

Comparison of Cognitive Function between Intracerebral Haemorrhage Stroke Patients with and without Hypertensive Crisis

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Abstract

Background: Intracerebral haemorrhage (ICH) stroke is characterized by neurological dysfunction, caused by focal collection of blood within the brain parenchyma or ventricular system that is not caused by trauma. Hypertension is one of the main risk factors for intracerebral haemorrhage. Hypertensive crisis, which is a more severe type of uncontrolled hypertension may aggravate the cognitive outcomes. The aim of this study was to compare cognitive function between intracerebral haemorrhage stroke patients with and without hypertensive crisis.

Methods: This study was a retrospective comparative analytic study, combined with a case-control study from August to November 2020. All medical records of patients with intracerebral haemorrhage, who were admitted to Dr. Hasan Sadikin General Hospital Bandung in 2019, were collected. The total score of mini-mental state examination (MMSE) which was recorded in the medical record was taken and compared between groups using the Mann-Whitney test. The MMSE was conducted on the day of discharge, and the minimum education level of the patients was elementary school.

Results: We found a total of 109 medical records with ICH, 67 of which were with hypertensive crisis. The median MMSE score in the hypertensive crisis group was slightly higher than in the non-hypertensive crisis group. Furthermore, there was no statistical difference in MMSE scores between intracerebral haemorrhage patients with and without hypertensive crisis (p -value=0.439).

Conclusion: There is no difference in cognitive function between intracerebral haemorrhage patients with and without hypertensive crisis. Further study is of great value to explore the relation between intracerebral haemorrhage patients with and without hypertensive crisis.

Keywords: Cognitive function, hypertensive crisis, intracerebral haemorrhage

Introduction

Stroke is a rapidly developing clinical sign of focal or global disturbance of cerebral function, lasting more than 24 hours or leading to death, with no apparent cause other than that of vascular origin.¹ Stroke can be classified into ischaemic and haemorrhage stroke.² Intracerebral haemorrhage (ICH) stroke is a subtype of haemorrhage stroke, characterized by neurological dysfunction caused by a focal collection of blood within the brain parenchyma or ventricular system, which is not caused by trauma.¹ Although ICH accounts for only 10–20% of all strokes, worldwide it

causes 50% of stroke-related mortality and disability.^{3,4}

Hypertension is one of the main risk factors for intracerebral haemorrhage stroke.⁵ Uncontrolled hypertension can lead to hypertensive crisis.⁶ A hypertensive crisis can be defined as severe increase in systolic blood pressure greater than or equal to 180 mmHg and/or a diastolic blood pressure greater than or equal to 120 mmHg.⁷ Intracerebral haemorrhage can cause several negative outcomes, including cognitive impairment.⁴ The mini-mental state examination (MMSE) is a widely used assessment tool to assess global cognitive function. The MMSE has several

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advantages, including brevity and good validity, and has been translated and validated into various languages.⁸

Intracerebral haemorrhage in the presence of severe hypertension, such as a hypertensive crisis tends to have a high risk of hematoma expansion.⁹ Increased bleeding volume may worsen cognitive function. This study aimed to compare the cognitive function between

intracerebral haemorrhage stroke patients with and without hypertensive crisis on discharge day.

Methods

This study was a retrospective study with a comparative analytic method of two independent groups, using a case-control

Table 1 Characteristics of Intracerebral Haemorrhage Patients with and without Hypertensive Crisis

Characteristics	With Hypertensive Crisis (n=67)		Without Hypertensive Crisis (n=42)		p-value
	n	%	n	%	
Gender					
Male	31	46	19	45	0.916
Female	36	54	23	55	
Occupation					
Unemployed	41	61	22	52	0.452
Student	0	0	1	2	
Office worker	15	22	15	36	
Entrepreneur	4	6	2	5	
Farmer/Fisherman/Labourer	4	6	1	2	
Others	3	5	1	2	
ICH location					
Right hemisphere	30	45	24	57	0.209
Left hemisphere	36	54	17	41	0.178
Frontal lobe	1	1	2	5	^x 0.558
Parietal lobe	9	13	6	14	0.900
Temporal lobe	13	19	7	17	0.719
Occipital lobe	0	0	3	7	^x 0.055
Brainstem	4	6	1	2	^x 0.647
Cerebellum	3	5	2	5	^x 1.000
Basal ganglia	19	28	13	31	0.772
Thalamus	23	34	12	29	0.531
Risk factor					
Hypertension	66	98	35	83	^x 0.005
Dyslipidemia	21	31	14	33	0.829
Diabetes mellitus	5	7	1	2	^x 0.403
Ischemic heart disease	5	7	2	5	^x 0.705
Atrial fibrillation	1	2	1	2	^x 1.000
History of stroke					
First time	52	77.6	31	73.8	0.650
Recurrent	15	22.4	11	26.2	

Note: ICH= Intracerebral haemorrhage, all use chi-square test except x= Fisher's exact test

Table 2 Distribution of Age, Intracerebral Haemorrhage Volume, and Years of Education in Patients with Intracerebral Haemorrhage Patients with and without Hypertensive Crisis

Characteristic	n	With Hypertensive Crisis (n=67)	Without Hypertensive Crisis (n=42)	p-value
Age, median (IQR), years	109	55 (48–59)	54 (45–60.75)	^x 0.462
ICH volume, median (IQR), mL	56	16.14 (5.95–23.75)	10.07 (4.30–22.6)	^x 0.351
Years of education, median (IQR)	92	12 (6–12)	12 (9–12)	^x 0.385

Note: ICH= Intracerebral haemorrhage, IQR= Interquartile range, X= Mann-whitney test

approach. Data were taken from medical records of ICH patients. Data collection was carried out from August 2020 to November 2020, after obtaining approval from the Research Ethics Committee Universitas Padjadjaran, with ethics number 027/UN6.KEP/EC/2021.

We collected all medical records of ICH patients with and without hypertensive crisis, who were admitted to Dr. Hasan Sadikin General Hospital Bandung from January 2019 to December 2019. Only subjects who had a total score of Mini-Mental State Examination (MMSE) conducted on discharge day, with a minimum education level of elementary school were recruited. The MMSE score was already stated in the medical record. Medical records with incomplete MMSE scores, decreased level of consciousness on discharge day, deceased patient, and aphasia were excluded from this study. The included subjects were then divided into two groups with and without hypertensive crisis. Hypertensive crisis status was determined by measuring blood pressure recorded in the medical record and/or final diagnosis by the doctor in charge.

The data were analyzed by IBM SPSS ver.25. Data normality test using the Kolmogorov-Smirnov method ($n > 50$) was performed on

the group with hypertensive crisis, while Shapiro-Wilk ($n < 50$) was performed on the group without hypertensive crisis. The Mann-Whitney test was used to compare the total MMSE scores between the two groups.

Results

From a total of 276 subjects with ICH during study period, 109 (39.5%) were included in this study. The data excluded were due to 52 subjects deceased (31.1%) which was 36.5% subjects with hypertensive crisis and 63.5% without hypertensive crisis. Other subjects that were excluded were due to incomplete data, consciousness, aphasia, and illiterate.

There were 67 subjects with hypertensive crisis and 42 subjects without hypertensive crisis with the female prevalence was higher than male in both groups, 54% and 55%, respectively (Table 1). The majority of patients in both groups were unemployed (61% and 52%). The main stroke location in the group with hypertensive crisis was in the left hemisphere (54%) and thalamus (34%), whereas the right hemisphere (57%) and basal ganglia (31%) were the main locations in non-hypertensive crisis group. In both groups, hypertension had the highest prevalence

Table 3 Comparison of MMSE Score in Intracerebral Haemorrhage Patients with and without Hypertensive Crisis

MMSE Score	With Hypertensive Crisis (n=67)	Without Hypertensive Crisis (n=42)	p-value
MMSE score			
Mean± SD	22.36±5.68	22.88±6.29	^x 0.439
Median	24	23.5	
Min-max	5–30	7–30	

Note: MMSE= Mini-mental state examination, ICH= Intracerebral haemorrhage, IQR= Interquartile range, X= Mann-Whitney test

of risk factors (98.5% and 83.3%) followed by dyslipidemia (31% and 33%). Most of the subjects in both groups had no previous history of stroke (78% and 74%). There was a statistically significant difference in the incidence of hypertension ($p < 0.05$) in both groups.

The median age in the group with a hypertensive crisis was higher than in the group without hypertensive crisis (Table 2). The hypertensive crisis group had the similar median education level as the non-hypertensive crisis group. The median of ICH volume in the hypertensive crisis group was larger compared to the groups without hypertensive crisis. There were no statistically differences in age, ICH volume, and education level between the two groups ($p > 0.05$).

Furthermore, the median MMSE score in the group with a hypertensive crisis was slightly higher than the group without hypertensive crisis (Table 3). For the normality test, we performed the Kolmogorov-Smirnov method on the group with hypertensive crisis, while the Shapiro-Wilk on the group without the hypertensive crisis. The distribution of data showed abnormalities. Hypothesis testing was conducted using the Mann-Whitney method in both groups and there was no significant difference between the two groups ($p > 0.05$).

Discussion

In this study, females were predominated in both groups. This finding is consistent with a previous descriptive cross sectional study, which found that females are predominantly prevalent.¹⁰ This condition could be due to longer life span of women, as the incidence of stroke increases with age.¹¹ However, this result might also due to the high prevalence of male previously excluded in this study. Interestingly, a meta-analysis study has found that the incidence of intracerebral haemorrhage in an Asian population is 15% lower in female than in male, although the difference was not statistically significance.³ According to a systematic review and meta-analysis of 59 studies in 19 countries, the incidence of intracerebral haemorrhage tends to be higher in men.¹² In this study, both groups showed that the majority of patients had 12 years of education. A longitudinal study also showed consistent findings in education levels, which found that 63% of primary intracerebral haemorrhage patients had 10 years or more of education.⁴ However, these findings were inconsistent with another study showing that

elementary school is the highest prevalence.¹⁰

Deep brain haemorrhage location tended to occur in both groups, specifically in the basal ganglia and thalamus. This could be due to the high prevalence of hypertension in this study.¹³ Intracerebral haemorrhage located in deeper structures tend to occur in patient with hypertension, with the most common site being the basal ganglia (55%), followed by thalamus (26%).⁹ In this study, left hemisphere lesions tended to occur in the hypertensive crisis group, while right hemisphere lesions tended to occur in the non-hypertensive crisis group. The importance of cognitive deficits is in the left hemisphere and supratentorial lesions, followed by the territory of anterior and posterior cerebral arteries.¹⁴ Left hemisphere lesions have a main role for most cognitive domains, mainly in the language aspect, while right hemisphere lesions are mainly associated with visuospatial and executive functions.¹⁵

Hypertension is the most frequent risk factor in patients with primary intracerebral haemorrhage.⁴ Our study has also demonstrated that hypertension is the risk factor with the highest prevalence with a significant difference between both groups. This study has found that the majority of stroke events in both groups are the first-time stroke events. Previous study has also shown that of spontaneous ICH patients, a previous medical history of stroke or transient ischemic stroke was found in only 15% of patients.¹³

In this study, the median age of hypertensive crisis group was higher than non-hypertensive crisis group. Possibly, it is caused by increased arterial stiffness, which reduces the arterial buffering capacity, leading to age-associated changes in blood pressure.¹⁶ This study also has found that the median of ICH volume in hypertensive crisis group is higher than non-hypertensive crisis group. It could be due to the existing evidence supports that there is an association between systolic blood pressure and hematoma expansion.¹⁷ However, data on education and ICH volumes were incomplete and might interfere with the results.

The median MMSE score of hypertensive crisis groups was slightly higher than the non-hypertensive crisis group. This might be caused by predominant female gender in the non-hypertensive crisis group compared to the hypertensive crisis group (55% and 54%). Female is associated with vascular cognitive impairment by related degenerative pathology that would interact with vascular pathology.¹⁸ Recurrent stroke in the non-hypertensive crisis group has a higher incidence compared to the

hypertensive crisis group (26% and 22%). Patients with a history of stroke have a steeper rate of cognitive decline. However, our study has shown no significant difference in cognitive function between the groups with and without hypertensive crisis, contrary to other studies showing that there is a relationship between cognitive impairment and hypertension severity.^{13,19} However, the study has some limitations such as lack of evidence of a temporal relationship between exposure and outcome.¹⁹ In addition, there is no significant difference in stroke location between the two groups in this study. As the location of stroke, especially the left hemisphere and cortical lobe, it is an important factor for cognitive function.

The limitation of this study could interfere with the result of the study. The small sample size is due to the large number of data excluded due to the high mortality of patient and incomplete data in this study. In addition, the day of the MMSE test performed in each subject is different, so that it might affect the results. Furthermore, pre-stroke cognitive status is not assessed in this study. Pre-existing cognitive impairment is one of the strongest prognostic factors for subsequent cognitive decline.¹³ The duration of hypertension is also an important determinant of cognitive impairment. There is an adverse effect of increasing the duration of hypertension on cognition.²⁰ In this study, the duration of hypertension is not assessed which may interfere with the results.

In conclusion, there is no significant difference in cognitive impairment between the hypertensive group and the non-hypertensive group. Further studies are recommended to pay attention to factors such as pre-stroke cognitive impairment, duration of hypertension, and variability in blood pressure. The MMSE score in this study has shown a cognitive impairment in both groups. Education about the risk of hypertensive crisis is of great value to prevent stroke and further cognitive impairment. Appropriate treatment of ICH patients with and without hypertensive crisis to prevent further cognitive impairment is needed. In addition, further studies need to be conducted on the relationship between hypertensive crisis and cognitive function, to assess whether there is a significant worsening of cognitive function in the hypertensive crisis condition.

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