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Original Research Article

A comparative study of the Glasgow Coma Scale, Glasgow Coma Scale-Pupil and the full outline of UnResponsiveness (FOUR) score in prediction of mortality in Department of emergency medicine in patients diagnosed with stroke

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Abstract:

Objectives: The present study was to compare the predictive ability of the GCS, GCS-P, and FOUR scores for early mortality among patients diagnosed with stroke in the department of emergency medicine.

Methods: A total of 200 Patients diagnosed with stroke presenting to the emergency department were enrolled. Neurological assessment was performed at admission using GCS, GCS-P, and FOUR scores. Patients were followed to assess mortality within early time frames and in-hospital outcomes. Clinical parameters, hospital stay, and outcomes were analyzed to determine the association between neurological scores and mortality.

Results: All 7 deaths within 48 hours (100%) occurred in patients whose outcome was death, while none of the discharged or LAMA patients experienced mortality within 48 hours. Among survivors, 164 discharged patients (85.0%) and 15 LAMA patients (7.8%) remained alive beyond 48 hours. Similarly, all 4 deaths within 72 hours (100%) occurred in patients with a fatal outcome, with no deaths among discharged or LAMA patients; 164 discharged patients (83.7%) and 15 LAMA patients (7.7%) survived beyond 72 hours. The association between mortality and final disposition was highly statistically significant for both 48-hour and 72-hour mortality ($p < 0.0001$). The mean length of hospital stay differed significantly between patients with early mortality and survivors. For mortality within 48 hours, the mean hospital stay was 1.71 ± 0.49 days for patients who died compared to 11.61 ± 7.57 days for those who survived ($p = 0.001$). Similarly, for mortality within 72 hours, patients who died had a mean hospital stay of 3.50 ± 0.58 days, while survivors stayed a mean of 11.42 ± 7.65 days ($p = 0.04$), indicating a statistically significant difference in both time frames.

Conclusion: All three neurological scoring systems were effective in predicting mortality in stroke patients presenting to the emergency department. However, the FOUR score showed better prognostic performance compared to GCS and GCS-P, making it a valuable tool for early risk stratification and clinical decision-making in acute stroke management.

Keywords: Stroke, Glasgow Coma Scale, Glasgow Coma Scale-Pupil.

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Introduction

Cerebrovascular accident involves cerebral regions that regulate consciousness. Various assessment instruments are used to evaluate the level of consciousness in CVA patients, including the National Institutes of Health Stroke Scale (NIHSS) and the Glasgow Coma Scale (GCS) [1]. The

Glasgow Coma Scale has several limitations. The verbal response component is invariably scored lowest in intubated patients, resulting in underestimation of the total score. Additionally, comprehensive assessment of consciousness requires evaluation of brainstem reflexes, medullary function, and respiratory patterns, which are not incorporated into the GCS. GCS lacks sensitivity for detecting minor fluctuations in consciousness among comatose patients during emergency department observation [2,3]. “In addition, eye response in GCS is a less reliable criterion to predict the prognosis and outcome of a condition in patients. A recent study presented a weak relationship between patients’ GCS scores and their prognosis.” To address the shortcomings of the GCS, alternative instruments have been developed to enable more accurate patient assessment. The Full Outline of UnResponsiveness (FOUR) scale is a newer tool designed to overcome these limitations and can be reliably used by physicians and other healthcare professionals, particularly in the intensive care setting [3].

The FOUR scale comprises four domains—motor response, eye response, respiratory status and brainstem reflexes—with values ranging from 0 to 16. Each domain is valued from 0 to 4, making scale easier for healthcare personnel to learn and apply. The FOUR scale has a higher reliability in predicting hospital mortality, survival rates, and patient prognosis. In addition, the FOUR scale evaluates respiratory function and brain stem reflexes, can identify disorders such as vegetative state and locked-in syndrome [4].

The FOUR scale has been assessed in patients with altered consciousness in two earlier studies. Nonetheless, additional research is required to evaluate the use of the FOUR scale in CVA populations presenting to the Emergency department. GCS fails to assess the verbal response in intubated population of CVA but the FOUR score has the ability to assess the brainstem reflexes and can determine level of consciousness accurately even in intubated population of CVA presenting to ED. Objective of the present study was to compare the accuracy of FOUR score and GCS and GCS- P in predicting in-hospital mortality of stroke patients [2,5].”

Materials & Method

Study Design: This study was a prospective observational study conducted to evaluate the predictive accuracy of the Glasgow Coma Scale (GCS), Glasgow Coma Scale–Pupil (GCS-P), and Full Outline of UnResponsiveness (FOUR) score in predicting early mortality among patients diagnosed with stroke.

Study Setting: The study was conducted in the Department of Emergency Medicine at Kalinga Institute of Medical Sciences (KIMS), PBMH, KIIT Deemed to be University, Bhubaneswar, Odisha.

Ethical Considerations: Ethical approval was obtained from the Institutional Ethics Committee (IEC). Informed consent was taken from all participants before their inclusion in the study. The confidentiality of patient data was maintained, and the study adheres to the ethical guidelines set by the Declaration of ICMR 2017.

Study Duration: The study was conducted during the stipulated study period 2024 – 2025 after obtaining approval from the Institutional Ethics Committee.

Study Population: All adult patients presenting to the emergency department with a diagnosis of acute stroke and fulfilling the inclusion criteria were enrolled in the study.

Sample Size: A total of 200 patients diagnosed with stroke were included in the study.

Inclusion Criteria: Patients meeting the following criteria were included in the study:

- Adult patients age >18.
- Patients without a family history of hereditary neuromuscular disorders.
- Patients admitted through the emergency department with a diagnosis of stroke.

Exclusion Criteria:

- Patient received in intubated or sedated state from other centre.
- Post ictal state.

Patient Enrolment: Patients who met the inclusion criteria were enrolled in the study after obtaining informed consent. A pre-designed case record form (CRF) was used to collect demographic and clinical data.

Materials for clinical data recording:

- Consent form
- Case record form

Method: After initial stabilization in the emergency department, detailed clinical evaluation was performed for all eligible patients. Demographic data including age and gender were recorded. Clinical parameters such as level of consciousness, need for intubation, diagnosis of stroke subtype, and associated comorbidities were documented.

Neurological assessment was performed at the time of admission using the following scoring systems:

1. **Glasgow Coma Scale (GCS):** The Glasgow Coma Scale was used to assess the level of consciousness based on eye opening, verbal response, and motor response.

2. **Glasgow Coma Scale–Pupil (GCS-P):** The GCS-P score was calculated by subtracting the Pupil Reactivity Score (PRS) from the total GCS score.
3. **Full Outline of UnResponsiveness (FOUR) Score:** The FOUR score was assessed using four components: eye response, motor response, brainstem reflexes, and respiratory pattern.

All scores were recorded by trained emergency medicine physicians at admission.

Outcome Measures:

Primary Outcome: Sensitivity, specificity, positive and negative predictive values of FOUR, GCS, GCS-P in prediction of mortality of stroke in department of Emergency Medicine

Secondary Outcomes:

- Using of FOUR, GCS, GCS-P scores in predicting the length of hospital stay.
- Using of FOUR, GCS, GCS-P scores in predicting the mortality of stroke patients within 72 hours of admission

Statistical Analysis: Data was analyzed with the help of IBM SPSS software version 26. Mean and standard deviations were observed. Chi squared test was applied. P-value was taken less than or equal to 0.05 ($p \leq 0.05$) for significant differences.

Results

Out of a total of 200 patients, 7 patients (3.5%) died within 48 hours, while 4 patients (2.0%) died within 72 hours. Mortality occurring after 72 hours was observed in 10 patients (5.0%). The majority of patients, 164 (82.0%), were successfully discharged, and 15 patients (7.5%) left the hospital against medical advice (LAMA).

The distribution of mortality within 48 and 72 hours was analyzed across different age groups. Mortality within 48 hours was highest in the 81–90 years age group, with 3 patients (42.9%) affected, followed by the 61–70 years group with 2 patients (28.6%), the 31–40 and 71–80 years groups with 1 patient each (14.3%), and no deaths in the 21–30 and 41–50 years groups. This association between age and 48-hour mortality was statistically significant (p = 0.001).

Mortality within 72 hours was observed only in the 51–60 years age group, affecting 4 patients (100%), while no deaths occurred in the other age groups. The association between age and 72-hour mortality was not statistically significant (p = 0.135).

“When analyzed by gender, 4 female patients (57.1%) and 3 male patients (42.9%) experienced mortality within 48 hours, while 70 females (36.3%) and 123 males (63.7%) survived beyond 48 hours. For mortality within 72 hours, 2 females (50.0%) and 2 males (50.0%) were affected, with 72 females (36.7%) and 124 males (63.3%) surviving. There was no statistically significant association between gender and mortality at either 48 hours (p = 0.261) or 72 hours (p = 0.586).”

Mortality within 48 hours was highest among patients with diabetes and hypertension (DM + HTN), affecting 3 patients (42.9%), followed by those with hypertension alone (2 patients, 28.6%) and patients with no comorbidities (2 patients, 28.6%). Other comorbidities, including AKI, asthma, CAD, CKD, CVA, CVA with HTN, DCM with hypothyroidism, DM alone, and prostatomegaly, had no deaths within 48 hours.

“Mortality within 72 hours was observed in 2 patients (100%) with a history of cerebrovascular accident (CVA) and in 2 patients (50.0%) with no comorbidities, while no deaths occurred in patients with other comorbidities. The association between comorbidities and 48-hour mortality was not statistically significant (p = 0.999), whereas the association with 72-hour mortality was highly significant (p < 0.0001).”

Table 1: Association between Conscious / unconsciousness, Intubation, and Diagnosis with Mortality in 48hrs and 72 hours.

		Mortality in 48 hrs		**Mortality in 72 hrs**	
Conscious / Unconscious		**Yes**	**No**	**Yes**	**No**
	Conscious	4 (57.1%)	182 (94.3%)	0 (0.0%)	186 (94.9%)
	Unconscious	3 (42.9%)	11 (5.7%)	4 (100.0%)	10 (5.1%)
	Total	7 (100.0%)	193 (100.0%)	4 (100.0%)	196 (100.0%)
	P-Value	**<0.0001**		**<0.0001**	
Intubation	No	1 (14.3%)	165 (85.5%)	0 (0.0%)	166 (84.7%)
	Yes	6 (85.7%)	28 (14.5%)	4 (100.0%)	30 (15.3%)
	Total	7 (100.0%)	193 (100.0%)	4 (100.0%)	196 (100.0%)
	P-Value	**<0.0001**		**<0.0001**	
Diagnosis	Hemorrhagic	7 (100.0%)	92 (47.7%)	2 (50.0%)	97 (49.5%)
	Ischemic	0 (0.0%)	100 (51.8%)	2 (50.0%)	98 (50.0%)
	Malignant ischemic / SAH	0 (0.0%)	1 (0.5%)	0 (0.0%)	1 (0.5%)
	Total	7 (100.0%)	193 (100.0%)	4 (100.0%)	196 (100.0%)
	P-Value	**0.025**		**0.99**	

When analyzed according to consciousness at admission, 4 patients (57.1%) who were conscious and 3 patients (42.9%) who were unconscious experienced mortality within 48 hours. In contrast, 182 conscious patients (94.3%) and 11 unconscious patients (5.7%) survived beyond 48 hours. Mortality within 72 hours was observed exclusively in 4 unconscious patients (100%), while no deaths occurred among conscious patients; 186 conscious patients (94.9%) and 10 unconscious patients (5.1%) survived beyond 72 hours. The association between consciousness and both 48-hour and 72-hour mortality was statistically significant ($p < 0.0001$)."

Mortality was significantly associated with intubation status. Within 48 hours, 6 intubated patients (85.7%) died compared to 1 non-intubated patient (14.3%), while 28 intubated patients (14.5%) and 165 non-intubated patients (85.5%) survived beyond 48 hours. All 4 deaths within 72 hours occurred among intubated patients (100%), with no deaths among non-intubated patients; 30 intubated patients (15.3%) and 166 non-intubated patients (84.7%) survived beyond 72 hours. These associations were highly statistically significant for both 48-hour and 72-hour mortality ($p < 0.0001$).

"Mortality varied according to the type of diagnosis. All 7 deaths within 48 hours occurred in patients with hemorrhagic strokes (100%), while no deaths were observed in patients with ischemic strokes or malignant ischemic/subarachnoid hemorrhage (SAH). Within 72 hours, mortality was evenly distributed between hemorrhagic and ischemic stroke patients, with 2 deaths (50.0%) in each group, and no deaths among patients with malignant ischemic stroke or SAH. Among survivors, 92 patients (47.7%) with hemorrhagic strokes, 100 patients (51.8%) with ischemic strokes, and 1 patient (0.5%) with malignant ischemic/SAH strokes survived beyond 48 hours. The association between diagnosis and 48-hour mortality was statistically significant ($p = 0.025$), whereas there was no significant association for 72-hour mortality ($p = 0.99$)."

Table 2:Association between Disposition with Mortality in 48hrs and 72 hours.

		Mortality in 48 hrs		Mortality in 72 hrs	
Disposition		**Yes**	**No**	**Yes**	**No**
	HDU	0 (0.0%)	72 (37.3%)	0 (0.0%)	72 (36.7%)
	ICU	7 (100.0%)	118 (61.1%)	4 (100.0%)	121 (61.7%)
	WARD	0 (0.0%)	3 (1.6%)	0 (0.0%)	3 (1.5%)
	Total	7 (100.0%)	193 (100.0%)	4 (100.0%)	196 (100.0%)
	P-Value	0.113		0.294	

When analysed by patient disposition, all deaths within 48 hours occurred in patients admitted to the ICU (7 patients, 100%), while no deaths were observed in the HDU or ward. Among survivors beyond 48 hours, 118 ICU patients (61.1%), 72 HDU patients (37.3%), and 3 ward patients (1.6%) remained alive. Similarly, all 4 deaths within 72 hours occurred in ICU patients (100%), with no deaths in the HDU or ward; 121 ICU patients (61.7%), 72 HDU patients (36.7%), and 3 ward patients (1.5%) survived beyond 72 hours. These associations were not statistically significant for either 48-hour mortality ($p = 0.113$) or 72-hour mortality ($p = 0.294$).

Table 3: Association between Discharge/death/ LAMA and Length of hospital stay (days) with Mortality in 48hrs and 72 hrs"

		Mortality in 48 hrs		Mortality in 72 hrs	
Discharge/Death/LAMA		**Yes**	**No**	**Yes**	**No**
	DEATH	7 (100.0%)	14 (7.3%)	4 (100.0%)	17 (8.7%)
	DISCHARGE	0 (0.0%)	164 (85.0%)	0 (0.0%)	164 (83.7%)
	LAMA	0 (0.0%)	15 (7.8%)	0 (0.0%)	15 (7.7%)
	Total	7 (100.0%)	193 (100.0%)	4 (100.0%)	196 (100.0%)
	P-Value	<0.0001		<0.0001	
Length of hospital stay (days)	Mean±SD	1.71 ± 0.49	11.61 ± 7.57	3.50 ± 0.58	11.42 ± 7.65
	P-Value	**0.001**		**0.04**	

When analyzed according to final disposition, all 7 deaths within 48 hours (100%) occurred in patients whose outcome was death, while none of the discharged or LAMA patients experienced mortality within 48 hours. Among survivors, 164 discharged patients (85.0%) and 15 LAMA patients (7.8%) remained alive beyond 48 hours. Similarly, all 4 deaths within 72 hours (100%) occurred in patients with a fatal outcome, with no deaths among discharged or LAMA patients; 164 discharged patients (83.7%) and 15 LAMA patients (7.7%) survived beyond 72 hours. The association between mortality and final disposition was highly statistically significant for both 48-hour and 72-hour mortality ($p < 0.0001$).

The mean length of hospital stay differed significantly between patients with early mortality and survivors. For mortality within 48 hours, the mean hospital stay was 1.71 ± 0.49 days for patients who died compared to 11.61 ± 7.57 days for those who survived ($p = 0.001$). Similarly, for mortality within 72 hours, patients who died had a mean hospital stay of 3.50 ± 0.58 days, while survivors stayed a mean of 11.42 ± 7.65 days ($p = 0.04$), indicating a statistically significant difference in both time frames.

Table 4: Association between GCS Score (Group) with GCS -P score (Group).

GCS Score (Group)	GCS-P score ≤8	GCS-P score >8	Total	p-value
1. ≤8	28 (100.0%)	0 (0.0%)	28 (14.0%)	<0.0001
2. >8	0 (0.0%)	172 (100.0%)	172 (86.0%)	
Total	28 (100.0%)	172 (100.0%)	200 (100.0%)	

Sensitivity: 100.0, Specificity: 100.0, Positive Predictive Value: 100.0, Negative Predictive Value: 100.0, Accuracy: 100.0%.

The Glasgow Coma Scale–Pupil (GCS-P) score was strongly associated with patient outcomes. All 28 patients (100%) with a GCS-P score ≤8 fell into the lower score group, while all 172 patients (100%) with a GCS-P score >8 were in the higher score group. This association was highly statistically significant ($p < 0.0001$), indicating that GCS-P score reliably distinguished between patients with poorer versus better neurological status. The diagnostic test demonstrated excellent performance, with a sensitivity of 100.0% and a specificity of 100.0%. The positive predictive value and negative predictive value were both 100.0%, indicating perfect ability to correctly identify both positive and negative cases. Overall, the accuracy of the test was 100.0%, reflecting complete concordance between the test results and the reference standard.

The Full Outline of Unresponsiveness (FOUR) score was significantly associated with GCS-P score groups. Among patients with a GCS-P score ≤8, 16 patients (57.1%) had a FOUR score ≤8, while 12 patients (42.9%) had a FOUR score >8. In contrast, all 172 patients (100%) with a GCS-P score >8 had a FOUR score >8. This association was highly statistically significant ($p < 0.0001$). The diagnostic test showed a sensitivity of 57.1% and a specificity of 100.0%. The positive predictive value was 100.0%, while the negative predictive value was 93.5%. Overall, the accuracy of the test was 94.0%, indicating high diagnostic reliability despite moderate sensitivity.""

The relationship between neurological scores and length of hospital stay was analyzed. For the Glasgow Coma Scale (GCS) score, patients with scores of 3–8 had a mean hospital stay of 11.64 ± 14.69 days, those with scores 9–12 stayed 12.96 ± 7.77 days, and patients with scores 13–15 stayed 10.41 ± 4.55 days, with no statistically significant difference ($p = 0.125$). Similarly, for the GCS-P score, patients with scores 1–8 had a mean stay of 11.64 ± 14.69 days, those with scores 9–12 stayed 12.82 ± 7.66 days, and scores 13–15 stayed 10.44 ± 4.59 days ($p = 0.157$), indicating no significant difference. In contrast, the FOUR score showed a significant association with hospital stay: patients with scores 0–4 had a mean stay of 4.11 ± 4.68 days, scores 5–8 had 6.57 ± 4.50 days, scores 9–12 had 15.33 ± 13.61 days, and scores 13–16 had 11.10 ± 5.64 days ($p < 0.0001$).

"Neurological scores were significantly associated with both 48-hour and 72-hour mortality. Patients who died within 48 hours had a mean GCS score of 5.14 ± 2.34, compared to 12.45 ± 3.22 in survivors, while mean GCS-P scores were 3.71 ± 3.30 in patients who died versus 12.30 ± 3.49 in survivors. Similarly, the mean FOUR score was 5.14 ± 4.81 in patients who died within 48 hours compared to 14.17 ± 3.10 in survivors. Mortality within 72 hours showed the same trend, with lower scores in deceased patients: GCS 3.00 ± 0.00 vs 12.38 ± 3.23 in survivors, GCS-P 1.50 ± 0.58 vs 12.21 ± 3.54, and FOUR score 4.00 ± 2.31 vs 14.05 ± 3.30. All associations were highly statistically significant ($p < 0.0001$).

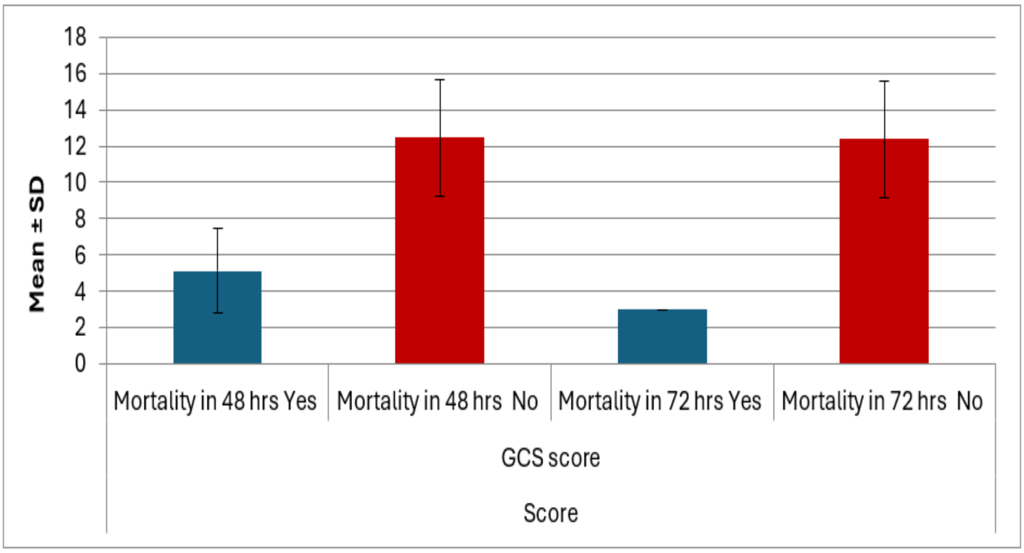

Figure 1: Distribution of mean GCS score with Mortality in 48hrs and 72 hrs.

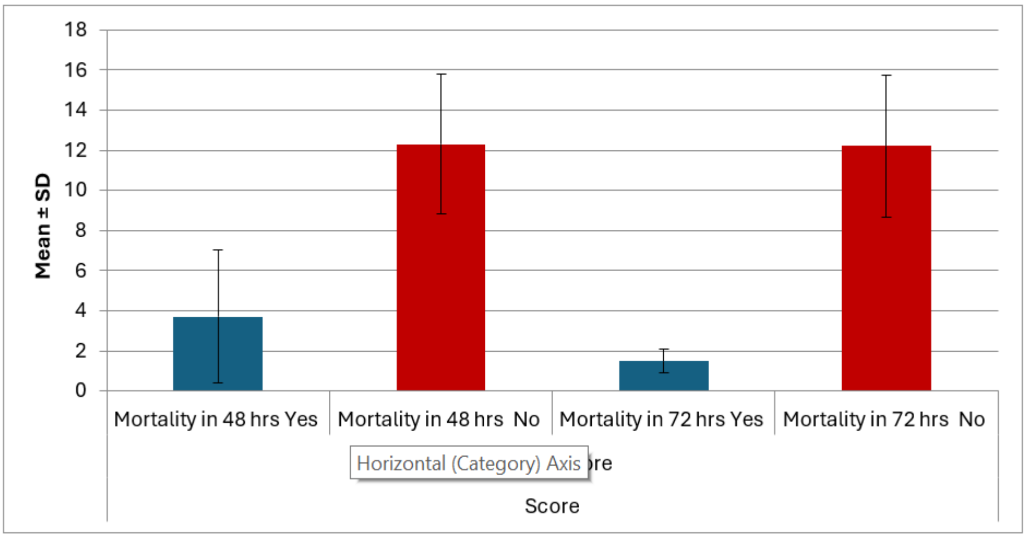

Figure 2: Distribution of mean GCS -P score with Mortality in 48hrs and 72 hrs.

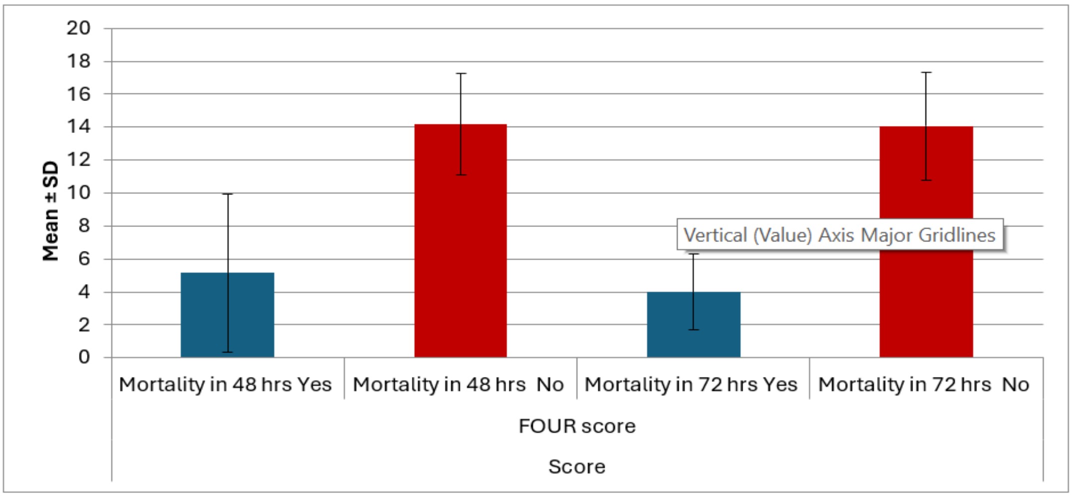

Figure 3: Distribution of mean FOUR Score with Mortality in 48hrs and 72 hrs.

Discussions

The present study demonstrate that early mortality is significantly associated with neurological severity at admission, with multiple clinical and statistical indicators supporting this association"

Early Mortality and Overall Outcome Distribution: The overall mortality rate in the present cohort was 10.5%, with 3.5% of deaths occurring within the first 48 hours and an additional 2.0% within 72 hours. The concentration of deaths in the early phase underscores the importance of early risk stratification. The predominance of favourable outcomes, with 82% of patients discharged, highlights that early mortality represents a distinct, high-risk subgroup rather than a uniform outcome across all stroke presentations.

Demographic Variables and Statistical Significance: Age showed a statistically significant association with mortality within 48 hours (χ^2 test, $p = 0.001$). Patients who died early were significantly older than survivors, as demonstrated by a higher mean age (71.86 ± 18.17 vs 61.00 ± 11.94 years; independent samples t-test, $p = 0.021$). This indicates that advanced age contributes to ultra-early mortality, likely reflecting diminished physiological reserve and increased vulnerability to severe neurological injury.

In contrast, age did not show a statistically significant association with mortality within 72 hours ($p = 0.135$), suggesting that age primarily influences immediate outcomes rather than short-term delayed mortality. Gender was not significantly associated with mortality at either 48 hours ($p = 0.261$) or 72 hours ($p = 0.586$), indicating that sex does not independently affect early in-hospital mortality in acute stroke.

In the present study, a predominance of the male population was observed among patients who survived beyond 48 hours, with 123 males (63.7%) compared to 70 females (36.3%), resulting in a male-to-female ratio of 1.7:1. This male preponderance may reflect greater exposure to high-risk activities among males.

"Similar findings have been reported in previous literature. Mehrotra et al. (2020), [6] in their study evaluating pupillary manifestations in closed head injury and their correlation with outcomes using the Glasgow Coma Scale (GCS) and Glasgow Outcome Scale (GOS), observed a marked male predominance, with 78 males and 22 females among 100 patients. Road traffic accidents constituted the most common etiology (75%), and the majority of cases occurred in the 16–55-year age group. Furthermore, pediatric patients demonstrated comparatively better outcomes, with 69.2% achieving a GOS score of 5, compared to 58% among adults, supporting the influence of demographic factors on neurological outcomes."

Comorbidities and Mortality Risk: The presence of comorbidities did not significantly influence mortality within 48 hours ($p = 0.999$). Although numerically higher deaths were observed among patients with combined diabetes mellitus and hypertension, the absence of statistical significance suggests that comorbid conditions alone are insufficient predictors of ultra-early mortality.

However, comorbidities demonstrated a highly significant association with mortality within 72 hours ($p < 0.0001$), driven primarily by patients with a prior cerebrovascular accident. This statistically strong association suggests that pre-existing neurological injury substantially increases vulnerability to early in-hospital death, likely through reduced cerebral reserve and compounded ischemic or haemorrhagic injury

Consciousness Level, Intubation, and Diagnosis: Level of consciousness at admission was strongly associated with mortality at both time points. Mortality within 48 hours ($p < 0.0001$) and 72 hours ($p < 0.0001$) was significantly higher among unconscious patients. Notably, all deaths within 72 hours occurred in unconscious patients, emphasizing the powerful prognostic value of impaired consciousness.

Similarly, intubation status demonstrated a highly significant association with mortality at 48 hours and 72 hours (both $p < 0.0001$). The majority of early deaths occurred among intubated patients, indicating that the need for mechanical ventilation serves as a marker of severe neurological compromise rather than an independent causative factor.

Stroke subtype also influenced early mortality. Haemorrhagic stroke was significantly associated with mortality within 48 hours ($p = 0.025$), with all early deaths occurring in this group. This reflects the aggressive natural history of intracerebral haemorrhage, characterized by mass effect and raised intracranial pressure. However, by 72 hours, the association between diagnosis and mortality was no longer significant ($p = 0.99$), suggesting convergence of risk between stroke subtypes over time.

"In another's study Halim MR et al [7] (2022**)** showed that A total of 105 patients were studied, with 34 survivors and 71 non-survivors, and a mean age of 64.55 ± 14.65 years. Septic shock (33%) and ischemic stroke (29%) were the most common diagnoses. Both GCS and FOUR scores showed significantly lower values in non-survivors compared to survivors ($p < 0.0001$). However, the difference between the two scales in mortality prediction was not statistically significant ($p = 0.93$)."

Disposition and Length of Hospital Stay: Although all early deaths occurred in ICU-admitted patients, disposition did not reach statistical significance for mortality at 48 hours ($p = 0.113$) or 72 hours ($p = 0.294$). This likely reflects appropriate triage of critically ill patients rather than an effect of the care setting itself.

Length of hospital stay differed statistically significantly between survivors and non-survivors. Patients who died within 48 hours had a significantly shorter hospital stay compared to survivors (1.71 ± 0.49 vs 11.61 ± 7.57 days; $p = 0.001$). A similar statistically significant difference was observed for 72-hour mortality (3.50 ± 0.58 vs 11.42 ± 7.65 days; $p = 0.04$). These findings indicate that shorter hospitalization is a consequence of early death rather than a protective factor.

"In another study Wijdicks EF et al [8] (2015) found that the study found that the Full Outline of UnResponsiveness (FOUR) score is a more accurate predictor of ICU mortality than the Glasgow Coma Scale (GCS) in critically ill patients. Among 1,645 patients analysed, the FOUR score achieved a higher AUC (0.742) compared to GCS (0.715; $p = 0.001$).

Neurological Scores and Predictive Accuracy: Neurological severity scores showed highly significant associations with early mortality. Mean GCS, GCS-P, and FOUR scores were all significantly lower in patients who died within both 48 and 72 hours compared to survivors (all $p < 0.0001$). This confirms that worsening neurological status is a strong and consistent predictor of early mortality.

The GCS-P score demonstrated perfect concordance with GCS classification, yielding 100% sensitivity, specificity, positive predictive value, negative predictive value, and overall accuracy. While statistically impressive, this finding likely reflects the derivative nature of GCS-P from GCS rather than superior independent predictive ability.

The FOUR score showed lower sensitivity (57.1%) but excellent specificity (100%) and high overall accuracy (94%). Importantly, the FOUR score demonstrated a statistically significant association with length of hospital stay ($p < 0.0001$), unlike GCS and GCS-P, which did not show significant associations. This suggests that the FOUR score may better reflect the overall neurological trajectory rather than mortality alone.

"In another study Agrawal N et al [9] (2023) found that the GCS, GCS-P, and FOUR scores are strong predictors of outcomes in traumatic brain injury patients, with all showing significant correlations with the Glasgow Outcome Scale at 1 and 6 months. Among them, the GCS score exhibited the highest correlation and predictive accuracy (AUC = 0.912), indicating its superior reliability in assessing prognosis, while the FOUR and GCS-P scores also provided valuable predictive insights, especially in ventilated patients. Our study showed that, most of patients had FOUR score >8, in GCS-P score >8 [172 (100.0%)] compared to GCS-P score ≤8 [12 (42.9%)]. This was statistically significant ($p < 0.0001$)."

In the present study, patients with GCS scores between 9 and 12 had a mean hospital stay of 12.96 ± 7.77 days; however, this association was not statistically significant ($p = 0.125$). Similarly, patients with GCS-P scores of 9–12 demonstrated a mean length of stay of 12.82 ± 7.66 days, which also failed to reach statistical significance ($p = 0.157$). In contrast, patients with FOUR scores ranging from 9 to 12 had a longer mean hospital stay of 15.33 ± 13.61 days, and this association was highly statistically significant ($p < 0.0001$). These findings suggest that, unlike GCS and GCS-P, the FOUR score may have a stronger association with hospital length of stay. This observation is consistent with previous evidence; Shalaby et al. (2019) reported that the FOUR score demonstrated superior predictive accuracy and prognostic capability for in-hospital outcomes compared with the modified GCS during the initial three days of assessment, highlighting its potential advantage in the evaluation of critically ill patients.

In the present study, patients who survived beyond 48 hours exhibited significantly higher GCS scores (12.45 ± 3.22) compared to those who died within 48 hours (5.14 ± 2.34), with this difference being highly statistically significant ($p < 0.0001$). A similar pattern was observed for 72-hour mortality, where the mean GCS score was 12.38 ± 3.23 in the non-mortality group versus 3.00 ± 0.00 in the mortality group, again demonstrating a statistically significant difference ($p < 0.0001$).

With respect to GCS-P, patients without mortality within 48 hours had significantly higher scores (12.30 ± 3.49) compared to those who died (3.71 ± 3.30), with the difference reaching high statistical significance ($p < 0.0001$). Similarly, for 72-hour mortality, the non-mortality group had a mean GCS-P score of 12.21 ± 3.54, whereas the mortality group demonstrated markedly lower scores (1.50 ± 0.58), which was also statistically significant ($p < 0.0001$).

Analysis of the FOUR score revealed comparable findings. Patients who survived beyond 48 hours had a significantly higher mean FOUR score (14.17 ± 3.10) compared to those who died (5.14 ± 4.81). Likewise, at 72 hours, the FOUR score remained substantially higher in the non-mortality group (14.05 ± 3.30) than in the mortality group ($4.00 \pm$

2.31), with these differences being statistically significant ($p < 0.0001$).

These findings are supported by prior literature. Bayraktar et al. (2019) [10] demonstrated that both the FOUR score and GCS showed good reliability when assessed by anaesthesiology and neurosurgery ICU specialists, with no significant inter-rater variability. Importantly, lower scores on both scales were associated with higher mortality, reinforcing the prognostic value of these neurological scoring systems in critically ill patients.

Conclusion

All three neurological scoring systems were effective in predicting mortality in stroke patients presenting to the emergency department. However, the FOUR score showed better prognostic performance compared to GCS and GCS-P, making it a valuable tool for early risk stratification and clinical decision-making in acute stroke management.

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