Section: General Medicine

Original Research Article

EARLY PREDICTORS OF RESPIRATORY FAILURE IN PATIENTS OF GUILLAIN-BARRE SYNDROME

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ABSTRACT

Background: Respiratory failure remains a major cause of morbidity and mortality in Guillain–Barré syndrome (GBS), yet early identification of patients requiring mechanical ventilation (MV) remains challenging. We prospectively evaluated clinical, biochemical, and electrophysiological predictors of respiratory failure in patients with GBS. **Materials and Methods:** In this prospective observational study, consecutive adults fulfilling Brighton Collaboration diagnostic criteria (Levels 1–3) for GBS were enrolled at a tertiary care teaching hospital in southern India. Baseline demographic, clinical, laboratory, and electrophysiological data were collected, including serum cortisol concentrations measured within 24 hours of admission. Respiratory function was serially assessed using bedside single-breath count (SBC). The primary outcome was respiratory failure requiring invasive mechanical ventilation during hospitalization. **Results:** Fifty patients were enrolled (median age, 40 years; 62% male), of whom 27 (54%) required mechanical ventilation. Age, sex, comorbidities, antecedent infections, baseline limb muscle strength, and cerebrospinal fluid protein concentrations were not associated with respiratory failure. Patients requiring MV more frequently exhibited neck flexor weakness (66.7% vs 35.0%; P=0.043), facial weakness, bulbar involvement, autonomic dysfunction (all P<0.05), and rapid progression to peak disability within 7 days (73.1% vs 33.3%; P=0.0099). All patients with autonomic dysfunction required MV. Baseline serum cortisol concentrations were significantly higher in patients requiring MV (30.63 µg/dL vs 20.83 µg/dL; P=0.00015) and in those with autonomic dysfunction (33.23 vs 14.73 µg/dL; P=0.004). Patients who developed respiratory failure also had lower baseline SBC values (<16) with progressive decline during hospitalization. Electrophysiological studies demonstrated predominantly demyelinating neuropathy, although incomplete testing precluded assessment of electrodiagnostic predictors. **Conclusion:** Neck flexor weakness, facial and bulbar involvement, autonomic dysfunction, rapid disease progression, elevated baseline serum cortisol, and declining SBC were associated with respiratory failure in GBS. Integration of these readily available clinical and biochemical markers may improve early risk stratification and facilitate timely intensive care referral. Larger multicentre studies are needed to validate these findings and determine their incremental value alongside established prediction models.

INTRODUCTION

Guillain–Barré syndrome (GBS) is an acute immune-mediated polyradiculoneuropathy and remains the leading cause of acute flaccid paralysis worldwide following the near-eradication of poliomyelitis. Despite advances in immunotherapy and supportive care, respiratory failure remains a major complication, occurring in 20–30% of patients and frequently requiring mechanical ventilation (MV). Ventilatory failure results from progressive weakness of the diaphragm and accessory respiratory muscles, often accompanied by bulbar dysfunction and autonomic instability. Patients requiring MV have

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prolonged intensive care unit (ICU) stay, increased morbidity, and poorer functional outcomes. Because respiratory deterioration may progress rapidly, delayed recognition can lead to emergency intubation, aspiration, and adverse neurological outcomes, emphasizing the need for early identification of patients at risk.[1]

Several clinical and neurophysiological factors have been associated with respiratory failure, including rapid disease progression, severe limb weakness, facial and bulbar involvement, neck flexor weakness, autonomic dysfunction, reduced pulmonary function, and electrophysiological evidence of extensive demyelination or conduction block.[2] However, their predictive value has varied across studies because of heterogeneity in patient populations, disease subtypes, and healthcare settings. The Erasmus GBS Respiratory Insufficiency Score (EGRIS) is the most extensively validated clinical prediction model, but its performance is inconsistent across external cohorts and it does not incorporate laboratory or electrodiagnostic biomarkers that may improve early risk stratification.[3]

Emerging evidence suggests that baseline plasma cortisol, reflecting the systemic stress response, together with early electrodiagnostic abnormalities, may provide complementary prognostic information before overt respiratory deterioration develops.[4,5] We therefore aimed to identify the clinical, laboratory, and electrodiagnostic predictors of respiratory failure requiring MV in patients with GBS to improve early risk stratification and guide timely intensive care and respiratory management.

MATERIALS AND METHODS

This prospective observational study was conducted at a tertiary care teaching hospital in southern India between July 2023 and June 2025. Consecutive adults with newly diagnosed Guillain–Barré syndrome (GBS) presenting to the emergency department, neurology outpatient department, or neurology inpatient services were prospectively enrolled and followed until hospital discharge or death. The study was approved by the Institutional Ethics Committee (Approval No.GMC/IEC/062/2023; approved in June 2023), and written informed consent was obtained from all participants or their legally authorized representatives.

Eligible participants were adults (≥18 years) with symptom onset within four weeks before presentation who fulfilled the Brighton Collaboration diagnostic criteria (Levels 1–3) for GBS.[6] Diagnosis was established based on the clinical presentation, cerebrospinal fluid (CSF) examination, and electrophysiological studies whenever available, in accordance with contemporary international recommendations. Patients were excluded if they had asymmetric limb weakness with preserved deep tendon reflexes suggestive of an alternative diagnosis; fever at neurological symptom onset indicating a possible infectious neurological disorder; clinical or laboratory evidence of hypokalaemia periodic paralysis; progression of weakness beyond four weeks suggestive of chronic inflammatory demyelinating polyradiculoneuropathy or other chronic neuropathies; or predominant bladder and/or bowel dysfunction raising suspicion of spinal cord pathology or other neurological disorders. Baseline demographic characteristics, antecedent infections, symptom duration, neurological findings, Medical Research Council (MRC) sum score, Hughes GBS Disability Scale score, cranial nerve involvement, autonomic dysfunction, and respiratory symptoms were recorded at enrolment. Patients underwent standardized daily neurological assessment throughout hospitalization. Particular attention was paid to clinical features previously associated with respiratory failure, including rapid progression of weakness, bulbar dysfunction, bilateral facial weakness, neck flexor weakness, autonomic instability, and severe limb weakness [Figure 2].

Respiratory function was assessed at least three times daily using bedside measures, including single-breath count (SBC), breath-holding time (BHT), and chest expansion. Among these, SBC was used as the principal bedside measure because of its simplicity, reproducibility, and established correlation with forced vital capacity (FVC) in patients with neuromuscular respiratory weakness.[7]

For SBC assessment, patients were instructed to inhale maximally and count aloud in a normal conversational voice at approximately two counts per second until another breath was required. Healthy adults typically achieve counts exceeding 40–50. Previous studies have demonstrated that SBC correlates with FVC, and values below 15 are associated with clinically significant respiratory muscle weakness and impending ventilatory failure in neuromuscular disorders.[8] Serial decline in SBC prompted intensified respiratory monitoring and evaluation for intensive care admission. Decisions regarding endotracheal intubation and invasive mechanical ventilation were based on the combined assessment of respiratory muscle weakness, bulbar dysfunction with impaired airway protection, worsening gas exchange, and bedside respiratory parameters.

Routine investigations included complete blood count, serum glucose, renal and liver function tests, serum electrolytes, erythrocyte sedimentation rate, electrocardiography, and chest radiography. Lumbar puncture was performed unless contraindicated, and CSF was analysed for biochemical, microbiological, and cytological parameters to support the diagnosis and exclude alternative disorders. Baseline serum cortisol concentration was measured within 24 hours of admission using a standardized immunoassay and evaluated as a potential biomarker for subsequent respiratory failure.

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Nerve conduction studies were performed whenever clinically feasible, preferably during the first week of hospitalization. Patients were classified into acute inflammatory demyelinating polyneuropathy (AIDP), acute motor axonal neuropathy (AMAN), acute motor and sensory axonal neuropathy (AMSAN), or equivocal electrophysiological subtypes according to established electrodiagnostic criteria.[9]

The primary outcome was respiratory failure requiring invasive mechanical ventilation during hospitalization. Respiratory failure was defined as the need for endotracheal intubation because of progressive respiratory muscle weakness, inability to maintain airway protection secondary to bulbar dysfunction, or objective evidence of respiratory insufficiency, as determined jointly by the treating neurologist and intensivist.

Statistical analysis: Continuous variables are presented as mean ± standard deviation or median (interquartile range), as appropriate, and categorical variables as frequencies and percentages. Comparisons between patients requiring mechanical ventilation and those managed without ventilation were performed using the Student's t test or Mann–Whitney U test for continuous variables and the Chi-square or Fisher's exact test for categorical variables. Variables with a P-value <0.10 on univariable analysis, together with clinically relevant covariates, were entered into multivariable logistic regression to identify independent predictors of respiratory failure. Adjusted odds ratios (ORs) with 95% confidence intervals (CIs) were calculated. Receiver operating characteristic (ROC) curve analysis was performed to evaluate the discriminative performance of significant predictors. All statistical tests were two-sided, and a P value <0.05 was considered statistically significant. Analyses were performed using IBM SPSS Statistics version 25 (IBM Corp., Armonk, NY, USA).

RESULTS

Fifty patients with Guillain–Barré syndrome (GBS) were enrolled, with a median age of 40 years (range, 18–75 years); 31 (62%) were male. Respiratory failure requiring mechanical ventilation developed in 27 (54%) patients. Neither age nor sex was associated with respiratory failure (P=0.23 and P=0.56, respectively). Similarly, diabetes mellitus, hypertension, smoking, alcohol consumption, previous respiratory disease, and antecedent infections showed no significant association with respiratory failure (all P>0.05).

All patients presented with symmetrical limb weakness. Baseline limb muscle strength was not associated with subsequent respiratory failure (P=1.00). In contrast, neck flexor weakness was significantly more frequent among patients who developed respiratory failure than among those who did not (66.7% vs 35.0%; P=0.043). Facial weakness, bulbar involvement, and autonomic dysfunction were also strongly associated with respiratory failure (all P<0.05); notably, all patients with autonomic dysfunction required mechanical ventilation [Figure 1]. Rapid disease progression, defined as reaching peak neurological disability within 7 days of symptom onset, was associated with a significantly increased risk of respiratory failure (73.1% vs 33.3%; P=0.0099).

Mean cerebrospinal fluid protein concentrations did not differ significantly between patients with and without respiratory failure (117.39 vs 111.73 mg/dL; P=0.11). In contrast, baseline serum cortisol concentrations measured within 24 hours of admission were significantly higher in patients who subsequently required mechanical ventilation (30.63 vs 20.83 µg/dL; P=0.00015) and in those with autonomic dysfunction (33.23 vs 14.73 µg/dL; P=0.004).

Nerve conduction studies were available in 41 patients and classified according to the criteria proposed by Hadden et al. [7] Demyelinating neuropathy was identified in 21 patients (51.2%), axonal neuropathy in 14 (34.1%), equivocal or unexcitable studies in 2 (4.9%), and normal studies in 4 (9.8%). Because electrophysiological data were unavailable in nine patients, further analysis of electrodiagnostic predictors was not performed. Patients who subsequently developed respiratory failure had lower baseline single-breath counts (<16) and demonstrated a progressive decline during hospitalization compared with those who did not require mechanical ventilation.

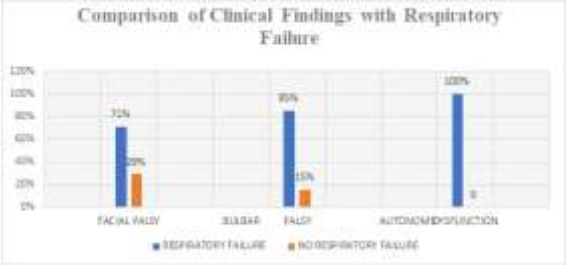

Figure 1: Comparison of Clinical Findings with Respiratory Failure

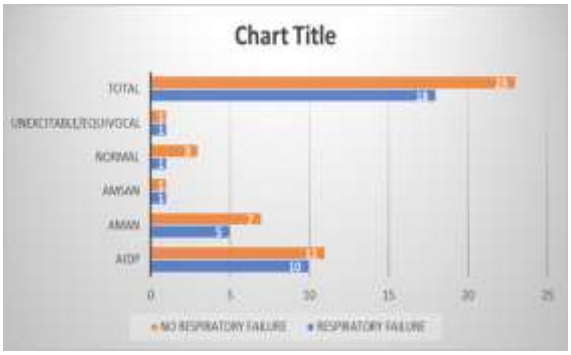

Figure 2: Categories of GBS (by NCS) and respiratory failure

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DISCUSSION

In this prospective observational study, more than half of patients with Guillain–Barré syndrome (GBS) required mechanical ventilation (MV), reflecting the severity profile expected in a tertiary referral setting. Respiratory failure remains the most clinically significant complication of GBS and is associated with prolonged intensive care unit (ICU) stay, increased mortality, and poorer functional outcomes. Early identification of patients at risk of ventilatory deterioration is therefore central to optimizing monitoring strategies and timing of ICU intervention. Our findings suggest that a combination of bedside neurological markers, serial respiratory assessment, and serum cortisol measurement may improve early recognition of patients likely to require ventilatory support.

Demographic characteristics, including age and sex, were not associated with respiratory failure, consistent with contemporary cohort studies demonstrating that clinical severity rather than baseline demographic factors determines respiratory risk in GBS. Similarly, common comorbidities and antecedent infections were not predictive of ventilatory failure. Although antecedent infections initiate autoimmune nerve injury through mechanisms such as molecular mimicry, their relationship with subsequent disease severity appears inconsistent, suggesting that host immune response and pattern of neurological involvement are more important determinants of respiratory compromise.

Among neurological features, neck flexor weakness, facial weakness, bulbar dysfunction, autonomic instability, and rapid progression to peak disability were strongly associated with respiratory failure. Neck flexor weakness may represent early involvement of cervical motor roots and axial respiratory musculature and has been incorporated into several clinical approaches for identifying impending ventilatory failure. Bulbar dysfunction and facial weakness likely indicate more extensive cranial nerve involvement and contribute directly to impaired airway protection, ineffective cough, aspiration risk, and respiratory deterioration. These findings are consistent with recent studies validating the importance of cranial nerve involvement, rapid progression, and autonomic dysfunction in predicting the need for ventilation.[10,11]

Autonomic dysfunction showed the strongest association with respiratory failure, with all affected patients requiring MV. Dysautonomia reflects widespread peripheral autonomic involvement and may coexist with haemodynamic instability, cardiac arrhythmias, and rapid neurological decline. Rapid progression to maximal disability within seven days was also associated with increased ventilatory risk, supporting the concept that aggressive immune-mediated nerve injury predisposes to early respiratory muscle involvement. Importantly, baseline limb weakness alone did not predict respiratory failure, highlighting that respiratory muscle impairment may evolve independently and that reliance on limb power assessment may underestimate risk.

Consistent with previous observations, cerebrospinal fluid protein concentration was not associated with respiratory failure. Although albumin cytological dissociation supports diagnosis, CSF protein reflects blood–nerve barrier dysfunction rather than the extent of respiratory motor involvement and has limited prognostic utility.

A notable finding was the association between elevated baseline serum cortisol and subsequent respiratory failure. Cortisol represents activation of the hypothalamic–pituitary–adrenal axis and systemic stress response, which may be amplified by autonomic dysfunction and severe immune-mediated disease. Although cortisol has not yet been established as a prognostic biomarker in GBS, studies in critical illness suggest that early neuroendocrine activation correlates with disease severity and adverse outcomes. Validation in larger cohorts may determine whether cortisol adds predictive value beyond established clinical scores such as the Erasmus GBS Respiratory Insufficiency Score (EGRIS).[12-14]

Serial single-breath count (SBC) assessment provided a practical bedside marker of respiratory decline. Although forced vital capacity remains the reference standard, SBC is inexpensive, reproducible, and particularly useful where pulmonary function testing is unavailable or difficult to perform. Integration of serial SBC measurements with clinical predictors may enhance early respiratory surveillance.[15]

The study strengths include prospective recruitment, standardized neurological assessments, and evaluation of clinical and biochemical markers. Limitations include single-centre design, limited sample size, referral bias, incomplete electrophysiological testing, and the absence of a fully developed multivariable prediction model. Future multicentre studies should evaluate whether incorporating biomarkers such as cortisol and dynamic respiratory measures improves existing prediction tools.

In conclusion, neck flexor weakness, cranial nerve involvement, autonomic dysfunction, rapid progression, elevated serum cortisol, and declining SBC were associated with respiratory failure in GBS. A multimodal risk assessment approach incorporating readily available clinical and biochemical parameters may facilitate earlier ICU referral and individualized respiratory management.

CONCLUSION

Neck flexor weakness, facial and bulbar involvement, autonomic dysfunction, rapid disease progression, elevated baseline serum cortisol concentrations, and declining single-breath count were associated with respiratory failure requiring

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mechanical ventilation in patients with Guillain–Barré syndrome. These readily obtainable clinical and biochemical markers may facilitate early risk stratification and timely identification of patients requiring intensive respiratory monitoring. Serial bedside assessment using the single-breath count may provide a practical adjunct to pulmonary function testing, particularly in resource-limited settings. Larger multicentre studies are needed to validate these findings and develop integrated prediction models to improve individualized respiratory risk assessment and clinical outcomes in Guillain–Barré syndrome.

REFERENCES

1. Leonhard SE, Mandarakas MR, Gondim FAA, Bateman K, Ferreira MLB, Cornblath DR, et al. Diagnosis and management of Guillain–Barré syndrome in ten steps. Nat Rev Neurol. 2019;15(11):671-683. doi:10.1038/s41582-019-0250-9.
2. Rajabally YA, Uncini A. Outcome and its predictors in Guillain–Barré syndrome. J Neurol Neurosurg Psychiatry. 2012;83(7):711-718.
3. Doets AY, Verboon C, van den Berg B, Harbo T, Cornblath DR, Willison HJ, et al. Regional variation of Guillain–Barré syndrome. Brain. 2018;141(10):2866-2877.
4. Leonhard SE, van Koningsveld R, Jacobs BC. Biomarkers in Guillain–Barré syndrome. Ann Clin Transl Neurol. 2023;10(5):789-802. doi:10.1002/acn3.51770.
5. van Doorn PA. Diagnosis, treatment and prognosis of Guillain–Barré syndrome (State-of-the-art review). Lancet Neurol. 2023;22(11):1013-1025.
6. Sejvar JJ, Kohl KS, Gidudu J, Amato A, Bakshi N, Baxter R, et al. Guillain–Barré syndrome and Fisher syndrome: case definitions and guidelines for collection, analysis, and presentation of immunization safety data. Vaccine. 2011;29(3):599-612.
7. Maury A, Vergez S, Galia F, et al. Single breath count test and its correlation with pulmonary function in neuromuscular disorders: a systematic review. Respir Med. 2023; 215:107308.
8. Hadden RDM, Cornblath DR, Hughes RAC, Zielasek J, Hartung HP, Toyka KV, et al. Electrophysiological classification of Guillain–Barré syndrome: clinical associations and outcome. Ann Neurol. 1998;44(5):780-8.
9. Breville G, Sukockiene E, Vargas MI, Lascano AM. Emerging biomarkers to predict clinical outcomes in Guillain–Barré syndrome. Expert Rev Neurother. 2023;23(12):1201-1215. doi:10.1080/14737175.2023.2273386.
10. Leonhard SE, Bresnan MJ, van Doorn PA, Jacobs BC. Diagnosis and management of Guillain–Barré syndrome in the intensive care unit. Neurol Clin. 2022;40(1):211-229. doi: 10.1016/j.ncl.2021.08.007.
11. Galassi G, Mazzoli M, Ariatti A, et al. Predictors of respiratory failure in Guillain–Barré syndrome: a 22-year cohort study from a single Italian centre. Eur J Neurol. 2024;31(7): e16090. doi:10.1111/ene.16090.
12. Walgaard C, Lingsma HF, Ruts L, van Doorn PA, Steyerberg EW, Jacobs BC. Prediction of respiratory insufficiency in Guillain–Barré syndrome. Ann Neurol. 2010;67(6):781-787. doi:10.1002/ana.21943.
13. Doets AY, Verboon C, van den Berg B, Harbo T, Cornblath DR, Willison HJ, et al. International validation of the Erasmus Guillain–Barré syndrome respiratory insufficiency score. Neurology. 2022;98(6):e595-e605. doi:10.1212/WNL.0000000000013149.
14. Wakerley BR, Yuki N. Respiratory monitoring and prediction of mechanical ventilation in Guillain–Barré syndrome. J Neurol Neurosurg Psychiatry. 2021;92(9):1017-1024. doi:10.1136/jnnp-2020-325986.
15. Papri N, Doets AY, Luijten L, Mohammad QD, Endtz HP, Lingsma HF, Jacobs BC, Islam Z. Prediction of respiratory failure and prolonged mechanical ventilation in Guillain–Barré syndrome: a prospective cohort study in Bangladesh. J Peripher Nerv Syst. 2024;29(4):428-440. doi:10.1111/jns.12607.

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