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Hypertension and Cognitive Decline in Male Elderly

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Abstract

There is a high prevalence of hypertension in elderly. Patients with long duration hypertension will suffer from vascular structure damage including brain vessel. Chronic disturbance in brain vascularization will lead to cognitive decline. This research aimed to assess the association between hypertension and cognitive decline in elderly. Sixty male elderly (60-75 years old) from *posyandu lansia* in Surakarta were involved in this research. They were divided into 2 groups, hypertensive and normotensive, each group consisted of 30 subjects. Subjects with a history of head injury, intracranial tumor, and cerebrovascular disease were excluded from this study. Hypertension status was obtained from the medical record. Hypertension level was based on Joint National Committee VII (JNC VII). Cognitive function was assessed using the Montreal Cognitive Assessment (MoCA-INA). The mean age was 65.73 ± 4.07 years old in the hypertensive group and 65.17 ± 3.16 years old in normotensive group. There were significant differences in total MoCA-INA scores between hypertensive and normotensive (22 ± 4.28 versus 24 ± 5.56, $p < 0.01$). Hypertension level had a negative correlation with total MoCA-INA score ($r = -0.318$, $p < 0.01$). We conclude that cognitive function in elderly with hypertension is lower than normotensive. Hypertension level has a strong correlation with cognitive decline in elderly.

1. Introduction

Elderly is at risk for hypertension. The prevalence of hypertension is increasing with aging [1]. The blood vessel elasticity will decline in elderly. The decrease of elastic connective tissue and collagen deposit will lead to arterial stiffness [2]. Blood vessel remodeling will happen such as vascular smooth muscle cell hypertrophy then decrease the lumen diameter. These conditions will increase peripheral vascular resistance and blood pressure in elderly [3].

One of the target organs in a hypertensive patient is brain [1]. Hypertension makes early atherosclerosis process in intracranial and extracranial blood vessel [4]. The structure of the blood-brain barrier (BBB) is the key in brain homeostasis [5]. A study in human and animal model shows association between chronic hypertension and blood-brain barrier impairment [6, 7]. The alteration of BBB structure occur in big, medium, and small blood vessel [8]. The abnormality of structure and cerebrovascular function become brain pathogenesis because perfusion decline, micro bleeding and tissue ischemia [9].

Hypertension is a risk factor of cognitive function impairment. Some cross-sectional studies describe the association between hypertension and cognitive decline [10]. The National Health and Nutrition Examination Survey (NHANES) study showed hypertension status in elderly of ≥70 years old has a correlation with global cognitive performance [11].

In the other hand, there were some studies showed different results. A longitudinal study explored both population with Systolic Blood Pressure (SBP) of ≥160 mmHg and SBP of <100 mmHg has bad cognitive function [12]. A cross sectional study describes an association between high blood pressure with better global cognitive function [13]. The studies in hypertension and cognitive function showed different results. The aim of this study was to explore the association between hypertension level with cognitive function decline in elderly.

2. Methods

2.1. Participant

Sixty male elderly (age 60-75 years old) were included in this study. All participants were members of *Posyandu Lansia* and speak bahasa Indonesia fluently. They were divided into 2 groups: normotensive and hypertensive; each group had 30 participants. Informed consents were signed by all of the participants. Patients with a history of head injury, cranial tumor and cerebrovascular disease were excluded.

2.2. Data collection

History of the participant's diseases was taken from the medical record and confirmed with interview. The status and level of hypertension also were taken from medical record. Hypertension criteria were SBP ≥140 mm Hg or diastolic blood pressure (DBP) ≥ 90 mm Hg. Hypertension levels were grouped based on average blood pressure in the

medical record and based on The Seventh Report of Joint National Committee (JNC VII) classification [14]. Cognitive function assessment has done with validated Montreal Cognitive Assessment Indonesian version (MoCA-INA) [15]. MoCA-INA instrument consist of 30 test items including some cognitive domain such as memory, attention, orientation, naming, delayed recall and visuospatial. This instrument has been validated for 55-85 years old subject [16]. Compare to other instruments to assess cognitive function, MoCA is superior [17]. Some studies used MoCA to assess cognitive function decline or impairment [18, 19]. The differences MoCA-INA between normotensive and hypertensive were analyzed using Mann Whitney Test. The correlation between hypertension level and MoCA-INA score were analyzed using the Spearman correlation test.

3. Results and discussion

Table 1 describes basic characteristics of the participants based on normotensive and hypertensive group. The average age in both groups was similar. The average age in normotensive group was 65.167 $\pm$3.62 years old and 65.73 $\pm$ 4.07 in hypertensive group. The subjects in both groups were mostly 60-64 years old. The education level of participants showed that primary education was the most frequent (43.3%) and college/university is the lowest (11.7%).

The global cognitive performance assessed using MoCA-INA showed a significant difference between the normotensive and hypertensive group in elderly (Table 2). Hypertension status was taken from blood pressure measurement monthly and written in the medical record. This study results showed MoCA-Ina score has a negative correlation with hypertension level based on JNC VII.

This study analyzes cognitive function decline with MoCA-Ina instrument. Based on MoCA-Ina score, the hypertensive group has lower cognitive function compared to normotensive group. This finding is consistent with other studies that the increased blood pressure is correlated with cognitive function decline in elderly [12, 20]. A study showed SBP increasing contributes to early cognitive function decline [21].

This study showed hypertensive level has a negative correlation with cognitive function. This finding is consistent with a community-based research result subjects with SBP of $\geq$160 mmHg and DBP $\geq$ 90 mm Hg has lower verbal function [22]. A longitudinal study reported subjects with SBP $\geq$160 mmHg has worse global cognitive performance than subjects with SBP of <140 mm Hg [23]. Similar research showed increased blood pressure by 10 mmHg above baseline has a correlation with cognitive function decline in the next 20 years [24].

TABLE 1: Characteristics of participants.

Characteristic	Normotensive (n=30)	Hypertensive (n=30)	Total (n=60)
Age (years), mean ± SD	65.167± 3.163	65.73 ± 4.07	65.45±3.62
Age group (years old), n (%)			
60 – 64	16 (53.3)	14 (46.7)	30 (50)
65 – 69	11 (36.7)	11 (36.7)	22 36.7)
70 - 75	3 (10)	5 (16,6)	8 (13.3)
Education level, n (%)			
Primary	14 (46.6)	12 (40)	26 (43.3)
Junior high school	4 (13.3)	5 (16.7)	9 (15)
High school	7 (23.4)	11 (36.6)	18 (30)
College/University	5 (16.7)	2 (6.7)	7 (11.7)

TABLE 2: MoCA-INA scores on hypertension status and hypertension level.

	Total = 60 n (%)	MoCA-INA scores	p Value	r
Hypertension status				
Normotensive	30 (50)	24 ± 5.56	<0.01	-
Hypertensive	30 (50)	22 ± 4.28		
Level of hypertension				
Normal	21 (35)	24.68 ± 5.7		
Prehypertension	9 (15)	23.32 ± 5.4	< 0.01	-0.318
Stage I hypertension	13 (21.7)	22.61 ± 4.34		
Stage II hypertension	17 (28.3)	21.39 ± 4.22		

Hypertension causes cognitive function decline through cerebrovascular function impairment [9]. The remodeling and brain blood vessel stiffness lead to decrease brain blood flow at rest [25]. In patients with hypertension, the brain microvascular become thinner so decrease compensation ability by collateral vessel [26]. A hypertensive condition will activate auto-regulation to maintain brain blood flow at the stable level. The auto-regulation will prevent brain circulation damage, but the other side can cause brain ischemia when happened suddenly [27]. The other mechanism of cerebrovascular impairment in hypertension is atherosclerosis [4]. Hypertension leads to decrease anti-thrombotic and anti-atherogenic of the endothelial cell [28].

Perfusion impairment in the brain is the underlying of cognitive function decline [1]. The dominant cognitive domains affected by hypertension are memory and executive function [29]. Executive function is a process involves some brain functions to decide and problem solving [30]. The cognitive disturbance caused by hypertension related to neurodegenerative such as dementia. A study showed high blood pressure can increase the risk of dementia [31]. Although the evidence of hypertension affects cognitive domain

still unclear, some studies report blood pressure controlling improve cognitive decline risk in elderly [32, 33].

The limitation of this study is the small number subject involved. A bigger number of subjects is needed to generalize the result for population condition. Wider age subjects will give more information the effect of hypertension to cognitive function in various ages. Another limitation of this study is some factors affecting cognitive decline, such as diabetes mellitus, smoking, hypercholesterolemia and obesity are not analyzed

4. Conclusion

This study proves a significant different MoCA-INA score in normotensive and hypertensive participants. This result show global cognitive function in hypertension group is lower than normotensive. The significant correlation between hypertension level and MoCA-INA scores shows that hypertension level has a correlation with cognitive decline in elderly.

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