ASSESSMENT OF SENSORY NERVE CONDUCTION IN ANAEMIC SOUTH INDIAN WOMEN

Anantharaman Ganapathy[1] , Dhanalakshmi.Y[2], Chitra .T [3], Jothi Marie Feula A[4], Arun Kumar.B[5],

III Year MBBS, 7th semester[1,] JIPMER, Puducherry, Associate Professor[2], Additional Professor[3,] Senior Resident[4], Assistant Professor[5], [2,4]Department of Physiology, JIPMER, Puducherry, [3]Department of Obstetrics and Gynecology, JIPMER, Puducherry, [5]Department of Physiology, Saveetha medical college, Chennai,.

Abstracts: **Background & objectives:** Anaemia is a major health problem worldwide, as it affects nearly 500 million women and more than 1 billion women are at risk. Anaemia also leads to defects in neurotransmitter development and myelination which can slow down the conduction rate in neurons. This study was aimed to assess Sensory nerve conduction of median nerve in upper limb and Sural nerve in lower limb, to compare the sensory nerve conduction velocity (NCV) and amplitude between anaemic and non anaemic women and to correlate nerve conduction velocity and haemoglobin concentration. **Methods:** This was a cross sectional study. Individuals who met the inclusion criteria were recruited into the study. The subjects were screened for Complete Blood Count (CBC) Parameters and were selected accordingly. The Haemoglobin concentration was estimated using auto analyser by Spectrophotometry method. For this 2 mL of venous blood was withdrawn from the volunteers following aseptic precautions. The number of volunteers screened were 45. The numbers of volunteers recruited into study group were 33. Nerve conduction studies for the study and control subjects were conducted at the Electrophysiology lab, Department of Physiology. Sensory nerve conduction of the median nerve in upper limb and sural nerve in Lower limb were studied. **Interpretation and Results:** Subjects in the study and control groups were age, height and weight matched. Sensory nerve conduction velocity of median nerve was significantly reduced and the latency was prolonged in study group when compared to the control group. In sural nerve, the conduction velocity was reduced in the study group. **Conclusion:** We conclude from our study that, due to decreased myelination and decreased rate and amount of neurotransmitter synthesis, The Nerve conduction Velocity of peripheral nerves decrease and their latencies increase in Anaemic women when compared to Non-Anaemic women.

Key Words: sensory nerve conduction, anemia, median and sural nerve.

Author for correspondence: Dr. Dhanalakshmi.Y, Associate Professor, Dept .of Physiology, JIPMER, Puducherry. Mobile-9444781210, Mail- saidhanalakshmi04@yahoo.com.

Introduction:

Anaemia is a major health problem worldwide, as it affects nearly 500 million women and more than 1 billion women are at risk[1]. According to World Health Organisation (WHO) Anaemia is defined as the lack of RBCs or Haemoglobin concentration below 12g/dL for adult non pregnant women[2].WHO studies, have also stated that, the mean blood haemoglobin concentration among non pregnant women is 12.6g/dL, which is above the threshold for anaemia[1] Studies by AnuRamamohan and NiyiAwofeso have showed that anaemia has a prevalence rate of 47% among South Indian Women[3].

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 has varied effects spread across all major tissues and organs of our body. It may cause 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[4].

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[5].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[4].

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[6].

Material and Methods:

It was a cross sectional study, conducted after obtaining permission from the scientific and the Ethics Committee of the institute.

Sample size Calculation: Sample size was calculated to be 33 in each group using open epi software version 3.

Recruitment of Subjects:

For the Anaemic population, i.e. study group the volunteers were recruited from the Obstetrics & Gynaecology outpatient department 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.

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 concentration was estimated using auto analyser by Spectrophotometry method. For this 2 mL of venous blood was withdrawn from the volunteers following aseptic precautions. The number of volunteers screened were 45. The numbers of volunteers recruited into study group 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 sensory nerve conduction study, the median nerve in upper limb and sural nerve in Lower limb were studied.

Sensory Nerve Conduction Study:

Median Nerve: The electrode placement areas were cleaned with spirit cotton. Recording electrode was placed at the proximal phalanx of the middle finger of the upper limb to be tested. The

reference electrode was placed 4cms distal to the recording electrode in the distal phalanx of the middle finger. Stimulation is applied 14cms proximal to the recording electrode along the course of the nerve at the level of the forearm in between the tendons of palmaris longus and flexor carpi radialis. The stimulus was increased from 0 mill amperes till the maximal amplitude of the Sensory Nerve Action Potential (SNAP) was obtained. The stimulus was increased by 20% to obtain the supramaximal stimulation of the nerve[19]. The responses were averaged to 10 times to obtain the final SNAP. The peak latency and amplitude of the SNAP was compared with the Standardised values in the lab.

Sural nerve: The electrode placement areas were cleaned with spirit cotton. Recording electrodewas placed behind the lateral malleolus of the lower limb. The reference electrode was placed 4 cm distal to the recording electrode.Stimulation was applied 14cms proximal to the recording electrode along the course of the nerve in the mid-calf region on the posterior aspect[20]. Recording wasdone in a similar manner to the previous one.

The parameters measured were onset latency (ms), peak latency (ms) and amplitude. Nerve conduction velocity is obtained by the formula,

$$\text{Velocity} = \frac{\text{Conduction Distance (mm)}}{\text{Peak Latency (ms)}}$$

Result:

Statistical Analysis:

The data was 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 were compared between the study and the control group by student's t test. Correlation between haemoglobin concentration and sensory nerve conduction parameters was done by Pearson correlation test for normally distributed parameters and by Spearman's test for non-normally distributed parameters.

Observation:

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 (Years)	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

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

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 Sensory Neurological Parameters between Study and Control Groups:

Sensory Nerve	Parameters	r value	P value
Median Nerve	Peak latency (ms)##	-0.367	0.003*
	Amplitude (μV)#	0.254	0.040*
	NCV (m/s)#	0.185	0.137
Sural Nerve	Peak latency (ms)##	-0.317	0.011*
	Amplitude (μV)#	0.216	0.107
	NCV (m/s)#	0.383	0.002*

Analysed by unpaired student's 't'test, * P< 0.05 were considered statistically significant
SNCV – Sensory nerve conduction velocity

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

MNCV – Motor Nerve Conduction Velocity. #Analysed by Pearson's test. ##Analysed by Spearman test. * P value less than 0.05 is considered statistically significant

Sensory Nerve	Parameter	Study Group (n=33)	Control Group (n=33)	P value
Median nerve	Peak Latency (ms)	3.41±0.37	3.16±0.45	0.011 *
	Amplitude (μV)	47.46±19.75	60.27±34.61	0.069
	SNCV (m/s)	51.70±4.9	55.30±7.0	0.018 *
Sural Nerve	Peak Latency (ms)	3.97±0.96	3.71±0.82	0.240
	Amplitude (μV)	9.98±5.50	13.91±5.94	0.004 *
	SNCV (m/s)	46.50±6.40	50.70±6.30	0.009 *

Discussion: In our study, we have compared both the motor and sensory nerve conduction parameters in 33 subjects and 33 controls. There was a significant difference in haemoglobin concentration between the study and control group. Both the groups were height, weight and age matched as nerve conduction is dependent on age, height and weight of the individual. In median sensory nerve conduction study there was a significant prolongation of latencies and reduction of nerve conduction velocities in study group when compared to the control group (table 2). . The results of our study were consistent with the study conducted by Degermenci et al which reported a prolongation of latency and reduction of conduction velocity in Iron deficiency Anaemia.[4] Also in the current study on correlation of haemoglobin concentration and nerve conduction parameters, haemoglobin concentration was found to be negatively correlated with the latency of conduction and positively correlated with the nerve conduction velocity (Table 3). Youdim[9] and Cook et al[10] have stated that 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[11]

Conclusion:

We conclude from our study that, due to decreased myelination and decreased rate and amount of neurotransmitter synthesis, The Nerve conduction Velocity of peripheral nerves 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 in the early reversible stage

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