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Original Research Article

Predictors of Mechanical Ventilation in Refractory Status Epilepticus

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Abstract

Background: Refractory status epilepticus is a neurological emergency frequently requiring intensive care and mechanical ventilation because of persistent seizures and impaired airway protection.

Objectives: To identify the predictors of mechanical ventilation in patients with refractory status epilepticus admitted to the intensive care unit.

Materials and Methods: This prospective observational study included 140 patients with refractory status epilepticus admitted to the ICU. Demographic, clinical, laboratory, and treatment-related variables were recorded. Patients were categorized into those requiring mechanical ventilation and those managed without ventilatory support. Multivariable logistic regression analysis was performed to identify independent predictors of mechanical ventilation.

Results: Mechanical ventilation was required in 72 (51.4%) patients. Ventilated patients had significantly lower Glasgow Coma Scale scores, higher Status Epilepticus Severity Scores, prolonged seizure duration, elevated serum lactate levels, aspiration pneumonia, longer ICU stay, and higher in-hospital mortality ($p<0.05$). Multivariable analysis identified GCS ≤8 (OR 4.82), STESS ≥4 (OR 3.76), seizure duration >60 minutes (OR 3.21), aspiration pneumonia (OR 2.74), serum lactate >4 mmol/L (OR 2.58), and acute symptomatic etiology (OR 2.29) as independent predictors of mechanical ventilation.

Conclusion: Low neurological status, prolonged seizures, severe disease, and systemic complications significantly predicted the need for mechanical ventilation in refractory status epilepticus. Early recognition of these factors may facilitate timely airway management and improve patient outcomes.

Keywords: Refractory Status Epilepticus, Mechanical Ventilation, Intensive Care Unit, Glasgow Coma Scale, STESS, Seizure Duration, Predictors.

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Introduction

Status epilepticus (SE) is a neurological emergency associated with significant morbidity and mortality if not treated promptly. Refractory status epilepticus (RSE), defined as persistent seizures despite administration of first-line benzodiazepines and an adequate dose of a second-line antiseizure medication, occurs in a substantial proportion of patients and frequently necessitates intensive care management. [1,2]

Patients with RSE often require continuous intravenous anesthetic therapy and mechanical ventilation to control ongoing seizures and maintain airway protection. The need for mechanical ventilation is associated with prolonged intensive care unit (ICU) stay, increased risk of ventilator-associated complications, and poorer clinical outcomes. [3] Early identification of patients at risk for ventilatory support may facilitate timely intervention and improve prognosis. The International League against Epilepsy (ILAE) has provided standardized definitions and classifications for status epilepticus, emphasizing rapid recognition and early initiation of appropriate therapy. [4,5] Current management guidelines recommend prompt administration of antiseizure medications followed by continuous anesthetic infusions in refractory cases, with close neurological and hemodynamic monitoring in the ICU. [6]

Several studies have identified factors such as advanced age, prolonged seizure duration, low Glasgow Coma Scale (GCS) score, high Status Epilepticus Severity Score (STESS), systemic complications, and underlying etiology as

important predictors of adverse outcomes in RSE. [2,7] However, limited data are available regarding predictors of mechanical ventilation among patients with refractory status epilepticus, particularly in developing countries.

Therefore, the present study was undertaken to evaluate the predictors of mechanical ventilation in patients with refractory status epilepticus admitted to the intensive care unit.

Materials and Methodology

Study Design: This prospective observational study was conducted in the Intensive Care Unit of a tertiary care teaching hospital over a period of 18 months.

Study Population: A total of 140 consecutive patients diagnosed with refractory status epilepticus and admitted to the ICU were included in the study.

Inclusion Criteria

- Patients aged 18 years or older.
- Diagnosis of refractory status epilepticus according to ILAE criteria.
- Failure of seizure control after first-line benzodiazepine therapy and at least one appropriately administered second-line antiseizure medication.
- ICU admission for further management.

Exclusion Criteria

- Psychogenic nonepileptic seizures.
- Post-anoxic status epilepticus following cardiac arrest.
- Patients with incomplete clinical records.
- Patients discharged or referred before completion of treatment.

Data Collection

Demographic details, comorbidities, seizure etiology, duration of seizures before hospital admission, Glasgow Coma Scale (GCS), Status Epilepticus Severity Score (STESS), laboratory investigations, arterial blood gas analysis, neuroimaging findings, electroencephalography (EEG) findings, and treatment details were recorded.

Patients were categorized into:

- **Group I:** Required mechanical ventilation.
- **Group II:** Did not require mechanical ventilation.

The requirement for mechanical ventilation was determined based on airway compromise, persistent seizures requiring continuous anesthetic infusion, respiratory failure, or impaired consciousness.

Outcome Measures: The primary outcome was identification of predictors associated with mechanical ventilation. Secondary outcomes included duration of ICU stay, duration of mechanical ventilation, hospital stay, neurological complications, and in-hospital mortality.

Statistical Analysis: Data were analyzed using SPSS version 26.0. Continuous variables were expressed as mean ± standard deviation and compared using the independent Student's t-test or Mann-Whitney U test. Categorical variables were compared using the Chi-square or Fisher's exact test. Variables showing statistical significance on univariate analysis were entered into multivariable logistic regression to identify independent predictors of mechanical ventilation. Odds ratios (OR) with 95% confidence intervals (CI) were calculated, and a p-value <0.05 was considered statistically significant.

Results

A total of 140 patients with refractory status epilepticus admitted to the intensive care unit were included in the study. Of these, 72 patients (51.4%) required mechanical ventilation (Group I), while 68 patients (48.6%) were managed without mechanical ventilation (Group II).

Table 1: Baseline Demographic and Clinical Characteristics of the Study Population

Variable	Mechanical Ventilation (n=72)	No Mechanical Ventilation (n=68)	p-value
Age (years)	56.8 ± 17.2	44.6 ± 15.4	<0.001*
Male	44 (61.1%)	40 (58.8%)	0.781
Female	28 (38.9%)	28 (41.2%)	
Hypertension	30 (41.7%)	18 (26.5%)	0.058
Diabetes mellitus	24 (33.3%)	16 (23.5%)	0.199
Previous epilepsy	26 (36.1%)	31 (45.6%)	0.256
Acute symptomatic etiology	46 (63.9%)	28 (41.2%)	0.008*

Patients requiring mechanical ventilation were significantly older and more frequently had acute symptomatic causes of refractory status epilepticus compared with those managed without ventilatory support (p<0.05). Gender and comorbidities were comparable between the two groups.

Table 2: Comparison of Clinical and Laboratory Parameters

Parameter	Mechanical Ventilation (n=72)	No Mechanical Ventilation (n=68)	p-value
Seizure duration before control (minutes)	96.4 ± 28.6	58.2 ± 21.8	<0.001*
Glasgow Coma Scale	7.4 ± 2.3	11.8 ± 2.1	<0.001*
STESS score	4.6 ± 1.1	2.9 ± 1.0	<0.001*
Serum lactate (mmol/L)	4.8 ± 1.6	3.1 ± 1.2	<0.001*
Metabolic acidosis	38 (52.8%)	18 (26.5%)	0.001*
Aspiration pneumonia	27 (37.5%)	10 (14.7%)	0.002*

***Statistically significant (p<0.05)**

Patients requiring mechanical ventilation had significantly longer seizure duration, lower Glasgow Coma Scale scores, higher STESS scores, elevated serum lactate levels, and a greater incidence of metabolic acidosis and aspiration pneumonia than those who did not require ventilatory support.

Table 3: ICU Management and Clinical Outcomes

Variable	Mechanical Ventilation (n=72)	No Mechanical Ventilation (n=68)	p-value
Continuous anesthetic infusion	63 (87.5%)	18 (26.5%)	<0.001*
Vasopressor support	28 (38.9%)	8 (11.8%)	<0.001*
ICU stay (days)	10.9 ± 4.8	5.8 ± 2.6	<0.001*
Hospital stay (days)	15.6 ± 6.3	10.8 ± 4.5	<0.001*
Neurological complications	24 (33.3%)	10 (14.7%)	0.011*
In-hospital mortality	18 (25.0%)	5 (7.4%)	0.005*

***Statistically significant (p<0.05)**

Mechanically ventilated patients required significantly more continuous anesthetic infusions and vasopressor support and experienced longer ICU and hospital stays. They also had significantly higher rates of neurological complications and in-hospital mortality compared with non-ventilated patients.

Table 4: Multivariable Logistic Regression Analysis for Predictors of Mechanical Ventilation

Variable	Adjusted Odds Ratio (OR)	95% Confidence Interval	p-value
Glasgow Coma Scale ≤8	4.82	2.08–11.17	<0.001*
STESS ≥4	3.76	1.69–8.34	0.001*
Seizure duration >60 minutes	3.21	1.48–6.95	0.003*
Aspiration pneumonia	2.74	1.19–6.29	0.018*
Serum lactate >4 mmol/L	2.58	1.14–5.86	0.023*
Acute symptomatic etiology	2.29	1.03–5.10	0.041*

***Statistically significant (p<0.05)**

Multivariable logistic regression demonstrated that Glasgow Coma Scale ≤8, STESS ≥4, prolonged seizure duration (>60 minutes), aspiration pneumonia, elevated serum lactate (>4 mmol/L), and acute symptomatic etiology were independent predictors of mechanical ventilation in patients with refractory status epilepticus.

Discussion

The present prospective observational study evaluated the predictors of mechanical ventilation in patients with refractory status epilepticus (RSE) admitted to the intensive care unit. More than half of the patients required mechanical ventilation, and these individuals had significantly lower Glasgow Coma Scale (GCS) scores, higher Status Epilepticus Severity Scores (STESS), prolonged seizure duration, elevated serum lactate levels, aspiration pneumonia, and higher in-hospital mortality than those managed without ventilatory support. Chateauneuf et al. [8] reported that patients with severe and super-refractory status epilepticus frequently require prolonged intensive care support, including mechanical ventilation, because of persistent seizures and systemic complications. Similarly, mechanically ventilated patients in the present study experienced longer ICU stays and a higher incidence of neurological complications. Kafle et al. [9] demonstrated that prolonged seizure duration and severe neurological impairment are major determinants of adverse outcomes in refractory generalized convulsive status epilepticus. Consistent with these findings, patients requiring mechanical ventilation in the present study had significantly longer seizure duration and lower GCS scores, indicating more severe disease at presentation. Power et al. [10] identified age, seizure severity, and underlying etiology as important prognostic factors in adult status epilepticus. In the present study, older age and acute symptomatic etiology were significantly associated with the need for mechanical ventilation,

suggesting that these factors contribute to a more complicated clinical course.

Mechanical ventilation itself may prolong ICU stay and increase the risk of hospital-acquired complications. Sutter et al. [11] observed that prolonged mechanical ventilation following status epilepticus was associated with poorer functional outcomes and increased mortality. Similar findings were observed in the present study, where ventilated patients had significantly longer ICU and hospital stays and higher mortality.

Rossetti and Lowenstein [12] emphasized that timely escalation of therapy, including continuous anesthetic infusion and ventilatory support when indicated, remains essential in the management of refractory status epilepticus. Likewise, Claassen et al. [13] highlighted the importance of aggressive seizure control using anesthetic agents in critically ill patients. Most ventilated patients in the present study required continuous anesthetic infusions, reflecting the severity of refractory seizures. Leitinger et al. [14] reported that neurological status and underlying etiology strongly influence outcomes in status epilepticus. The present study similarly identified low GCS score, prolonged seizures, and acute symptomatic etiology as important predictors of mechanical ventilation. Overall, the findings support previous evidence that early recognition of high-risk patients and prompt intensive care interventions may improve clinical outcomes.

Conclusion

Mechanical ventilation was required in more than half of the patients with refractory status epilepticus and was associated with increased morbidity and mortality. Low Glasgow Coma Scale score, higher Status Epilepticus Severity Score, prolonged seizure duration, elevated serum lactate, aspiration pneumonia, and acute symptomatic etiology were independent predictors of mechanical ventilation. Early identification of these high-risk patients, timely airway management, aggressive seizure control, and comprehensive intensive care support are essential to improve outcomes in refractory status epilepticus.

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