MAK HILL Publications Research Journal of Medical Sciences

Research Article
doi: 10.36478/makrjms.2024.11.459.462

Correlation of Serum Calcium, Infarct Size and NIHSS Score in Acute Ischemic Stroke

[1]Channamallappa Patil, [2]Shashidhar S. Devarmani, [3]Shridhar Patil and [4]M.K. Anuja

[1-4]BLDE DU Shri B M Patil Medical College Hospital and Research Center, Vijayapura, Karnataka, India

ABSTRACT

Globally, stroke is the major cause of both morbidity and mortality. Serum calcium appears to be indirectly a measure of severity of acute ischemic stroke. The NIHSS score appears to be a widely used tool in assessment of severity of stroke. A score of less than five denotes a minor score., scores of five to fifteen indicate a moderate stroke., scores of sixteen to twenty indicate a moderate to severe stroke and scores of twenty to forty-two indicate a severe stroke. With regard to the NIHSS score and infarct size in acute ischemic stroke, this study intends to assess the usefulness of blood calcium as a useful marker for assessment of ischemic stroke severity. This cross-sectional study was conducted at a tertiary hospital between September 2022 and June 2024.It included 60 patients of age greater than 18 years presenting within 48 hours of onset of acute ischemic stroke and excluded cerebral venous thrombosis, posterior circulation stroke, hepatic and renal disease and patients on calcium supplements. Patients were evaluated based on clinical history, physical examination and lab parameters like complete hemogram, liver function tests and renal function tests. Radiologically patients were evaluated by MRI of brain to assess infarct size. Sims et al. provided the formula for the analysis of the infarct size. The NIHSS score was determined and is interpreted as follows: 0 represents no stroke symptoms, 1-4 represents a small stroke, 5-15 represents a moderate stroke, 16-20 represents a moderate to severe stroke and 21–42 represents a severe stroke. P values less than 0.05 on two-tailed significance were deemed statistically significant, while P values less than 0.01 were deemed highly significant. The patient's average age ranged from 60 to 80 years old, with the majority of them being male (66.7%). The study population showed hypertension (38.3%) as a more common risk factor than type 2 diabetes mellitus (5%) and the majority had no comorbidities at the time of presentation. The mean serum calcium level was 8.710 with standard deviation of 0. 4711.The mean infarct size was 62.95125cm3 with standard deviation of 73. 3737cm3.The mean NIHSS score was 9.88 with standard deviation of 5.737. The majority of the patients were in moderate severity stroke severity category (65%). The study showed a moderate negative correlation between serum calcium and NIHSS score (r=-0.829) and was statistically significant (p value= <0.001). The study showed a moderate negative correlation between serum calcium and infarct size (r=-0.711) and was statistically significant (p value=<0.001). Serum calcium in this study showed a significant negative connection with the infarct's magnitude as well as the NIHSS score. Serum calcium levels will drop as clinical deterioration occurs as indicated by the NIHSS score which will rise in an acute ischemic stroke with larger infarct sizes because more calcium will be shifted from the extracellular to the intracellular area. So, blood calcium levels can be used as a prognostic indicator for acute ischemic stroke.

OPEN ACCESS

Key Words
Mortality, morbidity, serum, severe, stroke, calcium

Corresponding Author
Shashidhar.S.Devarmani,
Department of General Medicine, BLDE(Deemed to be university)Shri B M Patil Medical College Hospital and Research Centre, Vijayapura, Karnataka, India
shashidhardevarmani@bldedu.ac.in

Author Designation
[1]Final year Postgraduate
[2]Professor
[3]Assistant Professor
[4]Assistant Professor

Received: 29 August 2024
Accepted: 05 November 2024
Published: 07 November 2024

Citation: Channamallappa Patil, S.S. Devarmani, Shridhar Patil and K. Anuja, 2024. Correlation of Serum Calcium, Infarct Size and NIHSS Score in Acute Ischemic Stroke. Res. J. Med. Sci., 18: 459-462, doi: 10.36478/makrjms.2024.11.459.462

INTRODUCTION

Stroke remains a serious global health issue. In India, stroke is on the rise, accounting for a considerable portion of lifetime impairments and now ranking as the fourth most common cause of death as well as the fifth most prevalent cause of disability. Ischemic stroke accounts for approximately 68% of all cases and is the more prevalent of the two primary types of strokes[1]. Stroke is defined as "rapidly developed clinical signs of focal or global disturbance of cerebral function, lasting more than 24 hours or leading to death, with no apparent cause other than of vascular origin" by the World Health Organization[2]. A common intracellular messenger both during and after an ischemic phase which is calcium ion (Ca) affects the series of events that culminate in eventual neuronal damage. Under ischemia circumstances, the release of glutamate from neurons and glia activates the N-methyl-D-aspartate (NMDA) receptor. This, in turn, promotes the fast transfer of calcium from extracellular to intracellular locations in brain tissues, ultimately leading to cellular death[3]. Individuals whose initial infarct sizes were less than those whose infarct sizes were larger had superior outcomes. The larger the infarct size, the worse the outcome[4]. The National Institutes of Health Stroke Scale (NIHSS) is a commonly used standardised scale for evaluating stroke symptoms and signs. It is a 15-item impairment scale for measuring stroke severity. A score range of 0 to 42 points is used., higher numbers denote more severity. A score of less than 5 indicates no symptoms or a little score., a score of 5-15 indicates a moderate stroke., a score of 16-20 indicates a moderate to severe stroke and a score of 21-42 indicates a severe stroke[5].

MATERIALS AND METHODS

This cross-sectional study was conducted at Shri B. M. Patil Medical College Hospital and Research Centre, BLDE (Deemed to be University), Vijayapura, between September 2022 and June 2024. The institutional ethical clearance was obtained (IEC/746/2022-2023). A precision of 0.25 and a 95% confidence range were used to compute the sample size. Age above 18 and presentation within 48 hours of acute ischemic stroke onset were inclusion criteria. Exclusion criteria were cerebral venous thrombosis, posterior circulation stroke, hepatic and renal disease and patients on calcium supplements. A sample size of 60 was included in this study. Patients were evaluated based on clinical history, physical examination and lab parameters like complete hemogram, liver function tests and renal function tests. Radiologically patients were evaluated by MRI of brain to assess infarct size. Sims[6] provided the formula for the analysis of the infarct size. The slice of lesion with the biggest size was chosen. We used the ruler tool to determine the lesion's longest axis. At its greatest dimension, a second line was drawn perpendicular to the first. The names x (A) and y (B) axes were given to these two measures. By multiplying the number of slices by each slice's thickness, the Z(C) axis, a third axis was determined. The ultimate infarct size measured was ABC/2[6]. Serum calcium levels were measured by VitrosV5, IFS instrument by Arsenazo 3 reagent[7]. The NIHSS score was determined and is interpreted as follows: 0 represents no stroke symptoms, 1-4 represents a small stroke, 5-15 represents a moderate stroke, 16-20 represents a moderate to severe stroke and 21-42 represents a severe stroke. P values less than 0.05 on two-tailed significance were deemed statistically significant, while P values less than 0.01 were deemed highly significant.

RESULTS AND DISCUSSIONS

The average age group of patients were predominantly between 60 and 80 years of age with predominantly male patients (66.7%) (Table 1,2).

Table 1: Age: Number of Patients and Percentage Distribution

Age (Years)	No. of patients	Percentage
<30	4	6.7
30 - 39	5	8.3
40 - 49	5	8.3
50 - 59	8	13.3
60 - 69	14	23.3
70 - 79	15	25.0
80+	9	15.0
Total	60	100.0

Table 2: Gender: Number of Patients and Percentage Distribution

Gender	No. of patients	Percentage
Female	20	33.3
Male	40	66.7
Total	60	100.0

The study population showed hypertension (38.3%) as a more common risk factor than type 2 diabetes mellitus (5%) and the majority had no comorbidities at the time of presentation (Table 3).

Table 3: Comorbidities: Frequency and Percentage Distribution

Comorbities	Frequency	Percentage
Hypertension	23	38.3
Type 2 diabetes mellitus	3	5
Nil	34	56.7
TOTAL	60	100

The mean serum calcium level was 8.710 with standard deviation of 0. 4711.The mean infarct size was 62.95125cm3 with standard deviation of 73. 3737.The mean NIHSS score was 9.88 with standard deviation of 5.737 (Table 4).

Table 4: Mean, Median, Standard Deviation of Calcium, Infarct Size and NIHSS Score

	Calcium(MG/DL)	Infarct Size [(ABC)/2] In CM3	NIHSS score
Mean	8.710	62.95125	9.88
Median	8.800	37.25000	9.00
Std. Deviation	.4711	73.373763	5.737
Minimum	7.3	1.250	2
Maximum	9.8	306.500	28

The majority of the patients were in moderate severity stroke severity category (65%) (Table 5).

Table 5: NIHSS Score - Frequency and Distribution

NIHSS score	Frequency	Percentage
No stroke (0)	0	0
Minor stroke (1-4)	15	25.0
Moderate stroke (5-9)	39	65.0
Moderate to severe stroke	3	5.0
Severe stroke	3	5.0
Total	60	100.0

Table 6: Correlation of Calcium, NIHSS Score and Infarct Size

		Calcium(MG/DL)	NIHSS Score	Infarct Size[(ABC)/2] in CM3
Calcium(MG/DL)	Pearson Correlation	1	-.829**	-.711**
	Sig. (2-tailed)		.000	.000
	N	60	60	60
NIHSS Score	Pearson Correlation	-.829**	1	.825**
	Sig. (2-tailed)	.000		.000
	N	60	60	60
Infarct Size[(ABC)/2] In CM3	Pearson Correlation	-.711**	.825**	1
	Sig. (2-tailed)	.000	.000	
	N	60	60	60

The study showed a moderate negative correlation between serum calcium and NIHSS score (r= -0.829) and was statistically significant (p value= <0.001). The study found a statistically significant (p value = <0.001) moderately negative connection (r=-0.711) between serum calcium and infarct size (Table 6).

The current investigation sought to ascertain if serum calcium, NIHSS score and infarct size correlated with each other. There were 60 patients in this research, in whom serum calcium, NIHSS score and infarct size were measured. Most of them fell into the category of stroke with moderate severity. The results of the study demonstrated a strong inverse relationship between serum calcium with both NIHSS score and infarct size. These results were consistent with research done by Borah[9] where throughout all four quartiles, there were noteworthy inverse relationships between infarct size and both total and ionized calcium levels. Since blood calcium levels and infarct size are negatively correlated, the study proposed that serum calcium levels may be used as a prognostic indication in ischemic stroke. Other studies which had similar conclusions are as follows., the extent of the infarct and the severity of the stroke were shown to be significantly correlated negatively with total, adjusted, and ionized calcium levels in research by Prabhakar. Furthermore, the NIHSS score revealed a substantial negative correlation between the total calcium levels at presentation and the severity of the stroke[10]. In an investigation by Khattak the majority of patients in study sample experienced ischemic strokes, with NIHSS scores predominantly greater than 20, followed by scores in the range of 6-10. The Pearson correlation coefficient revealed a negative correlation of -0.236 between stroke severity and serum calcium levels[11].

In a study conducted by Prabhu to assess the association of serum calcium level with clinical severity of stroke. Patients with low serum ionized calcium levels exhibited more severe ischemic stroke, as indicated by the NIHSS score, compared to those with normal serum ionized calcium levels. In conclusion, by influencing the series of cytotoxic events that culminate in ischemic cell death, serum ionized calcium seems to have a role in the pathophysiology of ischemic stroke. This study showed that, compared to people with normal serum ionized calcium levels, those with low levels had an increased risk of ischemic stroke[8]. Thus, our research came to the conclusion that serum calcium, an affordable marker can be employed in predicting the acute ischemic stroke severity.

Limitations: Because of the tiny study sample, further extensive multi-centric research is required to ensure that the conclusions can be applied globally.

CONCLUSION

Serum calcium in this research significantly correlated negatively with both infarct size and NIHSS score. Acute ischemic strokes with larger infarct sizes will cause more calcium to be transferred from the extracellular to the intracellular area, lowering blood calcium levels and worsening clinical outcomes as shown by the NIHSS score. Thus, serum calcium can serve as a simple biochemical marker for assessing acute ischemic stroke severity.

REFERENCES

1. Jones, S.P., K. Baqai, A. Clegg, R. Georgiou and C. Harris et al., 2022. Stroke in India: A systematic review of the incidence, prevalence and case fatality. Int. J. Stroke, 17: 132-140.
2. Coupland, A.P., A. Thapar, M.I. Qureshi, H. Jenkins and A.H. Davies, 2017. The definition of stroke. J. Royal Soc. Med., 110: 9-12.
3. Chung, J.W., W.S. Ryu, B.J. kim and B.W. Yoon, 2015. Elevated calcium after acute ischemic stroke: association with a poor short- term outcome and long- term mortality. J Stroke., 17: 54-59.
4. Saunders, D.E., A.G. Clifton and M.M. Brown, 1995. Measurement of Infarct Size Using MRI Predicts Prognosis in Middle Cerebral Artery Infarction. Stroke, 26:
5. Zhuo, Y., Y. Qu, J. Wu, X. Huang and W. Yuan et al., 2021. Estimation of stroke severity with National Institutes of Health Stroke Scale grading and retinal features. Medicine, Vol. 100, No. 31 .10.1097/md.0000000000026846.
6. Sims, J.R., L.R. Gharai, P.W. Schaefer, M. Vangel and E.S. Rosenthal, 2009. ABC/2 for rapid clinical estimate of infarct, perfusion and mismatch volumes. Neurology, 72: 2104-2110.
7. Bawiskar, N., S. Kumar, S. Acharya, N. Kothari and R.R. Gemnani, 2023. Association of Serum Calcium With Infarct Size and Severity in Acute Ischemic Stroke: A Rural Hospital-Based Cross-Sectional Study. Cureus, Vol. 15, No. 8 .10.7759/ cureus.43015.

8. Prabhu, S.V., B.K. Tripathi, Y. Agarwal, B.C. Kabi and R. Kumar, 2022. Association of serum calcium levels with clinical severity of ischemic stroke at the time of admission as defined by NIHSS score: A cross-sectional, observational study. J. Family Med. Primary Care, 11: 6427-6432.
9. Borah, M., S. Dhar, D.M. Gogoi and A.A. Ruram, 2016. Association of Serum Calcium Levels with Infarct Size in Acute Ischemic Stroke: Observations from Northeast India. J. Neurosci.s Rural Pract., 7: 41-45.
10. P.K., P.S.N. and P.B.B. S, 2019. Correlation of serum calcium levels with infarct size and severity of stroke using NIHSS score in patients with acute ischemic stroke. Int. J. Res. Med. Sci., 8: 55-59.
11. Khattak, I.Q., M. Fida, R. Bibi, A. Saleem, R. Khan and M.U. Afridi, 2023. Correlation of Serum Calcium with Acute Ischemic Stroke. Pak. J. Med. Health Sci., 17: 190-193.