Original article

Assessment of motor nerve conduction in median and common peroneal nerves in Anaemic South Indian Women and its association with severity of anaemia

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Abstract.

Introduction: Anemia is lack of RBCs or Haemoglobin below 12g/dL for adult non-pregnant women and is subcategorized into Mild (Hb – 11-11.9 g/dL), Moderate (Hb- 8-10.9 g/dL) and Severe (Hb <8 g/dL). Anaemia leads to neuronal tissue hypoxia that decreases impulse conduction rate. Our objectives were to assess motor nerve conduction velocity of median nerve in upper limb and common peroneal nerve in lower limb and to compare it between anaemic and non-anaemic women and to correlate nerve conduction velocity and haemoglobin concentration.

Materials and Methods: This study included subjects from Department of Gynaecology and controls from JIPMER staff. Females, aged 8 to 40 years with Body Mass Index of 20-30 Kg/m² and Hb concentration of 7-12g/dL were recruited. Motor nerve conduction in median and common peroneal nerves were carried out.

Results: Motor nerve conduction velocities of the median and common peroneal nerves were compared between 33 subjects and 33 controls. There was significant reduction in nerve conduction velocities (median p value = 0.000), (common peroneal nerve p value 0.002) in anaemic group and correlation was positive between Hb concentration and NCV'S (median nerve r value = 0.000, common peroneal nerve r value = 0.003)

Conclusion: Motor nerve conduction velocity was decreased in anaemic women in comparison to non-anaemic women.

Keywords: Anaemia, Motor nerve conduction velocity.

Introduction:

Anaemia is a major health problem worldwide. Anaemia is characterized by a decrease in red cell mass and amount of Haemoglobin affecting the oxygen carrying capacity of blood, leading to decreased oxygen supply to the tissues thereby causing Tissue Hypoxia[1]. WHO defines Anaemia as the lack of RBCs or Haemoglobin below 12g/dL for adult non pregnant women[2]. According to WHO studies[3], globally the mean blood haemoglobin concentration among non pregnant women is 12.6g/dL, which is above the threshold for anaemia. But it is a major health problem worldwide as it affects nearly 500 million women and more than 1 billion women are at risk. Anaemia has also been subcategorized into Mild (Hb – 11-11.9 g/dL), Moderate (Hb- 8-10.9 g/dL) and Severe (Hb <8 g/dL) based on Haemoglobin levels. Studies by Anu Ramamohan and Niyi Awofeso have showed that anaemia has a prevalence rate of 47% among South Indian Women.

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Chronic Anaemia contributes to large proportions of morbidities among women worldwide. It causes a decrease in productivity of a society on a larger scale, thereby affecting the state. Anaemia can be either due to decreased red cell production or increased red cell loss/ destruction. The decreased production is caused by Iron and Vitamin B9 /B12 deficiency. Increased destruction or loss of RBCs can be in the form of Chronic Bleeding conditions and hemoglobinopathies. Anaemia causes tissue hypoxia initiating cardiovascular and erythropoietic compensatory mechanisms like Tachycardia and increased stroke volume leading to cardiac stress. In South Indian Women, eating habits, soil nutrients and the lifestyle culminate and result in folate or iron deficiency anaemia.

Anaemia also leads to defects in neurotransmitter development and myelination which can slow down the conduction rate in neurons. Anaemia leads to tissue hypoxia in neurons, which decreases the rate of impulse transmission as the synthesis of several neurotransmitters is dependent on oxygen requiring rate limiting enzymes[4]. Ganesh K Kumar et al have reported that chronic hypoxia in neurons due to various causes including anaemia, leads to a decrease in synthesis of neurotransmitters like Acetyl Choline, Glutamate and others by transcriptional mechanisms and decreased activation of Oxygen dependent regulatory enzymes[6]. Chronic hemorrhagic conditions in gastrointestinal, genitourinary and respiratory diseases such as Abnormal Uterine Bleeding, haematuria can cause decreased Haemoglobin levels leading to Anaemia and tissue hypoxia. Also pathologic blood loss due to Haemoptysis, Worm infestations, Haemorrhoids etc can lead to Iron deficiency Anaemia[16].

Previous study on the effect of anaemia on nerve conduction by Degermenci Y et al showed that in iron deficiency anaemia there is a decrease in both motor and sensory nerve conduction velocity and Amplitude with an increase in Latency in a general population of 20-40 years in Turkey[4]. Similar studies on nerve conduction in Iron deficiency Anaemia was carried out in India by Anandhalakshmi et al on motor nerves of upper and lower limb and similar findings were reported[5]. But the number of studies on the effect of Anaemia on both sensory and motor nerve conduction were inadequate and the data was insufficient.

In our study, we have analysed and studied the effects of anaemia on nerve conduction in South Indian Women, which is the first such study on the given population.

AIM AND OBJECTIVES:

1. To assess Motor Nerve Conduction of Median nerve in upper limb and Peroneal nerve in lower limb.
2. To compare the Nerve Conduction Velocity (NCV) and amplitude between anaemic and non anaemic women.
3. To correlate Haemoglobin concentration and Nerve Conduction Velocity NCV in Anaemic patients.

MATERIALS AND METHODS:

Sample size Calculation: It is a cross sectional study, conducted after obtaining permission from the UGRMC and the Institute Ethics Committee of the institute. Sample size was calculated to be 33 in each group using open epi software.

Recruitment of Subjects:

For the Anaemic population, i.e. study group the volunteers were recruited from the Gynaecology OPD and Ward, after inferring their Haemoglobin concentration and other Complete Blood Count (CBC) status. The number of anaemic women taken for the study was 33. The Anaemic patients were divided into 3 Groups –Mild,

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Moderate and Severe based on their Haemoglobin values, according to the WHO classification of severity gradations in anaemia[3].

- Mild Anaemia – Hb From 10.0-11.9 g/dL
- Moderate Anaemia - Hb from 8.0-10.9 g/dL
- Severe Anaemia - Hb less than 8.0 g/dL

Inclusion Criteria:

Study group

- Females, age between 18 to 40 years.
- BMI = 20-30 Kg/m².
- Known anaemic patients due to abnormal uterine bleeding, benign ovarian tumors and menorrhagia.
- Hb concentration range = 7-12 g/dL of blood.

Control Group

Volunteers were recruited among the healthy staff and students of our institute. The subjects were screened for Complete Blood Count (CBC) Parameters and were selected accordingly. The Haemoglobin and the CBC parameters were found out using Auto analyser by Spectrophotometry method. For this screening, 2 mL of blood was withdrawn from the volunteers following aseptic precautions. The numbers of volunteers screened were 45. The numbers of volunteers selected and studied were 33.

Inclusion criteria:

- Females aged between 18 to 40 years.
- BMI = 20-30 Kg/m².
- Healthy participants without anaemia due to any cause. Hb concentration range >12 g/dL of blood.

The Exclusion criteria common to both study and control groups was:

- Anaemia due to Carcinomas, Bone marrow defects and Pulmonary Tuberculosis etc.
- Hypertension.
- Thyroid disorders.
- Pregnant women and lactating mothers.
- Nerve conduction defects due to any other cause i.e., congenital demyelination defects, carpal tunnel syndrome, Diabetes Mellitus etc.

After Haemoglobin screening, Nerve conduction studies for the study and control subjects were conducted at the Electrophysiology lab, Department of Physiology. The duration of the study was 45 minutes. The study was conducted in the morning between 10-10:45 AM. The apparatus used for the study was EP/EMG machine, Neuropack M1, Model: MEB 9200 K. The anthropometric parameters and vital signs of the subjects were taken before the start of the study. For Motor nerve Conduction study, the Median nerve in Upper limb and Peroneal Nerve in Lower limb were studied.

Motor Nerve Conduction Study:

For the measurement of motor conduction velocity the nerve was stimulated at two points (distal and proximal points) and corresponding Compound Muscle Action Potential (CMAP) is recorded from the muscle supplied by that nerve.

For median nerve conduction study the active electrode was placed over the belly of abductor policis brevis muscle and for peroneal nerve the recording electrode was placed over the muscle belly of extensor hallucis

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brevis. The motor nerves are stimulated at two sites (proximal and distal) and the latency and amplitude are obtained. Nerve conduction velocity was obtained from the proximal and distal latencies.

OBSERVATION AND RESULTS:

Statistical Analysis:

The data were analysed using SPSS version 19. The Normality of Data was tested using Kolmogorov – Smirnov test. P value < 0.05 has been considered as statistically significant. The parameters are compared between the study and the control group by student's t test.

Table 1- Comparison of Anthropometric parameters and Haemoglobin concentration between study and control group:

Parameter	Study Group (n=33)	Control Group (n=33)	P value
Haemoglobin (g/dl)	10.4±1.4	12.8±0.5	0.000*
Age (Y)	34.69±7.82	32.39±7.86	0.5
Height (cm)	152.20±6.80	154.10±6.10	0.3
Weight (Kg)	58.39±11.72	60.27±9.84	0.07

Values are expressed as mean ± SD. Analysed by unpaired Student 't' test.

*P value less than 0.05 is considered statistically significant

Table 2- Comparison of Nerve Conduction Parameters between Study and Control groups:

Motor Nerve	Parameter	Study Group (n=33)	Control Group(n=33)	P value
Median Nerve	Latency (ms)	3.51±0.51	3.16±0.50	0.006*
	CMAP(mV)	11.78±3.44	11.88±3.12	0.9
	MNCV (m/s)	53.90 ±4.10	57.20±3.69	0.001*
Peroneal Nerve	Latency (ms)	3.97±0.73	3.58±0.41	0.012*
	CMAP(mV)	6.69±3.86	7.99±3.46	0.15
	MNCV (m/s)	48.46±4.60	52.00±4.30	0.002*

CMAP – Compound Muscle Action Potential , MNCV – Motor Nerve Conduction Velocity . Analysed by Independent student 't' test. *P value less than 0.05 is considered statistically significant

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Table 3- Correlation of Nerve Conduction Parameters and Haemoglobin concentration:

Motor Nerve	Parameter	r value	P value
Median Nerve	Latency (ms)	-0.1	0.112
	CMAP(mV)	-0.1	0.2
	MNCV (m/s)	0.4	0.000*
Peroneal Nerve	Latency (ms)	-0.19	0.12
	CMAP(mV)	0.16	0.18
	MNCV (m/s)	0.35	0.003*

CMAP – Compound Muscle Action Potential , MNCV – Motor Nerve Conduction Velocity . Analysed by Pearson's test. * P value less than 0.05 is considered statistically significant

DISCUSSION:

Comparison of anthropometric parameters and haemoglobin concentration between the study and control group is shown in Table 1. On comparison there was significant difference in haemoglobin concentration between the study and control group. There was no significant difference in age, height and weight between the two groups. Since age and height affect the nerve conduction parameters, the study and control groups are age and height matched. On comparison of median and peroneal nerve conduction parameters between the study and control group, there was a significant prolongation of latencies and reduction of nerve conduction velocities in study group when compared to the control group as shown in table 2. The results of our study are consistent with those conducted by Degermenci et al and Anandhalakshmi et al, which proved the association of Iron deficiency anemia and defect in motor nerve conduction. According to Youdim[8] and Cook et al[9] iron deficiency causes alterations in many metabolic processes including mitochondrial electron transport, synthesis and degradation of neurotransmitters, and diminished synthesis of proteins that have an impact on the functioning of the nervous system. Iron deficiency is the most common cause of anaemia, worldwide. Iron plays an important role in various metabolic and enzymatic processes leading to decreased motor activity and intellectual functions. Enzymes such as monoamine oxidase (MAO), catalase and cytochrome oxidases of both central and peripheral nervous system are affected adversely by iron deficiency. In a study performed on sheep by El-Sebae et al, MAO levels were found to be decreased in peripheral neuropathy[7]. Kabakus et al. assessed nerve conduction parameters in median and posterior tibial nerves in 18 children with Iron Deficiency Anaemia with 12 healthy children as controls and found that in children with Iron deficiency Anaemia, nerve conduction velocity and distal amplitude values were lower when compared with controls [10]. M Roncagliolo et al have found evidence

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of altered central nervous system development in infants with Iron deficiency anaemia along with delayed maturation of auditory brainstem responses[11].

CONCLUSION:

We conclude from our study that, due to decreased quantity of myelination and decreased rate and amount of neurotransmitter synthesis, the nerve conduction velocity and CMAP or decrease and their latencies increase in Anaemic women when compared to Non-Anaemic women. This is one of the safest, reliable and non invasive objective tests that enables us to find out the effect of Anaemia on nerve conduction at the earliest thereby influencing our treatment modality for the patients. We suggest that Nerve conduction studies should be done for all anaemic patients to detect and prevent Peripheral Neuropathy when it is in the early reversible stage.

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