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ORIGINAL ARTICLE

Prevalence of Hypocalcemia in Patients with Acute Ischemic Stroke at a Tertiary Care Hospital

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ABSTRACT

Objective: To ascertain the prevalence of hypocalcemia in patients with acute ischemic stroke at a tertiary care hospital and to analyze the mean scores on the modified Rankin Scale, assessing the stroke severity, in patients both with and without hypocalcemia."

Study Design: It was a cross sectional study.

Setting: Deptt. of Medicine, Services Hospital, Lahore.

Methodology: 100 eligible patients were examined the modified Rankin scale at the time of presentation, recording the scores. To ensure accuracy, overnight fasting was observed, and a 5 ml early morning fasting blood sample was collected via venipuncture using aseptic techniques, administered by the researcher. These blood samples were then sent in serum vials to the pathology lab and hypocalcemia was labeled.

Results: Mean age ± standard deviation was calculated to be 47.58 ± 8.43 years, 63 participants (63%) were male, while 37 participants (37%) were female. The mean Rankin score was determined as 3.67 ± 1.16. Furthermore, the frequency of hypocalcemia among patients with acute ischemic stroke who presented at the tertiary care hospital was observed in 53 cases (53%). To assess the severity of stroke, a comparison was made between the mean scores on the Modified Rankin Scale for patients with and without hypocalcemia. The results showed a mean score of 4.50 ± 0.67 in the group with hypocalcemia and 2.61 ± 0.69 in the group without hypocalcemia, with a p-value of 0.0001.

Conclusion: Acute ischemic stroke patients at a tertiary care hospital often have hypocalcemia. Additionally, patients with hypocalcemia exhibit significantly higher mean scores on the modified Rankin Scale, indicating increased stroke severity compared to those without hypocalcemia.

Keywords: Acute ischemic stroke, hypocalcemia, modified Rankin Scale, severity of stroke

INTRODUCTION

After ischemic heart disease, stroke is regarded as the second most common reason for people to pass away all over the globe. In the year 2016, stroke was responsible for around 10.2% of all global fatalities.[1] Stroke is a prominent cause of mortality within the realm of neurological illnesses, accounting for a substantial proportion of associated fatalities, namely 67.3%. Moreover, it is worth noting that in the year 2016, stroke accounted for 5.2% of the total disability-adjusted life years (DALYs) lost on a worldwide scale. Annually, an estimated 15 million persons throughout the globe encounter an incident of stroke.The user's text is too short to be rewritten academically. In the preceding thirty years, there has been a significant escalation in the incidence of stroke, especially in low-income nations, with a yearly growth rate of 14.3%. There are notable differences in the prevalence, impact on health, and death rates associated with stroke across different geographical areas and locales, particularly in nations characterised by varying socioeconomic levels.The range of numbers from 4 to 6.

South Asia, a major contributor to the global burden of stroke, exhibits substantial variations in stroke prevalence rates among different countries within the region.[7] Stroke in South Asia is distinct from the rest of the world due to its higher prevalence rates, affecting a younger demographic, increased mortality, a greater burden of modifiable stroke risk factors, and certain lesser-explored non-traditional risk factors.[7-9]

Pakistan, which is now ranked as the sixth most populated nation worldwide, has a scarcity of population-specific data pertaining to the occurrence of stroke and its corresponding risk factors. Karachi, the biggest metropolitan region in the nation, saw the conduction of just two small-scale population-based research around ten years ago. The aforementioned investigations reported stroke prevalence rates of 4.8%[10] and 19.1%,[11] respectively, which were found to be the highest within the area.

Extensive research has focused on investigating the prevalence of electrolyte imbalances in individuals suffering from acute strokes, primarily because of their potential impact on stroke outcomes and prognosis. Patients who have recently experienced an acute stroke often exhibit abnormalities in their electrolyte levels, and these imbalances can significantly influence the progression of the stroke. Among this population, it is common to observe hyponatremia, hypokalemia, hypocalcemia, hypomagnesemia, and phosphate abnormalities.

One frequently encountered electrolyte imbalance in individuals with acute stroke is hyponatremia. Research indicates that hyponatremia was detected in approximately 15% of patients within the first 24 hours of the onset of the stroke.[12] In addition, the results of an independent investigation showed that hyponatremia was a predictor of death during the first ninety days after an acute ischemic stroke in patients.[13]

Nearly half of the patients who presented with an ischemic stroke were found to have hypocalcemia, according to the findings of Ovbiagele et al[14].

There is only a single study by Guven et al[15] that examines the association between stroke severity and hypocalcemia, reporting a 31% frequency of hypocalcemia among stroke patients. In addition, Guven et al. discovered that patients who had hypocalcemia had a mean score of 5 0.75 on the modified Rankin scale, while patients who had normal calcium levels had a score of 3 1.25. However, as of this moment, no local research has been carried out to investigate the connection between the two.

In patients who have been admitted to a tertiary care hospital, the major purpose of this research is to explore the incidence of hypocalcemia and its link with the severity of ischemic stroke. It is noteworthy that stroke prevalence in Pakistan is considerably higher in comparison to Europe and other countries.[16] The death rate associated with stroke is considerable, ranging from 7% to 20%. Up to 63% of all stroke patients will have complications, and as many as 89% will become reliant on others for their day-to-day activities, making stroke a profoundly disabling illness.[17] As a consequence of this, there is an urgent need to determine the variables related with stroke as well as those connected to the severity of the stroke.

While a limited number of international studies have suggested a potential association between hypocalcemia and the dynamics of stroke, as well as its severity, there is still a scarcity of comprehensive evidence at both the international and local levels. Therefore, this study aims to contribute additional evidence and furnish clinicians with insights into the role of calcium in the context of stroke and its severity. Furthermore, this research endeavor has the potential to pave the way for further investigations into the role of calcium in stroke management, with the ultimate goal of reducing both mortality and morbidity associated with this condition.

METHODOLOGY

In this cross-sectional study conducted from 2021 to 2022 at the Department of Medicine, Services Hospital, Lahore, we recruited a total of 100 participants, both male and female, aged between 25 to 60 years. We specifically included individuals experiencing their first acute episode of ischemic stroke within 3 days of the onset of symptoms. Those excluded from the study encompassed individuals with a prior history of stroke (identified through medical history and consultation with a radiologist who assessed brain CT scans for evidence of previous infarctions), primary or tertiary hyperparathyroidism based on serum PTH levels, a known history of peripheral vascular disease, malignancy, or those diagnosed with calciphylaxis based on clinical history and examination findings. Additionally, individuals with pre-existing disabilities prior to the stroke, as determined through history and examination, and those who declined to participate were also excluded.

In cases where patients were unconscious, informed consent was obtained from immediate family members. We collected demographic information and recorded it in a standardized form. The researcher personally performed physical examinations using the modified Rankin scale at the time of presentation and documented the scores on the form. To ensure accurate results, patients underwent overnight fasting, and the researcher collected an early morning fasting blood sample of approximately 5 ml through venipuncture using aseptic techniques. The samples were placed in serum vials and sent to the pathology laboratory at Services Hospital, Lahore. The following day, the researcher retrieved the results and recorded them on the form. Hypocalcemia was defined according to predetermined operational criteria. Data confidentiality was rigorously maintained throughout the study.

The data analysis was performed using SPSS version 22.0. Numeric variables, including age and modified Rankin scale scores, were summarized using mean values and their corresponding standard deviations. Qualitative variables, such as gender and the presence of hypocalcemia, were presented in terms of frequencies and percentages. To ascertain potential differences in mean scores on the modified Rankin scale between the two groups, we applied an independent sample t-test. In our statistical evaluation, a p-value of less than 0.05 held significance.

RESULTS

The age distribution revealed that 21 individuals (21%) fell within the 25-40 years age group, whereas 79 individuals (79%) were aged between 41-60 years. The mean age ± standard deviation was calculated to be 47.58 ± 8.43 years. Regarding gender distribution, 63 participants (63%) were male, while 37 participants (37%) were female. The mean Rankin score was determined as 3.67 ± 1.16.

Furthermore, the frequency of hypocalcemia among patients with acute ischemic stroke who presented at the tertiary care hospital was observed in 53 cases (53%). Conversely, 47 cases (47%) did not exhibit any signs of hypocalcemia.

To assess the severity of stroke, a comparison was made between the mean scores on the Modified Rankin Scale for patients with and without hypocalcemia. The results showed a mean score of 4.50 ± 0.67 in the group with hypocalcemia and 2.61 ± 0.69 in the group without hypocalcemia, with a p-value of 0.0001.

Table 01: Modified Rankin Scale Scores in Stroke Cases

Modified Ranking Scale	Hypocalcemia		Without hypocalcemia	
	Mean	SD	Mean	SD
	4.50	0.67	2.61	0.69

P value=0.0001

DISCUSSION

Stroke is characterized as a clinical syndrome marked by the rapid emergence of signs indicating either localized or widespread impairment of cerebral functions. This impairment persists for more than 24 hours or results in fatality, with vascular causes being the primary underlying factors. In cases of ischemic stroke, reduced blood supply disrupts the production of high-energy compounds that rely on oxygen, consequently affecting three out of the four mechanisms governing cellular calcium regulation. The finding that calcium ions (Ca2+) play a role in the ischemia cascade has led to the creation of a number of different possible neuroprotective medicines. In the setting of acute focal brain damage, these medicines are intended to have the effect of altering the function that calcium ions play.

The aim of this study was to investigate the prevalence of hypocalcemia and its association with the severity of ischemic stroke in patients presenting to a tertiary care hospital. We conducted a comparison of our findings with the research by Ovbiagele et al.[14], who reported that nearly 50% of ischemic stroke patients had hypocalcemia. Conversely, there is only a single study by Guven et al.[15] that explores the relationship between stroke severity and hypocalcemia, finding a hypocalcemia frequency of 31% among stroke patients. Our study results differ from these previous findings. Furthermore, we observed that patients with hypocalcemia had a mean score of 5 ± 0.75 on the modified Rankin scale, whereas those with normal calcium levels had a mean score of 3 ± 1.25. These findings align with and support the outcomes of our study.

Patients who had just had an acute ischemic stroke were the subjects of a study[18] that Meghna Borah and her colleagues conducted with the intention of discovering whether or not there is a link between blood calcium levels (including total, adjusted, and ionised calcium) and infarct size (IS) in patients who had recently undergone a stroke. According to the findings of their study, total calcium, albumin-corrected calcium, and ionised calcium all showed a statistically significant negative relationship with IS, with correlation coefficients (r) of -0.578, -0.5396, and -0.5335, respectively. Ionised calcium also showed a statistically significant inverse connection with IS. Ionised calcium also demonstrated a statistically significant inverse association with IS. Notably, calcium levels in all four quartiles correlated negatively with IS, whereas calcium levels after correction for albumin correlated negatively with IS only in the lowest and highest quartiles. This finding is notable because it demonstrates that total and ionised calcium are not the same thing. Based on their findings, the researchers hypothesised that blood calcium levels are directly related to infarct size in ischemic stroke, making them a useful prognostic biomarker. As a consequence of their research, they came at this conclusion.

Another study[19] looked at how blood calcium levels at admission correlated with initial infarct sizes on diffusion-weighted magnetic resonance imaging (DWI) in individuals with acute ischemic stroke. One hundred seventy-three patients were included in the research; their mean age was 70.3, with a range of 24-100 years, and their median score on the National Institutes of Health Stroke Scale was 4, with a range of 0-38.

Median DWI infarct volumes ranged from 9.42 mL to 2.11 mL to 1.03 mL to 3.68 mL across the four quartiles of blood calcium levels. In particular, the lowest quartile of blood calcium level was associated with a larger median DWI infarct volume than the other three quartiles (P 0.005). After further multivariate analysis, it was shown that the median adjusted DWI infarct sizes

for the four quartiles of blood calcium levels (lowest to highest) were 8.9, 5.8, 4.5, and 3.8 mL, respectively. Compared to the other three quartiles, the median corrected DWI infarct volume in the lowest serum calcium level quartile was considerably higher (P 0.05). The results of this research showed that individuals with acute ischemic stroke who had higher blood calcium levels at admission had lower infarct sizes. These results indicate that blood calcium levels may be a therapeutic target for improving stroke outcomes and a clinical predictor in the time immediately after a stroke.

The aforementioned findings align with our own study. While only a limited number of international studies have identified hypocalcemia as a factor linked to stroke dynamics and its severity, substantial evidence remains scarce, both at the international and local levels. Consequently, our research has contributed to expanding the body of evidence and has furnished clinicians with valuable insights into the role of calcium in ischemic stroke and its severity.

Furthermore, our study has the potential to pave the way for additional research endeavors exploring the role of calcium in stroke management, with the ultimate goal of reducing both mortality and morbidity associated with this condition. To further validate our results, additional trials may be conducted.

CONCLUSION

Our study revealed a higher prevalence of hypocalcemia among patients with acute ischemic stroke who sought treatment at a tertiary care hospital. Additionally, we observed that patients with hypocalcemia had higher mean scores on the modified Rankin Scale, indicating greater stroke severity, in comparison to patients without hypocalcemia.

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