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EFFECTS OF PROTEIN ENERGY MALNUTRITION ON PERIPHERAL NERVE CONDUCTION IN CHILDREN

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ABSTRACT

Background: Peripheral nerve conduction changes caused by malnutrition can be shown clinically and electrophysiologically. They are produced mainly due to deficiency of micro and macronutrients like vitamins, minerals, protein, fat & Carbohydrate **Aim :** Protein energy malnutrition (PEM) affects the myelination and growth of the nervous system. The aim of this study was to assess the effects of PEM on peripheral nerve conduction in children. **Materials & Methods:** Study group includes 40 malnourished children of 5 – 10 years of age from Raja Mirasudar Hospital, Thanjavur based on Indian Academy of Paediatrics & WHO classification for malnutrition. Control group consists of 40 normal children of same age group. Nerve conduction study for median nerve was performed using eight channel digital polygraph. Nerve conduction velocity was evaluated. Results were analysed statistically using unpaired student 't' test. **Results** : Nerve conduction study (NCS) showed reduced motor and sensory nerve conduction velocity ($p < 0.05$) in children with Grade III malnutrition. Children with Grade I, II malnutrition showed reduced sensory nerve conduction velocity ($p < 0.05$). **Conclusion:** The present study shows significant reduction in nerve conducion velocity in children with malnutrition which may be due to nutritional deficiency affecting myelination of peripheral nerves which depends on duration and severity of malnutrition. So nerve conduction study can be used to detect malnutrition at its early stage.

INTRODUCTION

WHO defines protein energy malnutrition as a range of pathological conditions arising from coincidental lack in varying proportions of proteins and calories, frequently occurring in infants and young children usually associated with infection. About 60 – 70% of children have mild to moderate malnutrition and the remaining are severely malnourished.[1]

Protein energy malnutrition is known to be a major health and nutrition problem in India. [2] Children having birth order greater than or equal to 3 and those not immunized had higher prevalence of protein energy malnutrition.[3,4] A marginally adequate diet, as weaning diets in developing countries does not meet these increased needs. Protein energy malnutrition is observed even in industrialized countries, associated with the presence of clinical conditions that decrease food intake or absorption of food. Dietary proteins are the source of brain enzymes and neurotransmitters. The quality of dietary proteins determines the quantity of cerebral proteins and neurotransmitters. Thus the amino acid profile of cerebral extracellular milieu is a function of dietary proteins.[5,6] Malnutrition does not only risk the population for anemia and repeated infection, but it affects the developmental milestones and intellectual development. This persistent influence will lead to devastating effects in future. This burden continues in generations, as malnourished young girls become mother, deliver a malnourished young offspring.[7] Undernutrition can cause developmental delays among the children and adolescents, leads to poor school performance and cause school dropouts.[8] Iron deficiency alters myelination, Hippocampal energy metabolism during neonatal period. Zinc deficiency alters autonomic nervous system regulation, Hippocampal & Cerebellar development. Long chain fatty acids are essential for synaptogenesis, membrane function and myelination.[9] Malnutrition causes structural and functional pathology of brain. Effect of chronic protein energy malnutrition causes stunting and wasting in children. It can also affect higher cognitive processes during childhood (> 5 yrs of age) [10]. Kinds of behaviours & cognitive functions are impaired by malnutrition which is related to altered emotional response to a stressful events. [11] Measuring Nerve Conduction Velocity is a method of evaluation of status of peripheral nerves. Nerve conduction studies examines Peripheral motor & sensory nerve function by recording the evoked potential in nerve or muscle in response to electrical stimulation of a peripheral nerve[12,13]. Kumar et al observed delayed motor nerve conduction velocities in children with protein energy malnutrition. Delayed nerve conduction velocity in malnutrition is due to slowing or arrest of myelination that results from deprivation of nutrition [14]. Hence with the help of electrophysiological

study we can find the peripheral nerve conduction alterations in children with malnutrition.

MATERIALS AND METHODS:

Study design: Case control study

Place of research: This study was conducted in Research Laboratory , Department of Physiology, Thanjavur Medical College & Hospital, Thanjavur.

Study period: August 2013 to July 2014.

Ethics approval: Ethical committee approval was obtained from Institution before commencing the study. The aim, nature of the study was explained to the subjects & Parents / Guardians. An informed written consent was obtained from the Parent / Guardian of the child prior to the test.

Inclusion criteria: Study group consists of 40 malnourished children. Out of 40, 20 children (13 males, 7 females) had Grade III (Severe) malnutrition according to IAP & WHO classification [15] for malnutrition. They had Weight for age, 51 - 60% of expected weight & Height for age < 85% of expected height. Remaining 20 children (10 males, 10 females) had Grade I & II (mild to moderate) malnutrition as they had weight of 61 – 80 % of expected weight with normal height appropriate for their age. Control group consists of 40 normal children (20 males , 20 females) with weight > 80 % of expected with normal height for their age. Malnourished children with the age group of 5 – 10 years according to IAP classification & WHO Classification for malnutrition were included in this study.

Exclusion criteria: Children with genetic & endocrine causes for short stature were excluded from the study.

Sample size: Eighty

Procedure: Nerve conduction study (NCS) was performed using eight channel digital polygraph, model - IT 173SB (Neuro perfectplus)

Motor nerve conduction velocity (MNCV) was recorded by placing active electrode over muscle belly (Abductor pollicis brevis) & reference electrode at 3cm distal to active electrode at 1st metacarpophalangeal joint. Ground electrode was placed between stimulating & recording electrodes Median nerve was stimulated at wrist (3cm proximal to the distal wrist crease) & at elbow (near the volar crease of brachial pulse). Distance between the wrist & the elbow point of stimulation was measured in mm & conduction velocity (m / sec) was calculated by dividing the distance (mm) with latency difference. Sensory nerve conduction study was performed by placing ring electrodes at the index finger with the help of conducting gel. Ground electrode was placed over the forearm. Median nerve was stimulated at wrist. Sensory nerve action potential was recorded using antidromic conduction. The distance between the recording electrode & the stimulation site was measured. Sensory nerve conduction velocity (SNCV) was measured by dividing the distance by onset of latency. [16]

RESULTS

Statistical analysis was done by using SPSS version 20.The results were analysed using unpaired student 't' test. Values were expressed as mean with standard deviation. The control group was compared with grade III & grade I,II malnourished group. p value < 0.05 was considered as statistically significant.

Table 1: Anthropometric measurements of case & control group

Group	Height for age (cm)	Weight for age (kg)	Age (years) Mean ± SD
GradeI&II	123.0± 9.67	21.51±3.76	8.45±1.82
Grade III	103.4± 7.56	15.32±2.96	
Control	124.1± 1.58	26.75±4.50	7.57±1.74

Table 2: Nerve conduction study results in study group

Parameter (m/sec)	Control group	Study group (Grade III)	Study group (Grade I& II)
MNCV	46.58± 17	33.81±17.9*	40.66±20.0
SNCV	46.78± 12.1	30.75± 9.3*	38.96±17.5*

*p < 0.05 Significant, MNCV= Motor nerve conduction velocity, SNCV = Sensory nerve conduction velocity

DISCUSSION

Malnutrition is widely prevalent in all developing countries and children are the worst sufferers. Early development of malnutrition during the critical period of brain development has devasating effect on brain growth. This period extends from prenatal to early postnatal life. Active synthesis of myelin occurs in this period. Myelin is composed of protein & phospholipid derived from cell membrane of oligodendrocytes in central nervous system and from Schwann cells in peripheral nervous system. Malnutrition in this period results in physical, chemical, & functional changes in brain. All changes occurring in this period are likely to be irreversible that has a long lasting effect mainly due to delay in myelination. Malnutrition results in poor learning abilities, impaired cognitive functions and school dropouts [17].

This study has shown significant reduction in nerve conduction velocity in children with malnutrition. Motor & sensory nerve conduction velocity is significantly reduced in children with Grade III Malnutrition. Sensory nerve conduction velocity is significantly reduced in Grade I & II group.Sensory nerve conduction studies are more sensitive than motor nerve conduction study in detecting early or mild demyelinating diseases[18] . Shanthi ghosh et al[19] conducted nerve conduction study in 67 children to assess the effect of malnutrition on peripheral nervous system. Significant reduction in nerve conduction velocity was observed in children with severe protein energy malnutrition and ongoing longterm malnutrition .They found that undernutrition produces permanent molecular errors in brain membrane composition and affects biochemical maturity of

brain. This result is consistent with the present study result.

Kumar et al[14] measured nerve conduction velocity in children with protein calorie malnutrition. 38 marasmus, 13 kwashiorkor children were studied. They found that conduction velocity were reduced in each type of malnutrition suggested that PEM when it occurs during the development of nervous system affects myelination of peripheral nerves. Result of the present study agreed with this result.

The present study results agreed with results of Nimet kabakus et al [20]**.** They did peripheral nerve conduction study in children with iron deficiency anemia. Children with iron deficiency anemia were tested against healthy children . Median motor & sensory nerve conduction velocity were significantly lower than control group .

The result of present study is similar with research done by Jagjit S.Chopra [21]. Reduction in nerve conduction velocity was observed in children with protein calorie malnutrition.

CONCLUSION

This study shows significant reduction in nerve conduction velocity which may be due to nutritional deficiency affecting myelination of peripheral nerves . Severe and chronic malnutrition affects motor & sensory nerve conduction velocity. Mild to moderate malnutrition alters sensory nerve conduction velocity which is more sensitive than motor nerve conduction study in detecting early or mild demyelinating diseases. Thus there is strong association between duration and severity of malnutrition with NCS . So this electrophysiological tests can be used for early detection of malnutrition. But whether these changes are reversible or irreversible after nutritional rehabilitation needs to be evaluated.

Limitation of the study: This study doesnot eveluate the effect of nutritional supplementation on nerve conduction velocity in malnourished children.

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Conflict of Intrest : No conflict of interest

REFERENCES

1. Swarna Rekha Bhat. Achar's Textbook of Paediatrics. In: Nutrition:Normal nutrition and Malnutrition,Universities Press;2009;4th Edition. 45-53
2. Parthasarathy A, MKC Nair, PSN Menon, Raju C Shah, Nitin K Shah, HPS Sachdev etal., IAP Textbook of Pediatrics.In:Meenakshi N Mehta. Child nutrition,Jaypee;2006; 3rd Edition:120-139
3. Sen PM, Gupta VM, Singh TB. PEM among rural preschool children of eastern U.P Indian Journal of Maternal & child health.1996;7(4):95-98
4. Santhosh kumar A. Sunil kumar D, Ashok NC, Ragavendrasamy Koppad. PEM & its Association with immunisation status among 1-5 aged children in southern part of India, Mysore. IJCRR. 2013; 5(2):105-110
5. Agarwal KN. Textbook of Paediatrics. In: Nutrition, Ane Books Pvt.Ltd; 2010: 1st Edition.49- 81.
6. Mohammad Ramadan Hassaan. Ashgan Abd Alla Abdel-aal Alghobashy, Hadeel Mohammed Abdel-Rahman. Auditory neural efficiency in protein energy malnourished toddlers with and without iron deficiency anemia. Egyptian journal of Ear.Nose,Throat & allied Sciences. 2011;12:105-14
7. Aziz Abdul Rehman Jiwani. ISRA Medical journal.2011;3(3):82-83
8. Bruno de Benoist, Erin McLean, Ines Egli and Mary Cogswell.WHO global database on anemiaWorld prevalence of anaemia 1993-2005:1-13.
9. Michel K Georgieff. Nutrition & the developing brain: Nutrient priorities & measurement. The American journal of nutrition 2007; 85:614s-20s
10. Bhoomika R Kar, Shobini L Rao, Chandremouli BA. Cognitive development in children with chronic PEM. Behavioral & Brain function 2008,4,31:1-12
11. David A.Levitsky, Barbara J. Strupp. Malnutrition and the brain: Changing concepts, changing concerns. J.Nutr.1995;125:2212S-20S
12. Mallik, A.I weir. Nerve conduction studies: Essentials & pitfalls in practice. J neurol Neurosurg Psychiatry 2005 ;76(S II): ii23-ii31
13. Randolph W. Evans. Diagnostic testing in Neurology. In: Daniel M. Feinberg, David C Preston. Mononeuropathies, Saunders;3rd edition: 284-85
14. Kumar, Ghai OP, Singh N. Delayed nerve conduction velocity in children with PEM. J Paediatrics. 1997;90(1):149-53
15. Ghai OP, Piyush gupta, Paul VK. Ghai Essential paediatrics. In: Piyush Gupta, Dheeraj shah. Nutrition & Macronutrient disorders: Protein energy malnutrition, CBS Publications & Distributors; 2005;6th edition:101- 104.
16. Jain AK. Manual of Practical Physiology.2012;4th edition:297-301
17. Stoch MB, Smythe PM..Does undernutrition during infancy inhibit growth and subsequent intellectual development? Archs Dis Children.1963;38:546-552
18. Shanthi Ghosh, Kumkumvaid Manmohan, Maheshwari. Effect of degree & duration of PEM on Peripheral nerves in children .J neurology, Neurosurgery &Psychiatry, 1979, 42: 760-763.
19. Michel J Aminoff. Electrodiagnosis in clinical neurology. In.Jasper R. Daube. Nerve conduction studies, Elsevier;2005;5th edition: 285-308
20. Nimet Kabakus, Ahmet Ayar Tahir Kurtulus Yoldas. Reversal of Iron Deficiency Anemia-induced Peripheral Neuropathy by Iron Treatment in Children with Iron Deficiency Anemia. Journal of tropical paediatrics.2002;48(4):204-209.
21. Jagjit S Chopra, Upinder K Dhand, Saroj Mehta,Vilakshna Bakshi,Satyavathi Rana, Jagjivan Mehta. Effect of protein calorie malnutrition on peripheral nerves, A clinical, Electrophysiological & Histopathological study. Oxford J of Neurology.1986;109(2):307-23