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Comparison Profile of Quality of Life, Phosphorylated-Tau, and Superoxide Dismutase Plasma in Women Elderly with and without Dementia

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ABSTRACT

Accumulation of phosphorylated-tau and low levels of superoxide dismutase is associated with dementia affecting the quality of life in the elderly. This study aimed to determine differences in quality of life (QoL), phosphorylated-tau (p-TAU), and superoxide dismutase (SOD) plasma in women elderly with and without dementia. The research method was a cross-sectional study. Examination of dementia using MMSE (Mini-Mental State Examination) and CDR (Clinical Dementia Rating Scale). The measure of the quality of life using the WHO-QoL questionnaire and plasma level of p-TAU and SOD using ELISA (Enzyme-linked Immunosorbent Assay). The research sample consisted of 70 women elderly mean aged 74.69 ± 9.27 years who lived in three nursing homes. Data analysis used fisher test, independent sample t-test, Mann-Whitney test, and linear regression test. The findings showed that the quality of life differed significantly in the domain of physic (p=0.001), social-relationship (p=0.002), psychological (p<0.001), environment (p<0.001), and plasma level of p-TAU (p=0.028) and SOD (p<0.001) in women elderly with and without dementia. In term of its association with dementia, p-TAU (p=0.001), SOD (p=0.003), MMSE (p=0.028), and QoL-social (p=0.176) were final model factors of dementia in women elderly. In conclusion, there are significant differences in quality of life, p-TAU, and plasma SOD between women elderly with and without dementia.

Keywords: Dementia, elderly, phosphorylated-tau (p-TAU), SOD, quality of life (QoL)

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INTRODUCTION

Dementia causes a decline in intellectual, social, and physical functioning which can have a profound impact on the quality of life for people with dementia, their families, and their caregivers (1). In 2015 there were approximately 46.8 million people with dementia worldwide and it is predicted that this will continue to increase, especially in countries with lower and middle economic levels, including Indonesia. Given that there is no cure for dementia, efforts are needed to improve a better quality of life and reduce the risk of dementia for the next generation (2).

Predictors of dementia factors can be said to be biomarkers of dementia. A biomarker is a feature that can be objectively measured and analyzed as an indicator of normal biological or pathogenic processes or pharmacological responses to a treatment intervention (3). Accumulation of phosphorylated-tau and low levels of superoxide dismutase is associated with dementia (4) (5). Per mole of TAU in the normal brain, there are 2-3 mols of phosphate. TAU is hyperphosphorylated to at least three times greater than normal stoichiometry in the dementia brain, endorsing the notion that phosphorylation is a critical stage in the process of aggregation. Hyperphosphorylated forms of TAU often contribute to increased development of reactive oxygen (ROS) species and decreased detoxifying enzyme activity, including superoxide dismutase (6). Superoxide dismutase (SOD) is associated with vascular/neuro-inflammation control (7). Research on predictors of dementia factors in Indonesia is still limited. This study aimed to determine differences in quality of life (QoL), phosphorylated-tau (p-TAU), and superoxide dismutase (SOD) plasma in women elderly with and without dementia.

MATERIAL AND METHODS

Study Participants

The research subjects were 70 people who were divided into 2 groups, 35 elderly women with dementia and 35 people without dementia. All elderly came from three nursing homes in town B. The inclusion criteria in this study were elderly women aged > 60 years, had good hearing and vision, and were willing to be the subject of this study. Dementia screening uses the CDR (Clinical Dementia Rating Scale) and MMSE (Mini-Mental State Examination) questionnaire. The MMSE (Mini-Mental State Examination) consists of 30 questions with a cut off of 23 for dementia determination (8). Meanwhile, the CDR (Clinical Dementia Rating) consists of 5 questions with an assessment score of 5 scales, namely 0: no cognitive impairment, 0.5: very mild dementia, 1: mild, 2: moderate, and 3: severe (9).

Etichal consideration

This research has obtained written consent from the elderly and the nursing staff as guardians who are responsible for the elderly in the nursing home. This study was conducted by the Standard Ethics outlined in the Declaration of Helsinki and has received approval from the Research Ethics Commission of Padjadjaran University (No.1266/UN6.KEP/EC/2018).

Measurement of quality of life

Examination of the quality of life used the WHO-QoL questionnaire that consisted of 26 questions divided into four domains, namely physical (7 items), psychological (6 items), social relations (3 items), and environmental (8 items). The highest score is 100 (10).

Blood plasma examination

Blood samples of 3 ml in elderly women with dementia and non-dementia were taken using an EDTA tube containing heparin and stored at -8 ° C. Examination of p-TAU and SOD plasma levels using HPLC with the ELISA (Enzyme-linked Immunosorbent Assay) method at the Molecular Genetics Laboratory, Faculty of Medicine, Padjadjaran University.

Data collections

Sociodemographic data includes age, education, and marital status. The education category is divided into two, namely low and high education. Low education includes no school, elementary school, and junior high school. Meanwhile, high education includes senior high school and tertiary education. Marital status includes married and unmarried (never married/widowed).

Statistical Analysis

Data were analyzed using SPSS version 25 with a confidence value < 0.05. For determining distribution data, the Kolmogorov Smirnov test is used. The difference in variables between the two groups was determined using the Fisher test, the independent sample t-test, and the Mann-Whitney test. Meanwhile, a multiple linear regression test was used to determine the final model related to dementia.

RESULTS

Data collected from 70 elderly women showed a significant difference in CDR scores (p <0.001) and MMSE (p <0.001) between the two groups.

Characteristic of Subject

Based on sociodemographic data, there were no significant differences in age (p = 0.838), education (p = 0.355), and marital status (0.214) between the two groups. Meanwhile, CDR, MMSE, quality of life, and blood plasma data showed a significant difference of p-TAU plasma (p = 0.028) and SOD plasma (p <0.001) between the two groups (Table 1).

Table 1. Comparison of profile in women elderly with and without dementia

Variable	Dementia (n=35) Median (min-max)	Non-dementia (n=35) Median (min-max)	p value
CDR	7.5 (2-17)	2 (0-8)	<0.001*
MMSE	18 (0-23)	26 (25-29)	<0.001*
Age	73 (60-95)	76 (55-92)	0.838
Education (n, %)			
Low	30 (48.4)	32 (51.6)	0.355
High	5 (62.5)	3 (37.5)	
Marital status (n, %)			
Married	2 (28.6)	5 (71.4)	0.214
Unmarried	33 (52.4)	30 (47.6)	
Quality of Life			
Physic	38 (13-63)	44 (31-69)	0.001*
Psycologic	44 (13-69)	56 (31-75)	<0.001*
Social relationship	44 (6-75)	50 (19.75)	0.002*
Environtment	50 (25-88)	63 (38-94)	<0.001*
Blood plasma			
p-TAU (pg/ml)	67.37 (47.10-940.88)	56.46 (46.56-94.31)	0.028*
SOD (ng/ml)	0.86 (0.03-6.81)	2.66 (0.45-10.06)	<0.001*

*p< 0.05, fisher test, independent sample t-test and mann-whitney

The results of multiple linear regression tests showed that MMSE (p = 0.028), QoL-social relationship (p = 0.176), plasma SOD (p = 0.003), and p-tau plasma (p = 0.001) were the most associated with dementia (Table 2).

Table 2. Final model factors associated with dementia

Characteristics	Unstandardized B	Standar Error	Standardized B	T	p
(Constant)	0.77	0.13		6.07	<0.001*
MMSE	0.02	0.01	0.30	2.25	0.028*
QOL-social relationship	-0.01	0.00	-0.12	-1.37	0.176
SOD	0.06	0.02	0.25	3.11	0.003*
p-tau	-0.01	0.00	-0.25	-3.33	0.001*

*p<0.05; p-value were derived from multiple linier regression test, R^2=64.8%

DISCUSSION

Comparison Profile of Quality of Life in Women Elderly with and without Dementia

The findings of this study showed that there are substantial variations between the two groups in the four areas of quality of life. This is in line with research that indicates that the quality of life of elderly persons with dementia and non-dementia varies (10). Moreover, the final model shows that the quality of life of the social relationship domain is the factor most associated with dementia. This is consistent with research that low social participation, infrequent social contact, and loneliness are statistically significantly associated with dementia incidence (11).

The World Health Organization defined QoL as an individual's perception of their position in life, In the

context of the culture and value systems in which they live and about their goals, expectations, standards and concerns (12). It is a broad concept that is affected by the individual's physical health, psychological status, personal beliefs, social relationships and relationships with influential environmental characteristics in a complex way (13).

Elderly with dementia have a more complex quality of life. This shows that the quality of life of the elderly with dementia is not only based on cognitive limitations but also behavioral and psychological disorders experienced (1,14). The factors that influence the perception of quality of life in elderly with dementia are mood, self-belief, self-efficacy, and expectations (15).

Cognitive function refers to the ability to learn, train and remember information; it also reflects the complexity of assigned intellectual functions such as judgment and evaluation (16). Besides, cognitive decline significantly interferes with normal day-to-day functioning and the ability to learn, such as poor self-care (17). Decreased memory can result in limitation of the patient's ability to learn, perform self-care, and adherence to medication (16).

Dementia affects people with the disorder who gradually lose their skills, as well as their families and other supporters, who have to deal with the disease and deterioration of a family member or friend when reacting to their needs, such as increasing dependence and behavioral changes (18). Data showed that better cognitive performance is associated with better self-rated quality of life (19). The QoL of elderly patients is negatively affected by cognitive disabilities, depression, and other psychiatric problems along with medical illness. There was a positive correlation between the total score of MMSE and QoL and the subfields of "social participation", "death and dying" and "intimacy." After linear regression analysis, MMSE and GDS-15 scale scores were the most potent negative QoL predictors. (20).

Comparison Profile of p-TAU in Women Elderly with and without Dementia

Tau is a microtubule-associated protein (MAP) that regulates the assembly, dynamic behavior, and spatial organization of microtubules (MT) under physiological conditions (21). There is a substantial difference between p-TAU levels in elderly women with dementia and non-dementia in the findings of this study (p=0.001). This is consistent with research that showed p-TAU level in the elderly with dementia is higher than non-dementia (22). TAU proteins have a role in neuron microtubule stability, and promoting microtubule growth (23). Instead of cerebrospinal fluid total tau levels, p-TAU levels can be viewed as a possible biochemical marker for dementia with strong sensitivity and specificity, since it specifically reflects axon degeneration (24) .

Brain tau accumulates in the neuronal in dementia and functions as paired helical filaments (PHF). It has been suggested that the defects begin with a modification of tau by phosphorylation at the single-cell level, resulting in a destabilization of microtubules leading to a stage of pre-tangle. After this point, microtubule destabilization leads to the loss of dendritic microtubules and synapses, the degeneration of the plasma membrane and eventually cell death (21). Increased CSF concentrations of tau can be viewed as evidence for a diagnosis when a patient suffers from dementia, with accuracy reaching 85 percent. The highest levels of p-TAU were observed in early onset Alzheimer's disease, followed by late onset Alzheimer's disease and mixed Alzheimer's disease and vascular dementia. The lowest levels were Parkinson's disease dementia and Lewy body dementia (25).

Tau proteins are biological markers in the elderly with Alzheimer's. This protein is found in the biological fluids of the elderly's body (26). This is in accordance with the research of Nam et al. which showed that there was a higher serum Tau protein level in elderly people with Alzheimer's (24). Phosphorylated tau protein is a biomarker with higher specificity and sensitivity than total tau (22,27).

Comparison Profile of Plasma SOD in Women Elderly with and without Dementia

There is a substantial difference between plasma SOD levels in elderly women with dementia and non-dementia (p=0.003) in the findings of this analysis. This is in line with studies that showed substantial variations in SOD activity between males and females in the control group and Alzheimer's dementia patients (28,29). Oxidative stress may be involved in many somatic and psychiatric pathological condition produce the characteristic lesions in dementia (30-32). Low levels of SOD increase dementia and other mortality factors in the elderly (26,28).

For dementia patients, oxidative stress plays a significant role in brain damage. Antioxidant defense mechanisms including vitamins E and C, carotenoids, metabolites such as uric acid or glutathione, and antioxidant enzymes regulate the biological effects of these highly reactive compounds. In order to prevent brain damage, SOD acts against free radicals and reactive oxygen species (ROS) by catalyzing the formation of hydrogen peroxide from super-radicals (28). The reduced CSF SOD activity in dementia may represent impaired mechanisms of radical defense and may have pathophysiological significance (33).

CONCLUSION

There is significant difference between the profiles of quality of life, phosphorylated tau, and superoxide dismutase plasma in elderly women with and without dementia. This difference is seen in the physical, psychological, social, family and environmental domains in quality of life, low value of superoxide dismutase plasma and the increase of phosphorylated tau.

CONFLICT OF INTEREST

The authors have no conflict of interest in writing this article.

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