



A Study of choline in Learning and Memory of Medical Students

Physiology

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ABSTRACT

Aim: The purpose of this study is to investigate the Acetylcholine in learning and memory of medical students. Acetylcholine is a very common neurotransmitter, being found in central, peripheral, autonomic and somatic nervous systems. Chemically, acetylcholine is an ester of acetate (acetic acid) and choline. Choline is a natural amine and an essential nutrient in the Vitamin B group. It is created in certain neurons by the enzyme choline acetyltransferase from the choline and acetyl-CoA. CoA is created by mitochondria and is common throughout the body. **Design/Methods:** This is a descriptive Study and 90 medical students selected depending upon the university exam marks. **Results:** P value is < 0.001 which is significant increased serum acetylcholine concentration in good students when compared with average and poor students. **Conclusions:** We conclude that Medical students to improve take choline rich foods are more prone to develop learning and memory.

KEYWORDS:

Choline, Acetylcholine and CoA

I. Introduction

Acetylcholine is an important neurotransmitter in the nervous system. It is found in both peripheral and central nervous systems as well as in the cardiovascular and neuromuscular systems. While acetylcholine activates muscles and seems to produce predominantly excitatory responses in the peripheral nervous system, it is mainly a neuromodulator in the central nervous system¹. As a neuromodulator, acetylcholine helps sustain attention by enhancing sensory perception while we are awake. While we are asleep, it promotes the REM (rapid eye movement) stage of sleep. The acetylcholine pathways in the brain represents areas where there are high concentrations of the neurotransmitters as well as the cholinergic nerves that help transmits signals mediated by it. These pathways involved usually terminate at or pass through the cortex and hippocampus, areas of the brain involved in attention, learning and memory².

There are two main types of acetylcholine receptors in the body. These are muscarinic and nicotinic receptors. Muscarinic receptors are activated by both acetylcholine and muscarine but are blocked by atropine³. They can be found in both the central and peripheral nervous systems as well as in the lungs, heart, sweat glands and gastrointestinal tract. Nicotinic receptors, on the other hand, are activated by nicotine and acetylcholine. They mostly found in on muscles and on nerve cells in the central nervous system⁴.

Acetylcholine is synthesized in nerve cells making up the cholinergic pathway especially those found in the basal forebrain. The neurotransmitter is produced from choline and acetyl CoA in a reactive step catalyzed by the enzyme, choline acetyltransferase⁵. Another enzyme, acetylcholinesterase, found in the synapses between nerve cells is responsible for breaking down acetylcholine into choline and acetate.

There are no dietary sources of acetylcholine and also acetylcholine supplements. Therefore, the best way to increases acetylcholine production in the brain is to increase the amount of choline in the body since choline is the direct precursor of acetylcholine and improve the learning and memory⁶.

II. Materials and Methods

1.1. Chemicals:

Acetylcholine and Acetylcholine esterase were purchased from Sigma chemical company, USA. All the other chemicals used were of analytical grade.

1.2. Experimental Design

This study was conducted in Meenakshi Medical college and Research Institute, Kanchipuram, over a period from Dec 2016 to December 2016.

The Final year MBBS medical students were divided in to three groups of thirty students each. Group I- Medical students served as Good Students (Toppers), Group-II as Average students and Group-III as

Poor students based on university marks and viva voce. All procedures were performed according to institutional guidelines.

1.3. Blood Collection:

Blood was withdrawn in amounts of 5-10 ml. from the animal or human subject into a tube containing 250 i.u. of heparin, dried on to its internal surface, and immediately centrifuged. To one volume of plasma two volumes of distilled water were added, followed by two volumes of a 10% w/v solution of trichloroacetic acid. The tube was shaken and the protein precipitate filtered off. The filtrate was extracted with ether until only faintly acid. A known volume of this extracted filtrate, usually 3 ml., was acetylated, using the open-crucible method of Mentzer, Corteggiani & Carayon-Gentil (1939): the filtrate was first evaporated almost to dryness in a porcelain crucible over a boiling water-bath, removed, covered, and allowed to cool. It was then treated for 10 min with 1 ml. of acetylchloride, re-evaporated on a water-bath at 700 C in a fume cupboard, and the residue taken up to five times the original volume of the extracted filtrate with eserized Ringer's solution. The pH of this solution was immediately adjusted to 4 with 0-1 N-NaOH or HCl and it was stored in the cold until assayed.

III. Statistical Analysis

Data were analyzed using the SPSS software package, version 17.0 (SPSS Inc., Chicago, Illinois, USA). Quantitative data were expressed using range, mean, SD, and median, whereas qualitative data were expressed as frequency and percentage. P value was assumed to be statistically significant at 0.05.

IV. ETHICAL CONCERN

Ethical clearance was obtained from the Ethical committee meeting conducted at Meenakshi Medical College and Research Institute, Kanchipuram, Tamil Nadu, India.

V. Results

Choline and Cholinesterase levels in Final Year MBBS medical students:

Table.1. shows that the levels of choline and cholinesterase in final year MBBS medical students. In Group-I . Good Medical Students(Toppers) were significantly increased ($p < 0.05$) choline and cholinesterase levels when compared with Group-II. Average Medical Students and highly significantly ($p < 0.001$) increased when compared with Group-III. Poor medical students.

Particulars	Group-I Good Medical Students (Toppers)	Group-II Average Medical Students	Group-III Poor Medical Students
Choline (ug/ml)	1.78 + 0.12	1.12 + 0.11a#	0.77 + 0.08a*
Cholinesterase (IU/L)	7342 + 781	6592+ 660 a#	6184+ 610 a*

Each value is expressed as mean + SD for Thirty final year MBBS medical Students in each group

a- as compared with Group-I (Good Medical Students)

Statistical Significance : *p<0.001, #p<0.05.

VI. Discussion:

Choline is an essential nutrient that plays a key role in memory, learning and our ability to think and it is used to make the neurotransmitter acetylcholine, which is responsible for memory recall, many functions related to memory and neuroplasticity. Low choline intake can result in a decrease in acetylcholine levels in the brain. Choline is the precursor for this excitatory neurotransmitter, which we know is intimately connected to memory and brain function. Acetylcholine is involved in several stages of memory, especially the encoding of new memories and learning^{6,7,8}.

This neurotransmitter is also involved in sustaining attention and helping us focus. It boosts sensory perception so that we remain more alert and can help us block our distractions so that we can direct our concentration appropriately.

When using choline supplements for memory, the primary goal is to provide cholinergic neurons with more of the raw materials needed to synthesize acetylcholine. Acetylcholine is made using the enzyme choline acetyltransferase, choline and acetate^{9,10}.

This enzyme is present throughout the body, but is particularly important at the neuromuscular

junction, where the nerve fibers terminate. Acetylcholine is released when a nerve impulse reaches a neuromuscular junction. It diffuses across the synaptic cleft and binds to cholinergic receptors on the muscle fibers, causing them to contract. Cholinesterase splits acetylcholine into its components, thus stopping stimulation of the muscle fibers. The endproducts of the metabolism of acetylcholine are taken up by nerve fibers and resynthesized into acetylcholine.¹¹

In the present study was very similar to Berns et al, 2001 reported that students memory and learning capacity depends on food source like egg, liver which contains choline rich foods.

VII. Conclusion

We conclude that Medical students to improve take choline rich foods are more prone to develop learning and memory. Choline for memory may be effective, but it is important to choose the right form of choline for supplementation for increased memory performance.

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