follow-up nerve conduction study for the detection of subclinical diabetic neuropathy in children with newly diagnosed insulin-dependent diabetes mellitus. Pediatr Diabetes. 2010 Dec;11(8):521–8.
7. Association AD. Classification and Diagnosis of Diabetes. Diabetes Care. 2015 Jan 1;38(Supplement 1):S8–16.
8. Mishra UK, Kalita J. Principles of Nerve conduction study. In: Clinical Neurophysiology, 2nd edition. New Delhi (India): Elsevier; 2011. p.24-25.
9. Batta M, Sharma R, Gupta N, Garg S, Kaur G, Dhir SK, et al. Visual evoked potentials in children with type 1 diabetes mellitus. Int J Res Med Sci 2018;6:1165-8.
10. Dorchy H, Noel P, Kruger M, de Maertelaer V, Dupont E, Toussaint D, et al. Peroneal motor nerve conduction velocity in diabetic children and adolescents. Relationships to metabolic control, HLA-DR antigens, retinopathy, and EEG. Eur J Pediatr. 1985 Nov;144(4):310–5.
11. Hyllienmark L, Alstrand N, Jonsson B, Ludvigsson J, Cooray G, Wahlberg-Topp J. Early electrophysiological abnormalities and clinical neuropathy: a prospective study in patients with type 1 diabetes. Diabetes Care. 2013 Oct;36(10):3187–94.
12. Elbarbary N, Maghawry A, ElHilaly R, Refaat R. Evaluation of Median Nerve in Children with Type1 Diabetes using Ultrasonographic Imaging and Electrophysiology. In European Society for Paediatric Endocrinology; 2015 [cited 2019 Mar 24]. Available from: http://abstracts.eurospe.org/hrp/0084/hrp0084P1-43
13. dos Santos LHC, Bruck I, Antoniuk SA, Sandrini R. Evaluation of sensorimotor

polyneuropathy in children and adolescents with type I diabetes: associations with microalbuminuria and retinopathy. Pediatr Diabetes. 2002 Jun;3(2):101–8.
14. Ahmed, Hana et al "Nerve conduction study of sensory and motor lower limb nerves in children with type 1 diabetes mellitus attending Sudan Childhood Diabetes Center (P5.123)."Neurology 88.16 Supplement (2017): P5.123.
15. Marcus J, Ehrlich R, Kelly M, Murphy EG. Nerve conduction in childhood diabetes. Can Med Assoc J. 1973 May 5;108(9):1116–9.
16. Cenesiz F, Tur BS, Tezic T, Gurer Y. Nerve conduction in children suffering insulin dependent diabetes mellitus. Indian J Pediatr. 2003 Dec;70(12):945–51.