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Cohort study in outcome and one-year mortality of acute stroke patient in Academic Hospital Universitas Gadjah Mada

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Abstract

Background: Stroke is still becoming one of the most common non-communicable diseases in Indonesia. Sample Registration System survey in 2016 showed that in Indonesia stroke has become the most common cause of death at all ages, about 19.9%. Several factors including age, sex, BMI, type of stroke, family history of stroke, hyperlipidemia, diabetes, and severity of stroke were related and increased the mortality rate. Academic Hospital Universitas Gadjah Mada had not conducted this type of research, so the researcher wanted to know the one-year mortality rate after stroke, factors that related to mortality, and to improve the quality of stroke treatment at Academic Hospital Universitas Gadjah Mada. **Objective:** To know the one-year mortality rate in acute stroke patients in Academic Hospital Universitas Gadjah Mada by looking for the acute stroke characteristics, outcome of stroke patients, and risk factors that cause mortality in stroke patients. **Method:** This is analytic research using a retrospective cohort study through data collection of acute stroke patients (patients with <5 days stroke onset) from July 2019 until June 2022. Follow up on the condition in the first year after the stroke using medical records, direct examination, or via telephone or video call. Mortality rates were assessed one year after stroke and the predictors of death were evaluated using the Cox proportional hazard model. **Result:** One-year mortality after stroke in our study was related to age (>67 years old) (OR=2.29; 95% CI 1.18-4.46; p=0.015) and the severity of stroke was related to higher NIHSS score (NIHSS score during admission 16-42, (OR=38.49; 95% CI 8.92-166.0; p<0.001)) and ICU admission (OR=8.01; 95% CI 4.03-15.90; p<0.001). **Conclusion:** An association was found between stroke severity and one-year outcomes of acute stroke patients with old age (>67 years), high NIHSS scores, and ICU admissions.

Keywords: Acute Stroke, Hemorrhagic stroke, Infarct Stroke, Mortality, MRS, NIHSS, Outcome, Stroke,

1. INTRODUCTION

Stroke still become one of the most common non-communicable diseases in Indonesia. The prevalence of stroke in Sleman Regency is 14 in every 1000 citizens (1). Every year there is 795,000 people have a stroke, 610,000 are the first attack, and the other 185.000 are recurrent strokes (2).

Data from Basic Health Research (Riset Kesehatan Dasar/ Riskesdas) 2018 showed that the morbidity of stroke increased compared to the previous year. The prevalence of stroke increased to 10.9 percent, meanwhile, the previous year was 7 percent (3). The increase in stroke prevalence from year to year is followed by the increase in mortality of stroke. A survey from the Sample Registration System (SRS) in 2016 in Indonesia showed that stroke became the most common cause of death at all ages, about 19.9 percent (4).

There are several factors that cause death in acute stroke, those are age, the National Institutes of Health Stroke Scale (NIHSS) during admission, and basic MRS score. Patients older than 45 years have three times the risk of death, NIHSS score more than 10 had higher mortality at one year of onset, and patients with basic MRS scores more than 3 had doubled the risk of death at one-year follow-up compared to lower scores (5).

Another study, measuring mortality within 2 years after acute stroke, found that age, gender, BMI, type of stroke, family history of stroke, hyperlipidemia, diabetes, and severity of stroke were related and increased the mortality (6). Research by Appelros et al., (2003) found that dementia, age, stroke severity, and atrial fibrillation were associated with an increase in mortality within one year, thus it is necessary to treat these problems before a stroke occurs so as to prevent disability and due to stroke (7).

Research by Abdo et al., (2019) from hospitals in Lebanon found that there was a 14.1 percent mortality rate in one month and a 22 percent one-year mortality rate (8). Predictors for short and long-term mortality in univariate analysis were low socioeconomic status, admission to ICU, decreased level of consciousness, stroke severity, and the presence of complications. Marital status also predicts short-term mortality, while age >64 years, atrial fibrillation, coronary heart disease, and hypertensions are also long-term predictors. About one-fifth of patients do not survive one year after a stroke, so better prevention needs to be done to reduce the risk of death from stroke (8). The studies above have examined the mortality rate from stroke in the short and long term. At Academic Hospital Universitas Gadjah Mada itself, research on this consequence has never been carried out, thus the author wants to conduct this research to find out the mortality rate within a year after stroke, the factors that cause the mortality, and try to find ways to improve this condition for better strokes services at Academic Hospital Universitas Gadjah Mada.

2. RESEARCH METHOD

This study used an analytical research design using a retrospective cohort design, namely by collecting data on acute stroke patients (patients with stroke onset <5 days) from July 2019 to June 2022 and then following up their condition in the first year after stroke through medical records, direct inspection or via telephone/video call.

The inclusion criteria in this study were patients with a stroke onset of less than five days, patients aged 18-80 years, who had been diagnosed with stroke at RSA UGM, and had head CT scan data. The exclusion criteria in this study were patients whose identity was incomplete and difficult to follow up by the research team or patients with stroke-like symptoms but whose condition was found to be not a stroke by a neurologist at the final diagnosis. The operational definition in this study is that acute stroke is the onset of a stroke in less than five days, which can be an ischemic or hemorrhagic stroke. One-year mortality is the death rate that occurs one year after the stroke. Meanwhile, the dependent variable of the study covers two outcomes: the primary outcome is the 1-year stroke mortality rate, while the secondary outcome is the Modified Rankin Scale ≥3 in the subset of subjects with ischemic stroke type. The independent variables examined in this study were the subject's age at diagnosis, gender, the onset of stroke symptoms (<4.5 hours vs. ≥4.5 hours), stroke type (ischemic vs. hemorrhagic vs. ischemic and hemorrhagic), Glasgow Coma Scale (GCS) admission (<10 vs ≥10), admission NIHSS (mild to moderate/0-15 vs. moderate-severe to severe/16-42), body mass index based on WHO Asia Pacific category, history of previous stroke, history of the acute coronary syndrome, history of hypertension, history of dyslipidemia, history of arrhythmia, history of diabetes mellitus, history of blood disorders, history of dementia, and admission status in the ICU. In the medical record, if it is found that there is no history of illness and the results of supporting examinations are normal then it is considered that there is no history (for example, if it is not written History of hypertension and

blood pressure on admission is normal then it is written History of hypertension is negative, if it is not written History of dyslipidemia and the results of the lipid profile are normal or not Lipid profile examination is carried out then the history of dyslipidemia is written as negative).

The patients' characteristics were analyzed using descriptive analysis and presented with percentages. Mortality rates were assessed one year after stroke and predictors of death were evaluated using the Cox proportional hazards model. All variables with a p-value <0.25 were included in the adjusted model for further analysis using multivariate binary logistic regression.

3. RESULT

This study took data from medical records of acute stroke patients who were diagnosed with cerebral infarction and intracranial hemorrhage at the UGM Academic Hospital from July 2019 to June 2022. There were 1129 patients treated with an initial diagnosis of acute stroke. After we researched and investigated, we found 274 patients who were excluded due to various reasons, including non-acute strokes and intracranial hemorrhagic in cases of head injury. There were 855 acute stroke patients with a diagnosis of stroke, infarction, or hemorrhagic. Then a total of 855 patients looked for the characteristics of the patient and followed up for a year from the onset of the stroke, whether they were still alive or dead. It was found that 433 patients could not be contacted (lost to follow-up), so there were only 422 patients whose mortality condition could be determined within one year. (Figure 1).

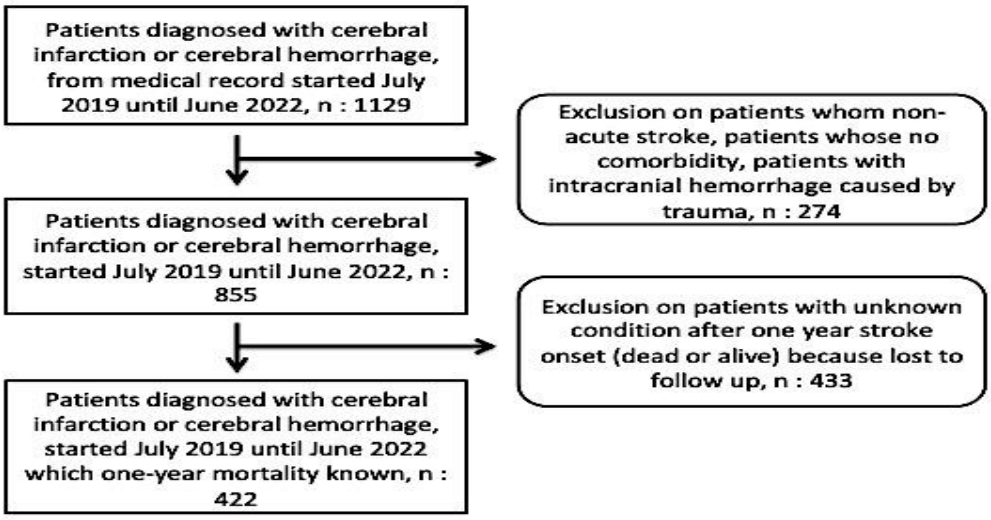

Table 1. Basic characteristics of subjects (n=422)

Variable	Frequency (%) / Median (Min–Max)
Age	63 (20–94)
<67 years	267 (63.3)
≥67 years	155 (36.7)
Sex	
Female	175 (41.5)
Male	247 (58.5)
Onset of Stroke	
≤4.5 hours	146 (34.6)
>4.5 hours	276 (65.4)
Type of Stroke	
Ischemic	330 (78.2)

Haemorrhage	83 (19.7)
Ischemic and Haemorrhage	9 (2.1)
GCS during Admission	15 (3–15)
<10	67 (15.9)
≥10	355 (84.1)
NIHSS during Admission	4 (0–41)
Mild and *Moderate* (0–15)	356 (84.4)
Moderate-Severe and *Severe* (16–42)	66 (15.6)
Body Maxx Index (BMI)	22.7 (11.1–42.6)
Underweight–Normal (<23)	222 (52.6)
Overweight–Obese (≥23)	200 (47.4)
History of Stroke	
No	336 (79.6)
Yes	86 (20.4)
Family history of Stroke	
No	420 (99.5)
Yes	2 (0.5)
History of ACS	
No	393 (93.1)
Yes	29 (6.9)
History of Hypertension	
No	105 (24.9)
Yes	317 (75.1)
History of Dyslipidaemia	
No	277 (65.6)
Yes	145 (34.4)
History of Arrhythmia	
No	396 (93.8)
Yes	26 (6.2)
History of Diabetes Mellitus	
No	299 (70.8)
Yes	123 (29.2)
History of Blood Disorder	
No	414 (98.1)
Yes	8 (1.9)
History of Dementia	
No	420 (99.5)
Yes	2 (0.5)
Admission to ICU	
No	308 (73.0)
Yes	114 (27.0)
MRS Score	4 (0–6)
<3	118 (28.0)
≥3	304 (72.0)
One-year Mortality of Stroke	
No	298 (70.6)

Yes	124 (29.4)

Abbreviation: GCS=*Glasgow Coma Scale*; NIHSS=*National Institutes of Health* Stroke Scale; ACS=*acute coronary syndrome*; ICU=*intensive care unit*; MRS=*Modified Rankin Scale*

From Table 1, it can be seen that the characteristics of patients who could be followed up to one year after stroke were 422 patients. The median age of patients in this study was 63 years with an age range ranging from 20 to 94 years. The majority of patients aged <67 years (63.3%). More than a half of the patients (58.5%) were men.

Based on stroke onset at admission, most of the patients (65.4%) were admitted to hospital after the hyper acute onset of stroke. Ischemic stroke type was found in approximately two-third of patients (78.2%), while the haemorrhagic stroke only in almost one fifth patients (19.7%). The results of Glasgow Coma Scale (GCS) (min-max) at admission was dominated with ≥10 (84.1%). The median patient NIHSS score was 4 (0-41), consisting of 356 patients (84.4%) experiencing mild and moderate strokes (NIHSS 0-15) and 66 patients (15.6%) experiencing moderate-severe strokes. and severity (NIHSS 16-41).

Body mass index (BMI) has a value range of 11.1-42.6 kg/m^2 with almost the same number in each category, both underweight-normal BMI (52.6%) and overweight-obese (47.4%). The majority of patients did not have a history of stroke (79.6%). The majority of patients did not have a family history of stroke (99.5%) and only a few patients had a family history of stroke, namely only 2 patients (0.5%).

The majority of patients did not have a history of acute coronary syndrome (ACS) (93.1%), while the remaining had a history of ACS, namely 29 patients (6.9%). A total of 317 patients (75.1%) had a history of hypertension, while the other 105 patients (25.9%) had no history of hypertension. Most of the patients had no history of dyslipidaemia (65.6%), had no history of arrhythmia (93.8%), and had a complication with diabetes mellitus (70.8%). The majority of patients (98.1%), did not have blood disorders and only a few patients (1.9%), had blood disorders.

Almost all of the patients (99.5%) had no history of dementia and most of them (73%) did not require Intensive care unit treatment. For post-stroke independence based on the modified Rankin Scale (mRS) values, there were 118 patients (28%) in the group of patients with moderate to severe disabilities (mRS value ≥3) and 304 patients in the group with moderate to severe disabilities (mRS value ≥3). 72%). A total of 298 patients (70.6%) were still alive at one year after stroke, while another 124 patients (29.4%) died at one year's follow-up after stroke.

Table 2. Association of Socio-demographic and Clinical Factors with 1 Year Stroke Mortality, with Bootstrap Application on Standard Error Estimates

Variable	One-year mortality (%)	Unadjusted OR		Adjusted OR	
		OR (95% CI)	p-value	OR (95% CI)	p-value
Age					
<67 years	25.5	Ref		Ref	
≥67 years	36.1	1.65 (1.08–2.54)	0.021	2.29 (1.18–4.46)	**0.015***
Sex					
Female	30.9	Ref			
Male	28.3	0.89 (0.58–1.35)	0.576		
Onset Stroke					
≤4.5 hours	34.9	Ref		Ref	
>4.5 hours	26.4	0.67 (0.43–1.03)	0.070	0.98 (0.50–1.94)	0.960
Type of Stroke					
Ischemic	21.8	Ref		Ref	
Haemorrhage + Ischemic	56.5	4.66 (2.86–7.59)	<0.001	1.18 (0.53–2.62)	0.680
GCS during Admission					
<10	77.6	Ref		Ref	
≥10	20.3	0.07 (0.04–0.14)	<0.001	0.72 (0.21–2.45)	0.596
NIHSS during Admission					
0–15	17.4	Ref		Ref	
16–42	93.9	73.50 (25.78–209.52)	<0.001	38.49 (8.92–166.0)	**<0.001***
Body Mass Index (BMI)					
Underweight–Normal (<23)	37.8	Ref		Ref	
Overweight–Obese (≥23)	20.0	0.41 (0.26 –0.64)	<0.001	0.59 (0.31–1.10)	0.098
History of Stroke					
No	29.2	Ref			
Yes	30.2	1.05 (0.63–1.76)	0.846		
History of ACS					
No	28.7	Ref			
Yes	37.9	1.51 (0.69–3.31)	0.298		
History of Hypertension					
No	26.7	Ref			
Yes	30.3	1.19 (0.72–1.95)	0.496		
History of Dyslipidaemia					
No	34.7	Ref		Ref	
Yes	19.3	0.45 (0.28–0.73)	0.001	0.71 (0.34–1.49)	0.373
History of Arrhythmia					
No	27.3	Ref		Ref	
Yes	61.5	4.26 (1.88–9.69)	0.001	2.67 (0.62–11.41)	0.185
History of DM					
No	28.1	Ref			
Yes	32.5	1.23 (0.78–1.94)	0.365		
ICU admission					
No	15.3	Ref		Ref	
Yes	67.5	11.56 (7.01–19.06)	<0.001	8.01 (4.03–15.90)	**<0.001***

Repetition bootstrap=1000; * = p<0.05

Abbreviation: OR=odds ratio; CI=confidence interval; GCS=*Glasgow Coma Scale*; NIHSS=*National Institutes of Health* Stroke Scale; ACS=*acute coronary syndrome*; DM=diabetes mellitus ICU=*intensive care unit*

The results of the multivariable binary logistic regression model for 1-year stroke mortality are presented in Table 2. From the results of the analysis it was found that subjects aged ≥67 years (OR=2.29; 95% CI 1.18-4.46; p=0.015), admission NIHSS score 16-42 (OR=38.49; 95% CI 8.92-166.0; p<0.001), and requiring ICU admission (OR=8.01; 95% CI 4.03-15 .90; p<0.001) has a statistically significant increased risk for stroke mortality within 1 year.

Table 3. Association of Socio-demographic and Clinical Factors with Modified Rankin Scale Score ≥3 in a subset of patients with ischemic stroke, with Bootstrap Application on Estimated Standard Error (n=330)

Variable	MRS ≥3 (%)	Unadjusted OR		Adjusted OR	
		OR (95% CI)	p-value	OR (95% CI)	p-value
Age					
<67 years	63.1	Ref		Ref	
≥67 years	75.0	1.75 (1.07–2.88)	0.026	1.61 (0.89–2.90)	0.115
Sex					
Female	69.4	Ref			
Male	66.1	0.86 (0.54–1.37)	0.524		
Onset Stroke					
≤4.5 hours	72.1	Ref		Ref	
>4.5 hours	65.5	0.73 (0.44–1.22)	0.233	0.58 (0.30–1.10)	0.097
GCS during Admission					
<10	93.3	Ref		Ref	
≥10	65.0	0.13 (0.03–0.57)	0.006	0.30 (0.08–1.14)	0.078
NIHSS during Admission					
0–15	65.3	Ref		Ref	
16–42	92.6	6.62 (1.54–28.53)	0.011	2.21 (0.58–8.43)	0.247
Body Mass Index (BMI)					
Underweight–Normal (<23)	75.0	Ref		Ref	
Overweight–Obese (≥23)	60.2	0.50 (0.31–0.81)	0.004	0.49 (0.27–0.89)	**0.019***
History of Stroke					
No	64.2	Ref		Ref	
Yes	80.0	2.23 (1.18–4.22)	0.014	2.56 (1.18–5.55)	**0.017***
History of ACS					
No	67.2	Ref			
Yes	72.0	1.25 (0.51–3.10)	0.624		
History of Hypertension					
No	87.5	Ref		Ref	
Yes	60.3	0.22 (0.11–0.43)	<0.001	0.19 (0.08–0.45)	**<0.001***
History of Dyslipidaemia					
No	78.5	Ref		Ref	
Yes	50.8	0.28 (0.17–0.46)	<0.001	0.42 (0.24–0.74)	**0.002***
History of Arrhythmia					
No	67.2	Ref			
Yes	72.7	1.30 (0.49–3.42)	0.594		
History of DM					
No	70.1	Ref		Ref	
Yes	62.3	0.70 (0.43–1.14)	0.157	0.89 (0.49–1.61)	0.705
ICU admission					
No	63.2	Ref		Ref	
Yes	85.9	3.56 (1.69–7.53)	0.001	2.96 (1.07–8.16)	**0.036***

Repetition bootstrap=1000; * = p<0.05
Abbreviation: MRS=*Modified Rankin Scale;* OR=odds ratio; CI=confidence interval; GCS=*Glasgow Coma Scale*; NIHSS=*National Institutes of Health* Stroke Scale; ACS=*acute coronary syndrome*; DM=diabetes mellitus ICU=*intensive care unit*

The results of the multivariable binary logistic regression model for mRS scores ≥3 for the subset of patients with ischemic stroke are presented in Table 3. From the results of the analysis, it was found that subjects with a history of stroke (OR=2.56; 95% CI 1.18-5.55; p=0.017) admission to the ICU (OR=2.96; 95% CI 1.07-8.16; p=0.036) had a statistically significant increased risk of having an mRS score ≥3. Meanwhile, patients with a BMI ≥23 (OR=0.49; 95% CI 0.27-0.89; p=0.019), a history of hypertension (OR=0.19; 95% CI 0.08-0.45; p<0.001), and a history of dyslipidemia (OR=0.42; 95% CI 0.24-0.74; p=0.002) had a statistically significant reduced risk of having an MRS score ≥3.

4. DISCUSSION

From this study, it was found that old age and stroke severity as evidenced by a high NIHSS score and ICU admission had an effect on mortality one year after stroke. This is in accordance with previous research conducted by Carval et al., (2022) which examined that an acute strokes requiring ICU admission had a poor prognosis because they had more severe stroke symptoms, required mechanical ventilation, and a high mortality rate (9). Old age and stroke severity were associated with an increased risk of death within one year in this study in accordance with previous studies conducted by Appelros et al., (2003) and Novbakht et al., (2020) (6,7). Another study conducted by Abdo et al., (2019) also proved that stroke severity is a predictor of death one year after stroke (8). Namale et al., (2020) stated that a high NIHSS score is a predictor of stroke mortality within 90 days. Compared with previous research, the findings from our study are consistent with previous studies (10).

From the results of statistical analysis for an MRS score ≥3, it was found that a history of stroke and admission to the ICU had a significant risk for an MRS score ≥3. An MRS score ≥3 indicates the patient's condition is functionally dependent because the morbidity due to the stroke they experienced was more severe, causing permanent disability. This is also in accordance with research conducted by Appelros et al., (2003) that dependency is associated with stroke severity, namely high NIHSS and patients with ICU admission (7). Research conducted by Ferrone et al., (2022) found that patients with recurrent stroke had worse clinical outcomes and caused morbidity and mortality. The results of our study are in accordance with previous studies (11).

From the results of our research, being underweight actually causes an increased risk of an MRS score ≥3. From the results of previous research conducted by Kang et al., (2023), it was found that patients who were overweight could actually prevent the risk of post-stroke vascular events and prevent recurrent strokes compared to those who were underweight (12). Obese patients are associated with the small vessel disease subtype of stroke which has a low risk of vascular recurrence, while thin patients are associated with the stroke subtype associated with large vessel atherosclerosis (13). Excess weight more often checks with a doctor or in treatment to control the risk factors because they appear to be more at risk than those who are thin, and morbidly obese patients may have died from other complications before having a stroke so thin patients are more at risk of recurrent strokes which cause increased mRS scores or functional dependency. This is also in accordance with previous research conducted by Kubo et al., (2017), which stated that underweight patients were associated with death within 3 months (14).

From the results of our research, a history of hypertension and dyslipidemia actually reduces the risk of an MRS score ≥3, which is contrary to the results of previous studies where hypertension and dyslipidemia are the main risk factors for stroke and recurrent stroke as well as the risk of stroke death within a year as stated in research by Abdo et al. al., (2019) which states that old age, atrial fibrillation, coronary heart disease, hypertension are predictors of long-term stroke death and are at risk of causing recurrent strokes which can result in disability (8). This may be because in patients who do not have a history of hypertension/dyslipidemia written in the anamnesis and the results of blood pressure measurements at that time are normal then it is written as no history of hypertension, likewise, if the results of the lipid profile are normal or a lipid profile examination is not carried out it is also included in the criteria of no history dyslipidemia. This can cause measurement results to be less accurate and cause bias.

Limitations in our study are that our study is a retrospective cohort where in collecting data from previous medical records many incomplete medical records were found, and physical examinations were not carried out by the same doctor which can cause bias related to the NIHSS score and MRS score, there is no standard anamnesis for stroke patients who ask for a complete history of the causes of stroke risk factors such as history of hypertension, diabetes, history of previous stroke, history of heart disease, history of dementia and so on as well as limitations in follow-up or contacting patients because the majority of patients do not answer

and are not willing to take part in the research. In the future, it is hoped that there will be research using a prospective cohort with better preparation, data collection, and physical examination by the same doctor and commitment to the patient for research for one year.

5. CONCLUSION

From this study, mortality one year after stroke was associated with old age (>67 years) and stroke severity characterized by a high NIHSS score (admission NIHSS score 16-42, and ICU admission. These results are in line and consistent with previous studies.

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