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3 Associaton between Blood Total Testosterone Levels and Consolidated Memory on Eldery Men at Veterans Institution

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Abstract

Background: Decreased total testosterone levels in the blood will disrupt memory consolidation. In this phase, one could still function normally even though it is difficult to recall the information that has been learned.

Methods: The subjects were taken consecutively and conducted by interview, generalist, and neurological physical examination, Word List Memory Task examination twice as well as measurement of total testosterone in the blood. The subjects were grouped into total blood testosterone levels of less than 298 ng/dl and more than equal to 298 ng/dl.

Results: Fifty-four subjects studied obtained that total blood testosterone levels <298 ng/dl in the Word List Memory Task (WLMT) group <21 (62.5%) were higher than the WLMT group ≥21 (37.5%). Furthermore, Total Testosterone in the blood more ≥298 ng/dl in the WLMT group <21 (15.2%) was less than in the WLMT group ≥21 (84.8%).

Conclusion: There was a correlation between total testosterone levels in the blood and memory consolidation in elderly men at the Veterans' Institute of Republic Indonesia in Surabaya.

Keywords: Elderly men, Total Testosterone in the Blood, Consolidation of Memory, Neurology

Introduction

It is estimated that the world population is 7 billion, up from 6.5 billion in 2006. The increase in number is followed by an increase in people aged 60 years and over¹ Between 1970 and 2025, the number of elderly people is expected to increase by 223% or about 694 million. In the year 2025, there will be about 1.2 billion people in the world aged 60 years and over then soon will be 2 billion in 2050². Increases occur in many developing

countries, including Indonesia. The increasing number of elderly people in the world brings several problems in the health field³ Health problems of decline in cognitive function will affect the pattern of interaction with the elderly living environment, with family members and social activities. This will add to the burden of families, the environment, and society⁴

In the aging process, there will be a circadian rhythm disorder that is a biological process that shows endogenous oscillations and recurs every 24 hours, including sleep-wake cycle, heart rate, blood pressure, hormone secretion, sensory ability, and mood are all governed by the hypothalamus.⁵

Disorders of hormone secretion possibility cause a decrease in total testosterone levels in men resulting in some symptoms and complaints such as cognitive and mood disorders as well as disorders of virility.

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Cognitive impairment is much complained by 39% of the population aged 50-59 years and increased to more than 85% at the age of over 80 years. Men (6,7) will experience a decrease in total blood testosterone levels of about 0.8-1.6% every year starting when entering the age of about 40 years.⁶ The decrease in total testosterone levels will disrupt the consolidation of memory so that there possibility complaints of forgetfulness. In this phase, one could still function normally even though it is difficult to recall the information that has been learned. However until now, the correlation between total testosterone levels and memory consolidation remains unclear.

Research on total testosterone levels with memory consolidation disorder in elderly men will be conducted at the Community of Veterans of Republic Indonesia⁸. This community consists of the struggle retired veteran (before independence), retired armed forces of Republic Indonesia (after Indonesian independence) and retired police⁹. The selection of Veterans Institution of the Republic of Indonesia in its population has a high well being educated, has the spirit to move and socialize and still pay attention to the importance of health problems¹⁰. So hopefully this community could help the smoothness of this research.

Examination of total blood testosterone levels needs to be performed, as the total blood testosterone levels could affect the formation of consolidated memory and the learning process, leaving the elderly easily to forget their memories.¹¹ Until now in Indonesia there is no research on this topic, therefore the authors are interested to determine the correlation between total blood testosterone levels and memory consolidation in the elderly male.

Methods

Fifty-four elderly men in Veterans of Republic Indonesia in Surabaya were enrolled from November 2014 to October 2015, attention function (Digit Span) >5, concentration function (Vigilance) >10, Mini-Mental State Examination (MMSE) >24, minimum level of senior secondary education or equivalent, willing to participated the research (informed consent). The method was performed according to consecutive cases (sampling from consecutive admission) until the sample number has been reached to set. Then, it was conducted an interview, performed memory check word list memory task twice and laboratory on participants

who meet the criteria for inclusion.

This was an observational analytic with the cross-sectional approach and has obtained the approval of ethical clearance from the ethics committee of Dr. Soetomo General Hospital, Surabaya Indonesia. The dependent and independent variable data will be analyzed analytically by using chi-square. Data analysis results will be displayed in graphical form. The entire process of data analysis will be processed using the SPSS 21 computer program. (SPSS, Inc., Chicago, IL)

Results

Basic Characteristics of Research Subject

A total of 54 study subjects consisting of 8 subjects with total testosterone less than 298 ng/dl and 46 subjects with testosterone more than or equal to 298 ng/dl. Characteristics age of the subjects obtained; 60-65 years was 25 people (46.3%) and age 66-70 years was 29 people (53.7%). Educational Characteristics was high school graduate level by 52 (96.3%) and university graduate by two (3.7%).

The subjects with hypertension were 17 (31.5%) people, and those who not suffer were 37 (68.5%) people. Subjects with diabetes mellitus were 19 (35.2%) people and those without was 11 (35.8%) people. Subjects with dyslipidemia were 11 (20.4%) people, and those who did not suffer were 43 (79.6%) people. Active subjects smoked was 22 (40.7%) people, and who did not smoke was 32 (59.3%) people. Subjects with memory consolidation disorder were 12 (22.2%) people, and those with no memory consolidation problems were 42 (77.8%) people. Subjects with total testosterone levels less than 298 ng/dl were 8 people (14.8%), and subjects with total testosterone levels more than or equal to 298 ng/dl were 46 people (85.2%).

The correlation between Hypertension and Memory Consolidation

In subjects with uninterrupted consolidation who experienced hypertension was fewer by 2 people (4.1.8%) than non-hypertensive by 10 people (27.0%). This difference was not statistically significant or clinical, with $p = 0.300$ and odds ratio (RO) of 0.360 (CI 95% 0.070-1.864)

Correlation between Diabetes Mellitus and Memory Consolidation

In the subjects with consolidated disruption who had diabetes was 6 (31.6%) people more than those who did not have diabetes by 6 (17.1%) people. This difference was not statistically significant or clinical, with $p = 0.307$ and odds ratio (RO) of 2.231 (CI 95% 0.604-8.224)

The correlation between Dyslipidemia and Consolidation of Memory

In subjects with uninterrupted consolidation who experienced dyslipidemia was 2 (18.2%) people fewer than non-dyslipidemia by 10 (23.3%) people. This difference was not statistically significant or clinical, with $p = 1,000$ and odds ratio (RO) of 0.733 (CI 95% 0.136-3.965)

Correlation between Smoking and Memory Consolidation

In subjects with uninterrupted consolidation who smoked was 5 (22.7%) people more than non-smokers by 7 (21.9%) people. This difference was not statistically significant or clinical, with $p = 1,000$ and odds ratio (RO) of 1.050 (CI 95% 0.286-3.864)

Correlation between Education and Memory Consolidation

In the subjects experiencing the consolidation that interrupted with senior high school education was 11 (21.2%) people less than college education by 1 (50.0%) people. This difference was not statistically significant or clinical, with $p = 0.398$ and odds ratio (RO) of 0.268 (CI 95% 0.016-4.641)

Correlation between Total Testosterone Levels and Memory Consolidation

In subjects with impaired consolidation having total testosterone levels less than 298 ng/dl for 5 (62.5%) people, it more than those with testosterone levels greater than or equal to 298 ng/dl by 7 (15.2%) people. This difference was statistically and clinically significant with $p = 0.01$ and odds ratio (RO) of 9.286 (CI 95% 1.798-47.964). This means that subjects with a total testosterone level less than 298 ng/dl have a risk for memory consolidation disorder 9,286 times greater than subjects with testosterone levels greater than or equal to 298 ng/dl.

Discussion

In this study, there was a difference in the proportion of memory consolidation disorders in subjects with total testosterone levels less than 298 ng/dl and greater than or equal to 298 ng/dl. It was tested by chi-square test with $p = 0.01$ and odds ratio (RO) of 9.286 (CI 95% 1.798-47.964). Based on these data, it could be stated that there was a significant correlation between total testosterone levels and memory consolidation, where subjects with total testosterone levels less than 298 ng/dl have a risk for memory consolidation disorder 9.286 times greater than subjects with testosterone levels more or equal to 298 ng/dl.

Based on data, there was no statistically significant difference with $p = 0.307$ and the odds ratio (RO) 2.231 (CI 95% 0.604-8.243). Therefore, the status of diabetes mellitus was not a meaningful confounding factor for the occurrence of memory consolidation disorder¹². This possibly due to the good control of blood glucose in subjects suffering from Diabetes Mellitus. All subjects who suffer from Diabetes have received adequate therapy so that blood glucose levels during examination have been controlled. This was in accordance with the assertion that the correlation of intensive decreased blood glucose levels in diabetics to memory function impairment. The study concluded that intensive blood glucose control could be slowing the decline in cognitive function (CI 95% 1.02 to 1.19; $p < 0.0156$). While the condition of chronic hyperglycemia accelerates the decline in cognitive function¹³.

Hypertension was one of the confounding factors in this study. Some literature says that there is a correlation between hypertension and memory impairment. Hypertension often did not cause actual clinical symptoms so many hypertensive people did not realize it. If not treated, hypertension could cause coronary heart disease, heart failure, stroke, kidney failure and other problems such as memory function impairment. Hypertension causes narrowing of the blood vessels. Decreased blood flow to the brain due to the narrowing could cause the brain to become inefficient¹⁴.

Measures of cognitive function in 288 hypertensive patients were produced high blood pressure (mean systolic 154.7 ± 21.3 and diastolic mean 88.6 ± 92) that had the significant role to cognitive function, including memory function with $p < 0.001$.¹⁵

In data there was no significant difference between a statistic and clinical with $p = 0.300$ and the odds ratio (RO) 0.360 (CI 95% 0.070-1.864). So it could be stated that the status of hypertension was not a meaningful confounding factor for the occurrence of memory consolidation disorder. The study of 50 elderly patients with hypertension who performed cognitive examination using MMSE obtained the result of no difference in the cognitive disturbance between elderly and hypertension ($p = 0.331$). In contrast, other studies provide different results due to differences in subject research factors included in the inclusion criteria. Giordano included inclusion criteria ranging in age from 53 years to 94 years and male or female sex. While in this study the subject of research was aged 60 years to 70 years and all are male sex.

In Data there was no statistically significant difference in the value of $p = 1.000$ and the odds ratio (RO) of 0.733 (CI 95% 0.136-3.965). So it could be stated that in this study, dyslipidemia was not a significant confounding factor for memory consolidation disorder. This was in contrast to prospective longitudinal community studies of LDL cholesterol with the risk of dementia in elderly people. The result of increased LDL cholesterol correlates with the risk of dementia with an odds ratio of 3.1 (CI 95% 1.5 - 6.1). In other studies provide a controversial result that there was a weak correlation between levels of High-Density Lipoprotein Cholesterol (HDL-C) and Low-Density Lipoprotein Cholesterol (LDL-C) with dementia disorders. This result was similar to Table 2. In Table 2, there was no statistically significant difference in the value of $p = 1.000$ and the odds ratio (RO) of 1.050 (CI 95% 0.286-3.864).

There have been several studies on the correlation of nicotine to cognitive function especially attention, learning, and memory. The effects of nicotine on neuroplasticity are controversial. Even some research on the effects of nicotine on attention, learning, and memory provide heterogeneous results. Subject who smoked had improved performance in motor responses, good attention, and memory recognition, but had a disruption to learning and memory recall. There have been several studies on the correlation of nicotine to cognitive function especially attention, learning, and memory¹⁶.

In Data, there was no statistically significant difference with $p = 0.398$ and odd ratio (RO) 0.268

(CI 95% 0.016-4.641). So it could be stated that in this study, the level of education was not a confounding factor that meaningful for the occurrence of memory consolidation disorder. These results not in accordance with some studies on the correlation between education level and cognitive impairment to the risk of dementia. Previous studies mentioned that the level of education was a predisposing factor of cognitive impairment and dementia. While the research using MMSE (Mini-Mental State Examination) and CDT (Clock Drawing Test) on elderly cognitive function profile over 60 years showed significant result, that subjects who received more than nine years of education (senior high school, diploma or bachelor), has a cognitive function that classified as normal while the elderly who only educated 9 years more experienced a decrease in cognitive function¹⁸.

Based on the activity theory proposed Stanley to achieve successful aging, the elderly must remain active in both mental and physical activity. One of the mental activities is by undergoing formal education up to the highest level¹⁹.

Results from previous studies were different from current research. In the previous study, there was no significant correlation between MMSE score and testosterone levels. Most patients have had low MMSE results although testosterone levels are within the normal limits. While in this study the factors (attention, concentration, MMSE and sleep disorders also depressive disorders) will be inserted into the subject of research when getting a bad result. Therefore, the memory consolidation disorder could be concluded as a result of low levels of testosterone alone.

Conclusion

There was a correlation between total testosterone levels and memory consolidation in elderly men at the Veterans' Institute of Republic Indonesia in Surabaya.

Conflict of Interest: There is no conflict of interest.

Source of Funding: This study is self-funded.

Ethical Clearance: This study was approved by Ethical Commission of Health Research Faculty of Medicine University of Airlangga.

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