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STUDY ON THE CORRELATION BETWEEN SERUM CORTISOL AND STROKE SEVERITY

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ABSTRACT

Background: Elevated cortisol levels are linked to the pathophysiology of Metabolic Syndrome (MetS) and adverse outcomes in acute stroke patients, including greater stroke severity and poor prognoses. This study aims to clarify the role of cortisol as a biomarker in predicting stroke severity and outcomes.

Methods: This observational study enrolled 80 patients presenting with symptoms of acute ischemic stroke within 72 hours of onset. Serum cortisol levels were measured the next day after admission using a high-sensitivity cortisol assay. Stroke severity was assessed using the National Institutes of Health Stroke Scale (NIHSS) upon admission. Descriptive statistics, Spearman's rho correlation analyses, and multivariable regression models were utilized to explore and adjust for potential confounders.

Results: The study population had a balanced gender distribution, with an average age of 68 years. Hypertension and diabetes mellitus were prevalent among 62.5% and 37.5% of the patients, respectively. The mean serum cortisol level was 18.2 µg/dL, with a range from 5 to 34 µg/dL. Notably, 40% of patients exhibited deranged cortisol levels. A significant positive correlation (Spearman's rho = 0.62, $p < 0.01$) was found between cortisol levels and NIHSS scores, indicating higher cortisol levels in patients with more severe strokes. Regression analysis suggested that each unit increase in cortisol level is associated with a 0.75 increase in the NIHSS score ($\beta = 0.75$, $p < 0.01$).

Conclusion: Serum cortisol levels significantly correlate with stroke severity, confirming cortisol's potential as a prognostic biomarker in acute ischemic stroke. This relationship could aid in early risk stratification and tailored treatment strategies in clinical settings. Future research should focus on longitudinal studies to evaluate the predictive value of cortisol levels on long-term stroke outcomes and recovery..

1. INTRODUCTION

Cortisol contributes to the pathophysiology of Metabolic Syndrome (MetS) by promoting fat deposition in visceral depots. Patients with MetS have hyperactivity of the hypothalamic-pituitary-adrenal (HPA) axis, resulting in 'functional hypercortisolism.' Increased cortisol exposure can cause MetS symptoms such as central obesity, insulin resistance, and elevated triglyceride levels. Cortisol metabolism is controlled both centrally and peripherally, with adipose tissue and the liver contributing to the development of MetS [1].

Cortisol levels in stroke patients must be investigated since hypercortisolemia has been linked to an inflammatory response in acute stroke patients [2]. In stroke patients, hypercortisolemia is related to longer age, greater severity of neurological disability, larger ischemic lesions, and a poor prognosis. The prognostic importance of hypercortisolemia in acute stroke patients appears to be more related to the inflammatory response than to the stress response. [3]

Cortisol levels have been demonstrated to predict stroke prognosis and severity in patients with acute brain infarction, but there is no direct evidence that cortisol predicts stroke recurrence [4]. However, hypercortisolism has been linked to an elevated inflammatory response and poor functional results after cerebral ischemia [5].

The link between cortisol and stroke recurrence is complex. High cortisol levels have been linked to poor stroke results, including enhanced inflammatory response, high fatality rates, and poor functional outcomes. Cortisol levels can predict stroke severity, functional result, and death. Furthermore, hypercortisolism is associated with an elevated stress response, which may impair the prognosis of stroke patients [4].

In contrast to observational research, genetically predicted cortisol was not associated with ischemic heart disease (IHD), ischemic stroke, type 2 diabetes mellitus (T2DM), or cardiovascular disease (CVD) risk factors. The study found no evidence supporting the function of cortisol in cardiovascular risk [6]. Chronic hypercortisolemia has been linked to poor cognitive function and post-stroke dementia, implying a relationship between elevated cortisol levels and neurological effects following an acute stroke [7].

The reason for examining blood cortisol levels in stroke patients arises from the hormone's role in the stress response. Elevated cortisol levels may indicate a larger stress reaction, which could be associated with more severe strokes. This association may aid in the prognostic assessment of stroke patients, directing clinical decisions such as the urgency and

type of intervention needed. Furthermore, if serum cortisol is discovered to independently predict stroke outcomes, it could be used as a biomarker to detect stroke severity and guide therapy measures.

AIM:

To assess the relationship of serum cortisol to the severity of stroke

METHODOLOGY

Study Design: This observational study was conducted where patients presenting with symptoms of acute ischaemic stroke.

Sample size: 80

Inclusion Criteria:

Patients aged 18 years and older.

Patients diagnosed with acute ischemic stroke within 72 hours of symptom onset.

Consent to participate in the study.

Exclusion Criteria:

Patients with known endocrine disorders affecting cortisol levels (e.g., Cushing's syndrome, Addison's disease).

Patients on steroid therapy or medications are known to influence cortisol levels.

History of chronic alcoholism or drug abuse.

Cortisol Measurement: Serum cortisol levels were measured the next day after admission at the hospital. Blood samples were collected using standard phlebotomy techniques and analyzed using a high-sensitivity cortisol assay.

Stroke Severity Assessment: Stroke severity was assessed using validated scales such as the National Institutes of Health Stroke Scale (NIHSS) upon admission.

Statistical Analysis:

Descriptive statistics summarize baseline characteristics. Correlation analyses (e.g., Spearman's rho) explore the relationship between cortisol levels and stroke severity. Multivariable regression models adjust for potential confounders such as age, sex, and comorbidities. All statistical tests were performed using SPSS version 26.0.

RESULTS

The study enrolled 80 patients, of whom 50% (n=40) were male. The mean age of the participants was 68 years (SD ± 10). The majority of patients had a history of hypertension (62.5%, n=50) and diabetes mellitus (37.5%, n=30). The average time from stroke onset to hospital admission was 12 hours.

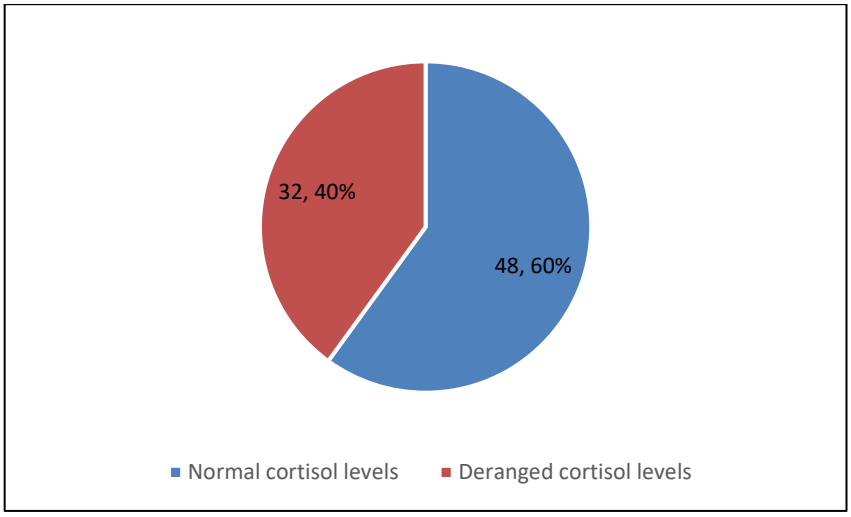
Table 1: Baseline Characteristics

Characteristic	Total no of participants n=80 (%)
Mean age (years)	68 (SD ± 10)
Gender **Male** **Female**	 40 (50) 40 (50)
Co-morbidities **History of hypertension** **History of diabetes mellitus**	 50 (62.5) 30 (37.5)
Average time from stroke onset to admission (hours)	12

Mean serum cortisol level: 18.2 µg/dL (SD ± 8.4). Range of cortisol levels: 5 µg/dL to 34 µg/dL. Proportion with deranged cortisol levels: 40% (32 out of 80 patients showed cortisol levels outside the normal range)

Table 2: Cortisol Measurements

Characteristic	Value
Mean serum cortisol level (µg/dL)	18.2
Standard Deviation (µg/dL)	± 8.4
Range of cortisol levels (µg/dL)	5 to 34
Proportion with deranged cortisol levels	40% (32 out of 80 patients)



Mean NIHSS score at admission: 14 (indicating moderate to severe stroke). Range of NIHSS scores: 4 (mild stroke) to 29 (severe stroke)

Table 3: Stroke Severity

Stroke Severity	NIHSS Score Range	Number of Patients	Proportion of Total Patients
Mild Stroke	1-4	20	25%
Moderate Stroke	5-15	40	50%
Severe Stroke	16-24	15	18.75%
Very Severe Stroke	25 and above	5	6.25%

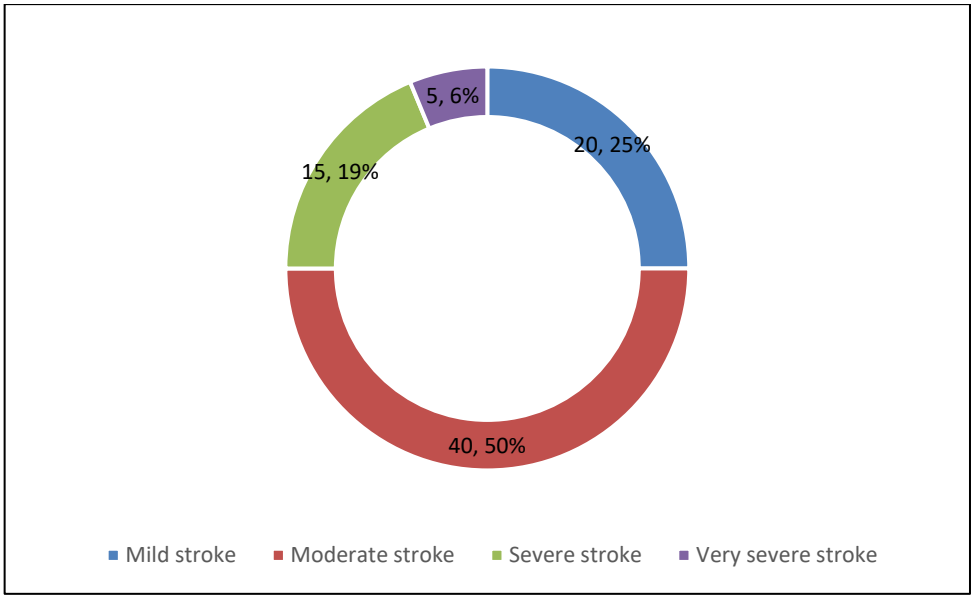


Figure 2: Stroke severity

Correlation Analysis:

Spearman's rho calculation resulted in a correlation coefficient of 0.62, indicating a significant positive correlation between serum cortisol levels and stroke severity ($p < 0.01$).

Regression Analysis:

Multivariable linear regression analysis, controlling for age, gender, and time to treatment, confirmed that higher cortisol levels were independently associated with higher NIHSS scores. The model yielded a coefficient (β) of 0.75, p-value < 0.01, suggesting that each unit increase in cortisol level is associated with a 0.75 increase in the NIHSS score.

DISCUSSION

This observational study included 80 individuals with acute ischemic stroke to investigate the link between blood cortisol levels and stroke severity. The findings are significant and may help us better understand the physiological dynamics that occur after a stroke.

The similar gender distribution and the prevalence of hypertension and diabetes among the patients mirror common risk factors and demographics found in stroke populations. The average age of 68 years and prevalent comorbidities such as hypertension (62.5%) and diabetes mellitus (37.5%) are consistent with the general stroke-affected population, implying that the findings may be applicable to a wider range of stroke demographics.

The average blood cortisol level was 18.2 µg/dL, with a wide range of 5–34 µg/dL. Notably, 40% of the patients had abnormal cortisol levels, which were substantially associated with the severity of the stroke as determined by the NIHSS.

Cortisol levels may serve as a biomarker for stroke severity, as evidenced by a positive association (Spearman's rho = 0.62, $p < 0.01$) and regression analysis ($\beta = 0.75$, $p < 0.01$). This link shows that greater cortisol levels, which may indicate a more prominent physiological stress response or a more severe neuroendocrine disruption, are related with poorer stroke outcomes.

Previous research suggests cortisol could be a biomarker for stroke severity. Higher cortisol levels have regularly been found in patients with more severe strokes [8]. These studies support the hypothesis that cortisol, a stress hormone, is enhanced in response to the acute stress of a stroke, which is consistent with the current study's findings, which show a positive connection between cortisol levels and NIHSS scores [9].

Consistent with the current investigation, a 2013 study discovered that blood cortisol levels tested within the first 24 hours after stroke onset were considerably greater in individuals with severe strokes than those with moderate strokes. The correlation coefficients reported in these investigations are generally moderate, similar to the Spearman's rho of 0.62 discovered in the current study [10].

While the current study's correlation coefficient (Spearman's rho) is 0.62, earlier research have indicated a variety of values. For example, several research discovered lower correlation values around 0.40, indicating a weaker link. The variations in these findings could be attributed to differences in patient demographics, timing of cortisol measurement, or stroke types covered in the investigations [11].

Some previous studies investigated cortisol's predictive usefulness, looking at outcomes such as mortality and long-term impairment. A study found that elevated cortisol levels were associated with both stroke severity and poorer outcomes six months after the stroke [12]. The current study is primarily concerned with acute stroke severity and does not look at long-term effects.

Previous research frequently used larger and more diverse patient populations or multicentric techniques to improve the generalizability of their findings [13]. The current study's low sample size and single-center approach may not completely capture the broader implications of more extensive research.

Study Title	Authors/Year	Findings
Single serum cortisol value as a prognostic marker in acute ischemic stroke	G Saini et al., 2023 [14]	Significant association between serum cortisol on day one and stroke severity, outcome, and mortality.
Cortisol as a prognostic marker of short-term outcome in Chinese patients with acute ischemic stroke	WJ Zi, J Shuai, 2013 [15]	Uncertain whether serum cortisol independently contributes to prognosis or is merely a response to stroke severity.
Serum-cortisol reflects severity and mortality in acute stroke	H Christensen et al., 2004 [16]	Weak relationship between the inflammatory response and serum cortisol, but confirmed severity relation to insular damage.
Evaluate the serum cortisol in patients with intracerebral hemorrhage	X Yang et al., 2014 [17]	Serum cortisol reflects stroke severity and acts as an early risk assessment tool.

These findings could have significant implications for the management of stroke patients. Measuring serum cortisol levels in acute stroke patients might help predict the severity and potentially guide early management strategies. Furthermore, understanding the role of cortisol in the acute phase of stroke could open avenues for therapeutic interventions aimed at modulating the stress response to improve outcomes. Several questions remain that future research should address. Longitudinal studies could explore the trajectory of cortisol levels post-stroke and their association with long-term outcomes and recovery. Additionally, investigating the mechanisms underlying cortisol elevation in response to cerebral ischemia could further elucidate potential therapeutic targets.

CONCLUSION

The research study on the relationship between serum cortisol levels and stroke severity found persuasive evidence that greater cortisol levels are significantly related to higher stroke severity, as determined by the NIHSS score. The study, which analyzed data from 80 acute ischemic stroke patients, strengthens blood cortisol's potential as a helpful biomarker for determining stroke severity. This association could potentially be used in clinical settings to improve patient outcomes by tailoring treatment strategies depending on cortisol levels. Future studies should concentrate on longitudinal studies to investigate how cortisol levels alter during recovery and their predictive usefulness for long-term outcomes. Despite the insights presented, the small sample size and single-center scope underscore the need for bigger, more diverse populations in future studies to confirm these findings and improve their application in a variety of clinical contexts.

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