Biomedical Journal of Indonesia
Journal Homepage: https://bji-fk.ejournal.unsri.ac.id

Serum Creatine Kinase-MB Levels in Elderly Patients After Hemorrhagic and Ischemic Stroke Without a History of Heart Disease

Mariel Daba[1*], Nathasya Ferdyastari[2]

[1,2]Department of Physiotherapy, Faculty of Health Science, Universitas Medika Suherman, Bekasi, Indonesia

ARTICLE INFO

Keywords:
Elderly
Hemorrhagic stroke
Ischemic stroke
CK-MB levels

Corresponding author:
Mariel Daba
E-mail address:
marielfisiomedika@gmail.com

All authors have reviewed and approved the final version of the manuscript.

https://doi.org/10.32539/BJI.v12i1.287

Received 31 July 2025;
Accepted 9 September 2025

ABSTRACT

Introduction. Elevations in cardiac biomarkers such as creatine kinase-MB (CK-MB) have been reported in stroke patients, even without clinical signs of heart disease. CK-MB, a cardiac-specific isoenzyme, indicates myocardial stress or injury. Exploring CK-MB dynamics in elderly post-stroke patients may provide insights into cardiovascular risk and prognosis. **Methods.** This comparative analytical cross-sectional study involved two groups of stroke patients admitted to Sentra Medika Hospital, Cikarang: hemorrhagic stroke (n=8) and ischemic stroke (n=8), totaling 16 participants. Inclusion criteria were age ≥60 years, stroke history within 3–6 months, and no cardiovascular disease based on medical records. Venous blood samples were collected to measure serum CK-MB levels using ELISA. Data were analyzed with an independent sample t-test. **Results.** A significant difference in mean CK-MB levels was observed (p=0.03). The hemorrhagic group had a mean CK-MB of 29 U/L, while the ischemic group had 26 U/L. Both values exceeded the reference level of <25 U/L, showing elevated CK-MB in both stroke types. **Conclusion.** Serum CK-MB levels were significantly elevated in elderly patients after hemorrhagic and ischemic stroke compared with normal values, suggesting CK-MB as a potential clinical marker in post-stroke patients.

1. Introduction

Stroke is a syndrome characterized by the sudden onset of focal neurological deficits resulting from vascular disturbances, either ischemic or hemorrhagic, which can lead to partial or complete loss of brain function. The significant impact of stroke on quality of life has established it as a major public health concern requiring serious attention.[1] In Indonesia, stroke is the leading cause of disability and the second leading cause of death.[2] Early detection and effective control of stroke-related risk factors have the potential to reduce mortality rates and improve functional outcomes through the development of faster and more innovative management strategies for at-risk populations. It has long been recognized that metabolic alterations in the central nervous system can influence cardiovascular function. Cardiac dysfunction in stroke patients is strongly correlated with sympathetic nervous system hyperactivity, which is often a consequence of insular cortex damage. Cardiac biomarkers such as troponin T and creatine kinase-MB (CK-MB) have been reported to increase in some patients with acute stroke, even in the absence of clinical evidence of myocardial injury.[1] Clinically, numerous enzymes, hormones, biological substances, and other biomarkers derived from blood or urine can be utilized in diagnostic processes.[3]

Creatine kinase (CK) plays an essential role in maintaining cellular energy homeostasis by regulating the conversion of phosphocreatine and adenosine triphosphate (ATP), thereby serving as a vital component in tissues with high energy demands such as skeletal muscle, myocardium, and the central nervous system. Under ischemic conditions, elevated CK levels may reflect tissue injury; for instance, in myocardial ischemia or infarction, increased CK-MB isoenzyme levels represent a classical marker of myocardial necrosis, whereas in cerebral ischemia or stroke, elevated CK levels, particularly the CK-BB isoenzyme, indicate neuronal tissue damage. Moreover, elevated CK levels are also observed in inflammatory conditions, including inflammatory myopathies such as myositis and muscular

dystrophies, as well as in systemic inflammatory states, where disruption of cell membranes facilitates the release of CK into the circulation. Therefore, CK can be regarded as a sensitive biomarker for detecting tissue injury in muscle, heart, and brain.[4]

Elevations in cardiac biomarkers such as creatine kinase-MB (CK-MB) have been observed in several patients experiencing acute cerebrovascular events, even in the absence of overt cardiac injury.[1] Increased CK-MB activity has been reported in the early phases of various acute neurological conditions, including ischemic stroke, subarachnoid hemorrhage, and head trauma.[5] CK-MB typically begins to rise approximately 4 to 6 hours after the onset of chest pain and accounts for nearly 30% of the total CK content in the myocardium.[6] This response is believed to be associated with sympathetic nervous system disturbances, leading to elevated intracranial pressure. An increase in CK-MB levels reflects myocardial tissue injury, whether acute or chronic in nature.[7] Numerous studies have found elevated serum CK levels in stroke patients, although the precise tissue origin and underlying mechanisms remain incompletely understood. Based on the aforementioned background, this study aims to evaluate the serum activity levels of creatine kinase-MB (CK-MB) in elderly patients who have experienced hemorrhagic and ischemic stroke. The findings of this study are expected to provide molecular clinical data that support the diagnostic process of cardiovascular disorders in post-stroke elderly patients without a history of heart disease at Sentra Medika Cikarang Hospital.

2. Methods

This study employed a comparative analytical approach with a cross-sectional design. The sample consisted of two groups of stroke patients admitted to Sentra Medika Hospital, Cikarang. Group 1 included patients diagnosed with hemorrhagic stroke, and Group 2 comprised patients diagnosed with ischemic stroke. For each subject, a single venous blood sample was collected to measure serum CK-MB levels using standard laboratory methods. The study received ethical approval from the Health Research Ethics Committee (HREC) of the Faculty of Health Sciences, Universitas Harapan Bangsa, under approval number B. LPPM-UHB/666/07/2024. All participants provided written informed consent prior to data collection.

Participants were selected using a purposive sampling method, with each group comprising 8 respondents, resulting in a total of 16 participants. Subjects were recruited between May and July 2024 based on their willingness to participate and fulfillment of the predefined inclusion criteria. The inclusion criteria consisted of elderly individuals aged ≥60 years with a history of stroke within approximately 3 to 6 months, normal heart rate based on clinical examination, willingness to sign the informed consent form, and commitment to participate in all stages of the intervention. The exclusion criteria included individuals with a history of stroke less than 3 months, a history of cardiovascular disease, or abnormal electrocardiogram (ECG) results as documented in their medical records.

Blood samples were collected intravenously from a single group of subjects, namely elderly individuals with acute stroke, by the attending nurse. CK-MB levels were measured two hours after blood collection. All blood samples were analyzed to determine serum CK-MB concentrations using the Enzyme-Linked Immunosorbent Assay (ELISA) method.

Serum CK-MB data were statistically analyzed using computerized software. Results were presented as mean values with the standard error of the mean (mean ± SEM). Data normality was assessed using the Shapiro–Wilk test, while hypothesis testing was performed using an independent sample t-test to compare the mean CK-MB levels between the hemorrhagic and ischemic groups.

3. Results

The results of the study on serum CK-MB activity in elderly patients with hemorrhagic and ischemic post-stroke conditions without a history of heart disease, conducted at Sentra Medika Hospital, Cikarang, demonstrated a statistically significant increase in the mean CK-MB levels ($p = 0.0003^{***}$) in the hemorrhagic group compared with the ischemic group.

The measurement of CK-MB levels in the hemorrhagic stroke patient group showed a mean value of 29 U/L, while the ischemic stroke group exhibited a mean CK-MB level of 26 U/L.

The mean serum CK-MB levels between the two groups demonstrated a statistically significant difference based on the results of the Independent Samples t-test. The hemorrhagic stroke group without a history of heart disease had a mean CK-MB level of 29 U/L, while the ischemic stroke group without a history of heart disease showed a mean level of 26 U/L. Compared to the normal serum CK-MB value in stroke conditions (<25 U/L), both groups exhibited elevated serum CK-MB levels. The results of the Independent Samples t-test are presented in Table 2 and Figure 1.

Table 2. Serum Creatine Kinase-MB levels in elderly patients after hemorrhagic and ischemic stroke

Group	Mean±SEM	*p*
Hemorrhagic	29 ± 1.1	0.03*
Ischemic	26 ± 0.7	

Independent sample T test, $p < 0.05$

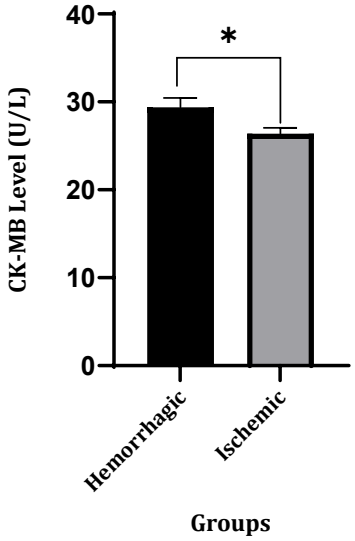

Figure 1. Comparison of CK-MB Level Graph

4. Discussion

The results of this study revealed a statistically significant difference in mean serum CK-MB levels between the two groups without a history of heart disease. These findings indicate that both groups experienced elevated serum CK-MB levels. This finding suggests that post-stroke elevations in CK-MB are more likely attributable to sympathetic nervous system activation resulting from insular cortex damage, rather than direct myocardial infarction.[8] The increase in CK-MB levels tends to be moderate and progressive in nature.[9] Previous studies have reported that elevated total creatine kinase (CK) levels are associated with an increased risk of recurrent stroke, disability, and mortality; however, CK-MB levels alone are not directly linked to poor clinical outcomes.[10]

The mean serum CK-MB levels recorded in this study were 29 U/L in the hemorrhagic group and 26 U/L in the ischemic group, both exceeding the normal reference value (<25 U/L).[11] Previous studies suggest that this elevation is associated with autonomic nervous system dysfunction and neurogenic cardiac injury, which can lead to excessive sympathetic activation, catecholamine release, coronary vasospasm, tachycardia, and neurogenic myocardial damage.[12] Furthermore, in elderly patients with comorbidities such as hypertension, coronary artery disease, and diabetes mellitus, the risk of mild myocardial injury is increased, potentially contributing to elevated CK-MB levels.[13]

In the group of patients with hemorrhagic stroke without a history of cardiac disease, the CK-MB level was recorded at 29 U/L, indicating an elevation compared to the normal CK-MB value of less than 25 U/L. This finding is consistent with previous studies reporting that increased CK-MB levels in stroke patients, including those with hemorrhagic stroke, are not always caused by primary cardiac injury but may be induced by neurogenic stress resulting from autonomic nervous system dysfunction.[14] Moreover, patients with severe hemorrhagic stroke and neurological complications tend to exhibit elevated CK-MB levels.[15] Other studies have also suggested that secondary cardiac injury caused by increased intracranial pressure and autonomic nervous system disturbances can contribute to elevated cardiac biomarkers such as CK-MB, particularly in cases of hemorrhagic stroke.[16]

This study reported that in the ischemic stroke patient group without a history of cardiac disease, the CK-MB level was measured at 26 U/L. This finding indicates that CK-MB levels can be elevated in ischemic stroke patients, particularly among those experiencing strokes of considerable severity.[14,15] Such elevations are generally transient and do not necessarily indicate acute myocardial injury but may be induced by neurogenic stress associated with

brain injury.[17] For instance, a study by Radhakrishnan et al. (2021) found that approximately 14% of stroke patients, including those with ischemic stroke, exhibited elevated CK-MB levels, which significantly correlated with stroke severity as assessed by the NIH Stroke Scale.[1] The elevation of CK-MB in both types of stroke is generally not due to acute myocardial infarction but is more likely caused by neurogenic stress, excessive catecholamine release, and autonomic nervous system dysfunction affecting the cardiac muscle.

In this study, the elderly post-stroke participants experienced stroke events within a timeframe of 3 to 6 months prior to the assessment. The analysis revealed a statistically significant change in serum CK-MB activity, with a p-value of 0,03*. These findings are consistent with previous studies reporting that CK-MB levels remain elevated in some stroke patients, likely due to incomplete recovery of autonomic nervous system regulation and the persistence of cardiac complications such as neurogenic cardiomyopathy or latent left ventricular dysfunction.[12] The elevation of CK-MB levels within 3 to 6 months post-stroke does not necessarily indicate myocardial infarction but may instead reflect minor myocardial injury or cardiac stress resulting from neurogenic mechanisms related to stroke. Consequently, CK-MB levels may serve as a prognostic indicator and support the need for long-term cardiovascular monitoring in post-stroke patients.[12,18]

The limitations of this study include a relatively small sample size of only 16 participants, which may limit the generalizability of the findings to a broader population. Additionally, the absence of a control group makes it difficult to compare results and ascertain the specific effects of the variables under investigation. Furthermore, CK-MB levels were measured only once for each group, preventing the assessment of longitudinal biomarker changes or the identification of temporal patterns that could be clinically relevant.

5. Conclusion

This study identified an elevation of serum CK-MB levels in elderly patients following hemorrhagic and ischemic stroke without a history of cardiac disease, compared to normal reference values. However, limitations such as a small sample size and the absence of a control group should be considered when interpreting the results. Therefore, these findings serve as a preliminary basis for further research in this field. Future studies are recommended to include a more representative sample with a more robust study design, incorporating control groups and longitudinal biomarker monitoring. Additionally, a more comprehensive analysis of the correlation between changes in CK-MB levels and clinical variables influencing post-stroke rehabilitation in the elderly population is warranted.

6. Author Contribution

M.D. conceived the initial idea, planned and conducted the research, and wrote the manuscript. N.F. assisted with the research and contributed to writing the manuscript.

7. Acknowledgements

The Institute for Research and Community Service (LPPM) of Universitas Medika Suherman for their support in the research grant application process and the implementation of the study. The undergraduate students of the Physiotherapy Study Program and the physiotherapists at the Medical Rehabilitation Unit of Sentra Medika Hospital Cikarang for granting permission and providing a place for the research, as well as the respondents who willingly participated in this study.

8. References

1. Radhakrishnan S, Moorthy S, Gadde S, Madhavan K. Role of Cardiac Biomarkers in the Assessment of Acute Cerebrovascular Accident. J Neurosci Rural Pract. 2021 Jan;12(1):106-111.
2. Kemenkes RI. 2024. Cegah Stroke dengan Aktivitas Fisik. Kementerian Kesehatan Republik Indonesia (https://kemkes.go.id/id/cegah-stroke-dengan-aktivitas-fisik), accessed on April 4, 2025.
3. Shamshirian, A., Alizadeh-Navaei, R., Abedi, S., Jafarpour, H., Fazli, H., Hosseini, S., Hessami, A., Karimifar, K., et al (2020). Levels of Blood Biomarkers among Patients with Myocardial Infarction in Comparison to Control Group. Ethiopian journal of health sciences, 30(1), 5–12.
4. Kitzenberg D, Colgan SP, Glover LE. Creatine kinase in ischemic and inflammatory disorders. Clin Transl Med. 2016 Dec;5(1):31.
5. Mohanapriya P, Sudharsan S, Sathishkumar JT. Significance of cardiac enzymes in patients with acute stroke. Journal of Medical Science and Clinical Research. 2017;5(10):29026–9.
6. Jacob, R., & Khan, M. (2018). Cardiac Biomarkers: What Is and What Can Be. Indian journal of cardiovascular disease in women WINCARS, 3(4), 240–244.
7. Mohamed WS, Abd ElGawad EA, ElMotayam AS, Fathy SE. Cardio embolic stroke and blood biomarkers: diagnosis and predictors of short-term outcome. The Egyptian Journal of Neurology, Psychiatry and Neurosurgery. 2019; 55:68.
8. Butcher KS, Baird AE, MacGregor L, Desmond PM, Tress BM. Cardiac enzyme elevations after stroke: the importance of specificity. Stroke. 2002;33(2):306–12.
9. Zeng YY, Zhang WB, Cheng L, Wang L, Geng DD, Tang WJ, He JC, Deng BB. Cardiac parameters affect prognosis in patients with non-large atherosclerotic infarction. Mol Med. 2021 Jan

6;27(1):2.
10. Li S, Wang A, Zhang Y, Tian X, Meng X, Wang Y, Li H, Wang Y. Creatine Kinase Is Associated with Recurrent Stroke and Functional Outcomes of Ischemic Stroke or Transient Ischemic Attack. J Am Heart Assoc. 2022 Mar 15;11(6): e022279.
11. Kiranmayi B, Lakshmi AN, Tagore R, Kambar C. Evaluation of Cardiac Markers in Chronic Renal Failure. IOSR J Dent Med Sci. 2015; 14:46-52.
12. Suleiman HM, Aliyu IS, Abubakar SA, Isa MS, El-Bashir JM, Adamu R, Ibrahim MZ, Mohammed A, Yusuf R, Manu M, Dogara AB, Mustapha SK, Bello N, Ozovehe SA. Cardiac Troponin T and creatine kinase MB fraction levels among patients with acute ischemic stroke in Nigeria. Niger J Clin Pract. 2017 Dec;20(12):1618-1621.
13. Sposato LA, Hilz MJ, Aspberg S, Murthy SB, Bahit MC, Hsieh CY, Sheppard MN, Scheitz JF; World Stroke Organisation Brain & Heart Task Force. Post-Stroke Cardiovascular Complications and Neurogenic Cardiac Injury: JACC State-of-the-Art Review. J Am Coll Cardiol. 2020 Dec 8;76(23):2768-2785.
14. Ay H, Arsava EM, Saribaş O. Creatine kinase-MB elevation after stroke is not cardiac in origin: comparison with troponin T levels. Stroke. 2002 Jan;33(1):286-9.
15. Mayer SA, Lin J, Homma S, Solomon RA, Lennihan L, Sherman D, Fink ME, Beckford A, Klebanoff LM. Myocardial injury and left ventricular performance after subarachnoid hemorrhage. Stroke. 1999 Apr;30(4):780-6.
16. Chen, Z., Venkat, P., Seyfried, D., Chopp, M., Yan, T., & Chen, J. (2017). Brain-Heart Interaction: Cardiac Complications After Stroke. Circulation research. 2017;121(4):451–468.
17. Dous GV, Grigos AC, Grodman R. Elevated troponin in patients with acute stroke - Is it a true heart attack? Egypt Heart J. 2017 Sep;69(3):165-170. doi: 10.1016/j.ehj.2017.01.005
18. Cui YX, Ren H, Lee CY, Li SF, Song JX, Gao XG, Chen H. Characteristics of elevated cardiac troponin I in patients with acute ischemic stroke. J Geriatr Cardiol. 2017 Jun;14(6):401-406. doi: 10.11909/j.issn.1671-5411.2017.06.001