



## Comparison of Alpha Wave Appearance Time in EEG in Subjects ; hyper- Reactor and Normo-Reactor to Cold Pressor Test

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### ABSTRACT

*The autonomic nervous system performs and regulates automatic bodily functions associated with breathing, heart rate, blood pressure, digestion, and the hormonal system. The autonomic nervous system itself has two parts: sympathetic and parasympathetic. The sympathetic and parasympathetic nervous systems initiate the stress and relaxation response, respectively. There is normally a balance maintained between the activities of the sympathetic and parasympathetic nervous systems. Reactivity of blood pressure to cold stress has been used as a measure of existing autonomic nervous system activity level by many authors. Autonomic nervous system activity is influenced by Reticular Activating System activity and vice-versa, activity of central nervous system can be studied in electroencephalogram so a relationship between cerebral cortical electrical activity and cold pressor test reactivity of an individual is a possibility worth exploring. Purpose of study is to compare alpha wave appearance time in EEG in subjects hyper- reactor and normo-reactors to cold pressor test. The subjects comprised of both male and female 120 young medical students of age group 18 to 21 years and selected randomly. Alpha appearance time in EEG in hyper-reactors is significantly more when compared to normo-reactors at 0.001 level of probability.*

**KEYWORDS : EEG, Cold Pressor Test, Hyper-reactor, Normo-reactor**

### Introduction :

The human nervous system is very complex and consists two major divisions: central and peripheral. The peripheral nervous system includes the autonomic nervous system, which has a particular association with negative psychological states such as stress, anxiety, and depression. The autonomic nervous system performs and regulates automatic bodily functions associated with breathing, heart rate, blood pressure, digestion, and the hormonal system. The autonomic nervous system itself has two parts: sympathetic and parasympathetic. The sympathetic and parasympathetic nervous systems initiate the stress and relaxation response, respectively. There is normally a balance maintained between the activities of the sympathetic and parasympathetic nervous systems. Chronic stress can disturb this balance and thereby cause stress-related health problems to arise. When one is exposed to a physiological or psychological stressor, the brain initiates a stress response, from which a series of chemical reactions ensue. The stress response is a healthy defense mechanism and involves the release of hormones that have numerous biochemical and physiological effects. However, the continued release of these hormones under conditions of chronic stress can have detrimental effects on health. Indeed, the hormonal response associated with long-lasting stress increases the risk of many diseases, including heart disease, stroke, and angina. Stress hormones also trigger increases in blood pressure, heart rate, and respiration and raise the risk of stroke, heart attack, and kidney diseases. Cognitive and physiological processes of the central nervous system associated with stress are known to affect most organs of the human body.

Reactivity of blood pressure to cold stress has been used as a measure of existing autonomic nervous system activity level by many authors. Autonomic nervous system activity is influenced by Reticular Activating System activity and vice-versa, activity of central nervous system can be studied in electroencephalogram so a relationship between cerebral cortical electrical activity and cold pressor reactivity of an individual is a possibility worth exploring.

**Objective of Study:** Comparison of alpha wave appearance time in EEG in subjects hyper- reactor and normo-reactor to cold pressor test.

**Material and Method-** The present work was undertaken in department of physiology, N.S.C.B. Medical College, Jabalpur, M.P. The subjects comprised of both male and female 120 young medical students of age group 18 to 21 years, selected randomly, studying in first M.B.B.S.classes.

**Cold pressor test:** Cold pressor status of all the cases was determined by doing the cold pressor test, described by Hines and Brown (1933) in the following manner. Every subject was allowed to rest in a calm, quiet and comfortable room in supine position, for a period of 30 minutes. Prior to the rest period, nature of the test was explained to the subjects, so as to allay any undue apprehension in the students. Then by Auscultatory method, blood pressure was recorded by mercury sphygmomanometer every 10 minutes until last two consecutive readings were identical. With the subject still in supine position cuff of the sphygmomanometer tied in right arm, the left hand was immersed in ice cold water (at 4 deg C) up to just above wrist level. The hand was kept immersed in ice cold water for 60 seconds i.e. one minute. Immediately after 60 seconds, blood pressure reading was taken, and hand was withdrawn from ice cold water. Another blood pressure reading was taken 60 seconds after the removal of hand from ice cold water.

Based upon the recordings of blood pressure of subjects, they were differentiated into two groups using the criteria for Hyper-reactors and Normo-reactors to cold pressor test according to Hines and Brown (1933 & 1936- AM. Heart.J. 11:1-9 Jan. 1936) (2).

**Hyperreactors:** Those subjects in whom systolic blood pressure increased by 20 or more mm of Hg and/or diastolic blood pressure increased by 15 or more mm of Hg.

**Normoreactors:** Those subjects in whom rise in systolic blood pressure was less than 20 mm of Hg and/or rise in diastolic blood pressure was less than 15 mm of Hg.

### EEG recording for Alpha wave Appearance Time:

For recording of EEG, Medicare 8-channel EEG Machine was used. Students were instructed to come with certain preparations. They were requested to wash their hair and scalp with soap or preferably shampoo and not to apply any oil to their hair or scalp on the day their EEG was to be done.

The EEG of students was recorded on Medicare 8-channel EEG Machine using 10/20 international system of electrode placement over scalp. EEG recording was done for 1 minute, with the subject's eyes open. Then the subject was asked to close his eyes. The genesis/appearance of alpha wave was studied in the posterior i.e. occipital lobes bilaterally. Calculation of alpha appearance time was done as follows:

Because EEG paper moved at a speed of 5 cm = 50 mm in 1 second i.e. 1000 milliseconds. Therefore, 1 mm distance on EEG paper represented 20 milliseconds. Distance on EEG paper from the point of closure of eyes to appearance of alpha wave was measured. This distance in mm when multiplied by 20 gave the alpha appearance time, in EEG, in milliseconds.

#### Observation:

**Table- 1**

**Table showing mean age of the students**

Cases	Number	Mean Age (in years)	F-value	p-value
Total	120	18.90±0.95	1.94	>.05
Male	62	19.01±1.0		
Female	58	18.78±0.88		

**Table-2**

**Cold pressor test:- systolic elevation in whole study sample, male and female groups**

Cases	No	Mean rise in Systolic B.P.(in mm of Hg)	t value	P value
Total	120	13.11 ± 6.27	10.85	<.001
Male	68	14.87±6.59		
Female	52	11.24±5.36		

**Table-3**

**Cold Pressor Test :- Diastolic Elevation in Whole Study sample, Male and Female groups**

Cases	No	Mean rise in Diastolic B.P.(in mm of Hg)	t value	P value
Total	120	8.60±4.10	5.74	<.05
Male	62	9.54±4.30		
Female	58	7.69±3.70		

**Table-4**

**Comparison of Alpha wave Appearance Time in EEG in Subjects Hyper-reactor and Normo- reactor to Cold Pressor Test**

Cold Pressor Status	No	Mean Alpha Appearance time in EEG (in milliseconds)	t value	P value
Normo-reactor	86	438.78±187.15	8.46	<.001
Hyper-reactor	34	914.12±305.75		

#### Result:

1-The subjects chosen for this study (n= 120) were young medical students having a mean age of 18.90±0.95 years. Males (n= 62) among them were averaging 19.01±1 years and females (n= 58) averaged 18.78±0.88 years. There was no statistically significant age difference between male and female groups; and they formed a single age group [Table 1].

2- In cold pressor test, the mean rise in systolic B.P. of whole group was 13.11±6.27 mm of Hg whereas that of males and females was 14.87±6.59 and 11.24±5.36 mm of Hg, respectively. Because P value was less than 0.001, hence it is evident that a very highly significant difference exists between male and female groups; systolic rise being higher in males as compared to females [Table 2].

3- In cold pressor test, rise in diastolic B.P. of whole group was 8.60±4.10 mm of Hg. Diastolic elevation was significantly higher [P less than 0.05] in case of males [mean diastolic elevation 9.45±4.30 mm of Hg] as compared to females [mean diastolic elevation 7.69±3.70 mm of Hg] [Table 3].

4-Alpha appearance time in EEG in hyper-reactors was also significantly more [914.12±305.75] msec when compared to normo-reactors [438.78±187.15] msec at 0.001 level of probability[Table 4].

#### Discussion:

Alpha appearance time in EEG and rise in systolic and diastolic blood pressure in cold pressor test are associated strongly, as the hyper-reactor group in the cold pressor test had significantly higher alpha

appearance time as compared to normo-reactors [t= 8.46, P<0.001] [Table 4]. Cold pressor test is a basically physiological stress test and it directly influence to autonomic nervous system and autonomic nervous system activity is also influenced by Reticular Activating System activity, a relationship between cerebral cortical electrical activity and cold pressor reactivity of an individual is a possibility worth exploring. Reactivity to cold pressor test and alpha appearance time in EEG can be used as predictors to assess the anxiety level in a subject.

#### Conclusion:

Alpha wave appearance time in EEG in hyper-reactors is very high significantly more when compared to normo-reactors at 0.001 level of probability.

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