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NARRATIVE REVIEW

Supportive Care for Severe Tetanus in the Intensive Care Unit: A Narrative Review

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Abstract

Tetanus is an acute infectious disease caused by Clostridium tetani and remains associated with high mortality, particularly in severe cases requiring intensive care unit (ICU) admission. The neurotoxin tetanospasmin induces persistent muscle spasms, autonomic dysfunction, and respiratory failure, rendering ICU management complex and resource-intensive. This narrative review aims to synthesize current evidence on multimodal supportive care strategies that improve clinical outcomes in patients with severe tetanus managed in the ICU. This literature review identifies several interrelated components as central to successful management, including early airway control and mechanical ventilation, optimized sedation and spasm control using benzodiazepines, magnesium sulfate, and selected adjuvant agents, targeted nutritional and metabolic support through early enteral feeding, prevention of ICU-related complications, and early rehabilitation to mitigate ICU-acquired weakness. Collectively, evidence indicates that a comprehensive, evidence-based supportive care approach improves hemodynamic stability, reduces complication rates, and facilitates functional recovery in patients with severe tetanus.

Keywords: Tetanus; Intensive Care Units; Supportive Care; Mechanical Ventilation; Sedation

Introduction

Tetanus is a life-threatening acute infectious disease caused by Clostridium tetani, which produces a potent neurotoxin known as tetanospasmin. Despite being preventable through immunization, tetanus continues to occur frequently in low and middle income countries, including Indonesia, and remains associated with high mortality, particularly in patients with severe disease requiring intensive care unit (ICU) admission.[1] Global vaccination programs have substantially reduced the incidence of tetanus; however, the disease continues to impose a significant burden in resource-limited settings, where severe complications and poor outcomes are more commonly encountered.[1–3] The epidemiology of tetanus has also shifted in recent decades. An increasing proportion of cases is now observed among older adults, especially in countries that have successfully eliminated neonatal tetanus.[1,4] Age-related immunodeficiency has emerged as an important risk factor contributing to this demographic transition.[1,5] In settings with

limited access to advanced critical care, mortality rates among patients with severe tetanus may still range between 20% and 50% in the absence of adequate intensive care support.[6,7] In addition, recent observational data have highlighted a substantial burden of autonomic and respiratory complications in this population, underscoring the importance of early risk stratification and comprehensive ICU management.[5,7]

The pathogenesis of tetanus is primarily mediated by disruption of inhibitory neurotransmitter release, particularly gamma-aminobutyric acid (GABA) and glycine, resulting in sustained muscle spasms, rigidity, and autonomic dysfunction. These complex pathophysiological processes necessitate a comprehensive approach to care in the ICU that extends beyond antimicrobial therapy and toxin neutralization. Effective management requires multimodal supportive strategies, including airway stabilization, control of muscle spasms, adequate nutritional support, and prevention of complications related to prolonged immobilization and mechanical ventilation.[2]

The objective of this narrative review is to identify, synthesize, and summarize evidence-based multimodal supportive care strategies that improve clinical outcomes in patients with severe tetanus requiring intensive care. The discussion focuses on four key components of supportive management: airway and ventilatory support, sedation and spasm control, nutritional and metabolic support, and prevention of complications. This review aims to provide a scientific foundation for the development of evidence-based clinical protocols to optimize the management of severe tetanus in the ICU.

Theoretical Basis and Pathophysiology

Tetanus is an acute infectious disease caused by the neurotropic toxin tetanospasmin, produced by Clostridium tetani, a gram-positive, anaerobic, spore-forming bacillus capable of long-term survival in the environment. Infection occurs when bacterial spores enter the body through an open wound, where anaerobic conditions facilitate germination into the vegetative form. The organism subsequently produces two principal toxins, tetanospasmin and tetanolysin, of which tetanospasmin is primarily responsible for the characteristic clinical manifestations of tetanus. Following local production, the toxin disseminates via lymphatic and perineural pathways to the central nervous system, particularly the brainstem and spinal cord.[6]

From a pathophysiological perspective, tetanospasmin exerts its effects by inhibiting the release of inhibitory neurotransmitters, specifically GABA and glycine, at inhibitory interneurons within the spinal cord and brainstem. This inhibition results in the loss of inhibitory control over alpha motor neurons, leading to sustained muscle rigidity and recurrent spasms. Concurrently, continuous stimulation of the autonomic nervous system induces sympathetic hyperactivity, manifesting as blood pressure lability, tachycardia, cardiac arrhythmias, and an increased risk of sudden cardiovascular collapse.[2,3]

The severity of tetanus is influenced by several factors, including the incubation period, the speed of symptom onset, and the anatomical location of the primary

wound. Injuries located closer to the central nervous system, such as those involving the head or neck, are typically associated with a shorter incubation period and more severe clinical manifestations. Disease severity has traditionally been assessed using the Ablett classification, which grades tetanus based on the frequency and duration of muscle spasms, respiratory involvement, and autonomic stability. In addition, the Dakar scoring system has been developed to provide a more objective prognostic assessment by incorporating patient age, incubation period, time to symptom onset, spasm frequency, and the presence of autonomic dysfunction.[5]

Airway and Ventilatory Management

Respiratory failure remains one of the leading causes of mortality in patients with severe tetanus, making airway management a central priority in intensive care. Respiratory compromise in tetanus may result from multiple mechanisms, including sustained spasms of the respiratory muscles, laryngospasm, upper airway obstruction due to excessive secretions, and respiratory depression secondary to sedative or muscle relaxant therapy. Consequently, early airway control is essential to prevent hypoxemia, aspiration, and sudden respiratory collapse.[2]

Tracheostomy is generally preferred over prolonged endotracheal intubation in patients with severe tetanus, as it provides greater airway stability, reduces the risk of laryngeal spasm, facilitates secretion clearance, and enables prolonged mechanical ventilation. In addition, tracheostomy minimizes repetitive mechanical stimulation of the larynx, which can precipitate reflex spasms which could potentially be fatal in this patient population.[8] Early consideration of tracheostomy is therefore recommended in patients anticipated to require extended ventilatory support.[7]

Mechanical ventilation is indicated in cases of refractory respiratory muscle spasm despite adequate sedation, as well as in patients who develop respiratory depression related to sedative or neuromuscular blocking agents. Ventilatory modes should be individualized based on the patient's hemodynamic status and severity of muscle spasms, with particular attention to patient–ventilator synchrony to avoid excessive stimulation. Continuous monitoring of oxygenation, airway pressures, and arterial blood gas parameters is essential to assess ventilatory effectiveness and guide ongoing management.[9]

In addition to invasive airway interventions, supportive care measures include regular chest physiotherapy and aggressive secretion management to maintain airway patency. Environmental modification within the ICU—such as reduced lighting, noise control, and minimization of sensory stimulation—plays an important role in preventing stimulus-induced spasms.[10,11] A multimodal approach integrating early airway stabilization, appropriate ventilatory support, effective spasm control, and a low-stimulation environment has been associated with reduced mortality and improved outcomes in patients with severe tetanus requiring intensive care.[2]

Sedation and Spasm Control

Sedation and spasm control represent core components of supportive management in severe tetanus, as intense muscle spasms not only cause severe pain but also interfere

with ventilation and may precipitate life-threatening complications, including respiratory failure and malignant arrhythmias secondary to autonomic overstimulation. The primary objectives of sedative therapy are to suppress excessive neuromuscular activity, attenuate sympathetic stress responses, and enable safe mechanical ventilation and patient rest in the intensive care setting.[2]

Benzodiazepines, such as diazepam and midazolam, are considered first-line agents for spasm control due to their action as GABA-A receptor agonists. By enhancing inhibitory neurotransmission within the central nervous system, these agents reduce motor neuron excitability, thereby alleviating muscle rigidity and spasms while providing anxiolytic and sedative effects. Benzodiazepines are commonly administered as continuous infusions with dose titration based on clinical response, with careful monitoring for respiratory depression and hemodynamic instability.[2,12]

Adjunctive use of α_2-adrenergic agonists, including dexmedetomidine and clonidine, has been employed to mitigate sympathetic hyperactivity, reduce sedative requirements, and stabilize heart rate and blood pressure. Dexmedetomidine offers sedative and analgesic effects with minimal respiratory depression, making it a potentially valuable option in patients with severe autonomic dysfunction. However, current evidence supporting its routine use in tetanus remains limited, and close hemodynamic monitoring is essential during therapy.[11,12]

Magnesium sulfate plays an important adjunctive role in the management of severe tetanus by exerting muscle relaxant properties, reducing acetylcholine release at the neuromuscular junction, and inhibiting catecholamine release from sympathetic nerve terminals and the adrenal medulla. Magnesium therapy may enhance spasm control and contribute to autonomic stabilization, particularly in patients with refractory symptoms. Opioids, such as morphine, may also be administered to alleviate pain and blunt sympathetic responses associated with recurrent muscle spasms.[2,12]

In patients with severe tetanus who develop refractory spasms causing ventilatory compromise despite maximal sedative therapy, the use of neuromuscular blocking agents (NMBAs) becomes a definitive intervention. Agents such as vecuronium, rocuronium, atracurium, and pancuronium have been utilized for this purpose. Pancuronium possesses sympathomimetic properties that may exacerbate tachycardia and should be used with caution in patients with autonomic instability. In contrast, vecuronium and rocuronium are often preferred due to their more stable hemodynamic profiles.[1,2,13]

A multimodal strategy combining benzodiazepines, magnesium sulfate, and selected adjuvant agents such as dexmedetomidine or clonidine has been shown to provide more effective spasm control, reduce spasm frequency, and improve cardiovascular stability. This approach requires close ICU monitoring to prevent adverse effects related to drug synergy, including respiratory depression, hypotension, and bradycardia.[14]

Nutritional and Metabolic Support

Nutritional and metabolic support is a critical component of supportive management in patients with severe tetanus requiring intensive care. The disease is associated with a hypermetabolic state and

accelerated protein catabolism resulting from persistent muscle spasms, fever, and severe physiological stress. These factors markedly increase energy and protein requirements, while dysphagia, aspiration risk, and the need for deep sedation further compromise nutritional intake. Adequate and timely nutritional support is therefore essential to preserve lean body mass, promote tissue repair, and improve overall clinical outcomes.[2]

Early enteral nutrition is recommended once hemodynamic stability has been achieved, preferably via a nasogastric or nasoduodenal tube, as the enteral route helps maintain gut mucosal integrity and reduces the risk of nosocomial infections. In patients with severe spasms or a high risk of aspiration, partial or total parenteral nutrition may be considered temporarily until a safe transition to enteral feeding is feasible. Energy requirements typically range from 30 to 35 kcal/kg/day, while protein needs may reach 1.5–2.0 g/kg/day, depending on the severity of muscle spasms and the degree of catabolic stress. Balanced provision of carbohydrates and lipids is necessary to optimize metabolic efficiency and prevent complications such as hyperglycemia.[15]

Close metabolic monitoring is required to prevent and promptly address common disturbances, including electrolyte imbalances such as hypokalemia, hypomagnesemia, and hypophosphatemia, which may be exacerbated by increased metabolic demands and the use of magnesium sulfate therapy. Regular assessment of blood glucose levels, electrolyte profiles, and fluid balance is essential to guide nutritional adjustments and minimize metabolic complications. In addition to macronutrients, micronutrient supplementation—including B-complex vitamins, vitamin C, and zinc—plays an important role in supporting energy metabolism, tissue regeneration, and immune function Careful attention to hydration status and fluid balance is also necessary, particularly in patients experiencing profuse diaphoresis or increased insensible fluid losses due to sustained muscle spasms.[2,15]

Prevention of Complications and Early Rehabilitation

Prevention of complications is an essential component of supportive management in patients with severe tetanus requiring intensive care, given the prolonged disease course, extended immobilization, and frequent need for deep sedation and long-term mechanical ventilation. These factors substantially increase the risk of secondary morbidity, with commonly reported complications including ventilator-associated pneumonia (VAP), venous thromboembolism, stress-related gastrointestinal bleeding, and pressure injuries. Systematic and proactive preventive strategies are therefore critical to reducing mortality and facilitating recovery.[6]

Ventilator-associated pneumonia represents one of the most frequent complications associated with prolonged mechanical ventilation and excessive airway secretions in patients with tetanus. Preventive measures should adhere to established ventilator care bundles, including elevation of the head of the bed to 30–45 degrees, regular oral hygiene with antiseptic agents, scheduled airway suctioning, and routine reassessment of ventilatory requirements. Early tracheostomy, when indicated, may further reduce pulmonary infection risk compared with prolonged endotracheal intubation by

improving secretion clearance and minimizing airway irritation.[16]

The risk of venous thromboembolism is increased as a result of prolonged immobilization and heightened sympathetic activity. Pharmacological prophylaxis with low-dose unfractionated heparin or low–molecular weight heparin is recommended, complemented by nonpharmacological measures such as passive limb mobilization and the use of elastic compression stockings to promote venous return. Stress-related gastrointestinal ulcers may occur due to severe systemic stress and increased gastric acid secretion; therefore, prophylactic administration of proton pump inhibitors or histamine H_2-receptor antagonists is warranted to reduce the risk of upper gastrointestinal bleeding.[17]

Pressure injuries and musculoskeletal complications, including joint stiffness and muscle contractures, can be mitigated through regular repositioning, use of pressure-relieving mattresses, and early initiation of passive physiotherapy. These interventions help preserve skin integrity, improve peripheral circulation, and prevent long-term functional impairment. Adequate skin care, hydration, and nutritional support further contribute to wound healing and reduce susceptibility to infection, particularly in patients with prolonged critical illness.[18]

Following prolonged ICU stays, patients with severe tetanus are at risk of developing ICU-acquired weakness as a consequence of extended immobilization and prolonged exposure to neuromuscular blocking agents. Early rehabilitation strategies are therefore crucial and should be initiated during ICU care, beginning with passive mobilization and progressing gradually to active exercises as clinical stability permits. Early physiotherapy has been shown to improve functional outcomes, shorten recovery time, and enhance the ability to resume independent activities after critical illness.[9–11] Overall, effective prevention of complications in severe tetanus requires an integrated, multidisciplinary approach involving medical management, nursing care, and rehabilitation to ensure long-term stability and optimal functional recovery in the intensive care setting.[19]

Evidence and Recent Research Trends in Supportive Management of Tetanus in the ICU

Recent literature increasingly emphasizes the importance of multimodal supportive strategies in the management of severe tetanus in the intensive care unit (Table 1). Contemporary narrative syntheses have highlighted that the implementation of modern ICU-based care—including early mechanical ventilation, effective spasm control, and integrated supportive management—has been associated with a substantial reduction in mortality, from approximately 50% in settings without intensive care facilities to 10–20% in hospitals equipped with advanced airway management and invasive hemodynamic monitoring. These findings underscore the critical role of early tracheostomy, continuous monitoring, and coordinated ICU care in improving survival outcomes. However, as these conclusions are largely derived from narrative syntheses, the absence of pooled quantitative analyses limits the strength of causal inference.[1]

Observational studies conducted in resource-limited settings have demonstrated that autonomic dysfunction is a frequent complication in patients with severe tetanus and is strongly associated

with prolonged ICU stay and extended duration of mechanical ventilation. Mean ICU lengths of stay exceeding two weeks and ventilator dependence averaging more than 16 days have been reported in patients with significant autonomic instability, with worse overall prognostic outcomes observed in this subgroup.[9] These findings highlight autonomic dysfunction as a key determinant of disease severity and resource utilization in the ICU.[20]

More recent retrospective data from high-income settings indicate a shifting demographic pattern, with an increasing proportion of tetanus cases occurring in elderly populations. Although mortality rates in these cohorts are relatively low when comprehensive ICU care is available, survivors frequently experience significant declines in physical function and prolonged hospitalization, with reported mean lengths of stay exceeding two months.[5] These observations suggest that improved survival does not necessarily translate into favorable functional outcomes, particularly among older patients.[19,20]

Prospective observational evidence has further demonstrated that structured, protocol-based multimodal supportive management—encompassing airway control, sedation, and nutritional support—can shorten ICU length of stay, reduce the incidence of refractory spasms, and improve survival in patients with severe tetanus. The principal strength of this approach lies in its real-world applicability and comprehensive integration of ICU interventions. Nevertheless, the absence of control groups and multivariate analyses in such studies limits definitive conclusions regarding causality and introduces potential selection bias.[2]

Additional exploratory evidence has examined the role of advanced monitoring and adjunctive therapies. Case-based reports have suggested that the use of α_2-adrenergic agonists may contribute to rapid stabilization of heart rate and blood pressure in patients with severe autonomic dysfunction, without significant respiratory depression. While these findings provide a plausible physiological rationale for their use as sedative adjuncts, the lack of comparative data precludes generalization.[20] Similarly, prospective studies evaluating heart rate variability as a marker of autonomic function have identified abnormal variability patterns as potential predictors of poor prognosis. Although innovative, these studies are limited by small sample sizes and the absence of interventional evaluation, and therefore should be interpreted as hypothesis-generating rather than definitive.[21]

Practice-based clinical guidelines derived from modern ICU experience consistently emphasize the importance of early spasm control, adequate ventilatory support, structured nutritional management, and systematic prevention of complications such as pneumonia and autonomic instability. These guidelines advocate a multidisciplinary and coordinated ICU approach to severe tetanus management. However, many recommendations remain based on expert consensus rather than high-quality controlled trials, underscoring the need for further empirical validation.[13]

Collectively, current evidence supports the concept that supportive management of severe tetanus in the ICU must be comprehensive and multimodal, integrating early airway and ventilatory support, effective spasm control, autonomic stabilization, and adequate nutritional

therapy. Although individual studies exhibit methodological limitations, together they contribute meaningful insights into contemporary ICU management of tetanus.[19-21] A synthesis of recommended supportive management strategies for severe tetanus in the ICU is summarized in Table 1.

Table 1. Recommended Multimodal Supportive Strategies for Severe Tetanus in the Intensive Care Unit

Intervention Domain	Recommendations
A. Airway and Ventilatory Management	• Perform early airway control to prevent hypoxemia and aspiration. • Tracheostomy is preferred over prolonged endotracheal intubation to improve airway stability and secretion management. • Initiate mechanical ventilation in cases of refractory respiratory muscle spasms or sedative-induced respiratory depression; ventilatory modes should be individualized according to hemodynamic status. • Monitor arterial blood gases and airway pressures regularly to assess ventilatory effectiveness. • Maintain a low-stimulation ICU environment (reduced noise and lighting) to minimize reflex spasms.
B. Sedation and Spasm Control	• Use benzodiazepines (e.g., diazepam, midazolam) as first-line agents to suppress muscle spasms. • Consider α_2-adrenergic agonists (dexmedetomidine or clonidine) for autonomic dysfunction control and to reduce ventilatory requirements. • Add magnesium sulfate for muscle relaxation and autonomic stabilization. • Administer opioids (e.g., morphine) for analgesia and attenuation of sympathetic stress responses. • Titrate sedative doses carefully with close monitoring for respiratory depression, hypotension, and bradycardia.
C. Nutritional and Metabolic Support	• Initiate early enteral nutrition via nasogastric or nasoduodenal tube once hemodynamic stability is achieved to preserve gut integrity. • Consider partial or total parenteral nutrition in patients with high aspiration risk or intolerance to enteral feeding. • Target energy intake of 30–35 kcal/kg/day and protein intake of 1.5–2.0 g/kg/day. • Perform regular monitoring of blood glucose, electrolytes (potassium, magnesium, phosphate), and fluid balance. • Ensure adequate micronutrient supplementation, including B-complex vitamins, vitamin C, and zinc, to support metabolism and immune function.

D. Complication Prevention	• Apply ventilator care bundles to prevent ventilator-associated pneumonia (head-of-bed elevation, oral hygiene, routine suctioning). • Provide venous thromboembolism prophylaxis using low-dose unfractionated heparin or low–molecular weight heparin, combined with passive mobilization • Administer proton pump inhibitors or H_2-receptor antagonists for stress ulcer prophylaxis. • Implement regular repositioning, use pressure-relieving mattresses, and initiate early passive physiotherapy to prevent pressure injuries and contractures. • Maintain skin hygiene, hydration, and adequate nutritional status to promote wound healing and reduce secondary infections.
E. Rehabilitation	• Initiate passive mobilization as early as possible, even during deep sedation, to prevent joint stiffness and muscle contractures. • Progress to active mobilization once sedation is reduced or discontinued and clinical stability permits. • Perform regular functional assessments to enable early detection and prevention of ICU-acquired weakness.

Limitations and Future Research Directions

The primary limitation of this narrative review lies in its descriptive nature, as the synthesis is largely based on observational studies, case series, and case reports with varying levels of evidence. Consequently, the strength of generalizability to broader clinical practice remains limited. In addition, most of the included studies originate from intensive care settings with heterogeneous resource availability, which may influence clinical outcomes through differences in sedation protocols, ventilatory strategies, and nutritional support. Variability in drug dosing, combination regimens, and duration of supportive interventions further complicates direct comparison across studies and underscores the absence of universally accepted standards for the management of severe tetanus in the ICU. These limitations highlight existing evidence gaps in defining optimal strategies for spasm control, timing of tracheostomy, and effective nutritional interventions in this patient population.

To strengthen the evidence base, future research should prioritize well-designed prospective studies with controlled methodologies to objectively evaluate the impact of multimodal supportive care on mortality, ICU length of stay, and hemodynamic stability. Multicenter studies employing standardized protocols are particularly needed to identify prognostic factors associated with treatment success and to reduce variability in clinical practice. In addition, the incorporation of physiological biomarkers, such as heart rate variability, may offer a promising approach for early detection of autonomic dysfunction and for monitoring therapeutic response in patients with severe tetanus. Collectively, these research directions may contribute to the development of more

robust, evidence-based guidelines and improve the consistency and effectiveness of supportive care strategies in the intensive care setting.

Conclusions

This narrative review highlights that multimodal supportive management in the intensive care unit is a decisive factor in improving outcomes of patients with severe tetanus. The synthesis indicates that the primary contribution of supportive care lies in coordinated airway stabilization, effective spasm control, metabolic and nutritional optimization, and systematic prevention of ICU-related complications, rather than reliance on any single therapeutic intervention. A key insight emerging from this review is that the effectiveness of tetanus management is strongly determined by the integration and timing of supportive strategies, particularly in addressing autonomic instability and prolonged critical illness.

From a practical perspective, these findings reinforce the need for structured, multidisciplinary ICU protocols that prioritize early airway control, individualized sedation strategies, and proactive complication prevention. At a theoretical level, the review underscores the importance of viewing severe tetanus as a complex neurocritical condition in which supportive care directly influences survival and functional recovery. Future research should focus on prospective, multicenter studies with standardized protocols to define optimal combinations of supportive interventions, establish objective prognostic markers, and inform evidence-based policy and guideline development for the management of severe tetanus in the intensive care setting.

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Conflict of Interest

The author(s) report no conflict of interest.

Data Availability Statement

No new data were generated or analysed in this study.

Author's Contributions

Conceptualization: CDS, MJ. Methodology: CDS. Literature search: CDS, MJ. Data collection, analysis, and interpretation: CDS, MJ. Writing – original draft: CDS, MJ. Writing – critical review & editing: IPFN, MJ. Supervision: CDS, IPFN. All authors have read and approved the final version of the manuscript

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