Narrative review

Mechanical Ventilation and Anesthesia Strategies in Patients with Acute Respiratory Failure Due to Guillain-Barré Syndrome

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Abstract:

Background: This narrative review delves into the nuances of mechanical ventilation and tracheostomy in the context of Guillain-Barré Syndrome (GBS), aiming to provide a comprehensive understanding of the indications, anesthesia management, ventilation settings, and related considerations.

Method: The review was conducted by analyzing relevant literature and studies that address the use of mechanical ventilation and aanesthesiaa in GBS patients

Results: Indications to initiate mechanical ventilation encompass acute respiratory distress/arrest, hypoxia, hypercarbia, and acidosis, failure of non-invasive ventilation. Early Mechanical Ventilation (EMV) might be considered in cases of impaired swallowing. Anesthesia management poses challenges due to altered responses to neuromuscular blocking drugs (NMBDs); while sucssefull general anesthesia cases are reported in literature. While depolarizing agents like succinylcholine are contraindicated, non-depolarizing agents such as rocuronium and vecuronium may be used with caution. The role of sugammadex in reversing NMBDs' effects is explored but not yet fully established. Tracheostomy might be considered for patients requiring prolonged mechanical ventilation.

Conclusion: This narrative review provides information about the multifaceted considerations of mechanical ventilation and anesthesia in GBS.

Keywords: Guillain-Barré Syndrome, Mechanical Ventilation, Anesthesia, Pain Management.

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Introduction

Guillain-Barré syndrome (GBS), being the first common acute flaccid paralysis disease worldwide, is a rare neurological disorder manifesting with acute flaccid symmetrical weakness of body muscles [1]. It is well known that this clinical heterogeneous syndrome is triggered by infectious diseases like Campylobacter jejuni, Zika virus, and the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) through immune-mediated pathways, mostly in the presence of permissive genetic background [2]. The syndrome develops from distal limbs and progresses proximally or weakness of respiratory, pharyngeal, and laryngeal muscles, while other symptoms like pain and autonomic symptoms mostly emerge [1,2]. The advanced disease might affect vital functions of the body like respiration [3]. Diagnosing GBS includes considering clinical features, cerebrospinal fluid testing showing increased protein levels with a normal white blood cell count, and nerve conduction studies indicating reduced nerve conduction velocities [6]. Approximately 20% of patients with GBS develop respiratory failure that might require mechanical ventilation in more severe forms of the syndrome [4]. Patients being diagnosed with severe weakness at first, shorter time to peak disability, and old age are at higher risks of developing respiratory failure [7]. Further complications such as pneumonia might lead to an intricate state [8]. Acute respiratory failure in GBS patients is associated with a risk of complications, including pneumonia, atelectasis, and barotrauma [9]. In this review, we would evaluate optimal mechanical ventilation and anesthesia strategies to help mitigate these risks and minimize adverse outcomes.

Indications of intubation for GBS patients:

The decision to start mechanical ventilation for GBS patients is being taken individualized considering clinical condition, blood gas parameters, severity of neuromuscular weakness, and risk of respiratory failure [10]. Based on the literature, indications of mechanical ventilation for GBS patients are as below:

Acute respiratory distress/arrest: In case of symptoms like severe shortness of breath, labored and rapid breathing, low blood pressure, confusion, extreme tiredness, and bluish discoloration of the skin due to poor oxygenation (cyanosis), emergency intubation for respiratory failure is indicated [11,12]. These situations happen due to bulbar weakness aand increased risk of aspiration, compromised airway patency, and ineffective cough [12,13].

Hypoxia, Hypercarbia, and Acidosis: Blood gas abnormalities, including hypoxia ($PaO_2 < 60$ mm Hg), hypercarbia ($PaCO_2 > 50$ mm Hg), and acidosis ($pH < 7.3$), can indicate the need for intubation to address respiratory failure [14].

Early Mechanical Ventilation (EMV): Impaired swallowing is considered an indicator of EMV for GBS, but trials did not observe differences in the rate of pneumonia in patients with early mechanical ventilation and others [7].

Failure of Non-Invasive Ventilation (bilevel positive airway pressure or Continuous positive airway pressure) [15].

Settings of Mechanical ventilation in GBS:

In patients with Guillain-Barré Syndrome (GBS), synchronized intermittent mandatory ventilation (SIMV) is favored over assist-control ventilation [16]. The use of Positive End-Expiratory Pressure (PEEP) is one of the strategies employed to optimize ventilatory support for GBS patients. In a historical cohort study, it was observed that over time, the use of higher PEEP and lower tidal volumes were increased in practice after 1990 in mechanically ventilated GBS patients (as shown in Table 1), but there were no

differences in outcomes after considering these setting changes [16].

Anesthesia for mechanical ventilation in GBS:

Anesthesia management poses challenges for mechanical ventilation in GBS, especially when considering the use of neuromuscular blocking drugs (NMBs). Neuromuscular blocking drugs (NMBDs), including the depolarizing and non depolarizing agents, are medications used in anesthesia to induce paralysis of skeletal muscles, leading to muscle relaxation [17]. GBS patients may exhibit altered responses to NMBDs. Succinylcholine is contraindicated due to the risk of hyperkalemia and cardiac arrest, while Rocuronium and vecuronium might be used with caution in GBS [18,19]. Sugammadex, a drug that reverses the effects of rocuronium and vecuronium, has been reported in a patient with chronic GBS undergoing surgery. However, its safety is not yet fully established [20].

There have been cases of Cesarean deliveries performed under general anesthesia for pregnant patients diagnosed with GBS. In one case, Cesarean delivery was performed successfully under general anesthesia for a pregnant woman diagnosed with GBS who required tracheostomy and ventilator support due to respiratory muscle weakness and respiratory failure [21]. Another case report described a pregnant patient with GBS who underwent an emergency Caesarean section under general anesthesia, considering the patient's autonomic dysfunction and the presence of fetal distress [22].

Pain is a common symptom in patients with GBS. Adequate analgesic control has been achieved using nonsteroidal anti-inflammatory medications, oral and parenteral opioids, quinine sulfate, and epidural morphine sulfate. However, the use of opioid analgesics should be approached cautiously due to potential side effects and interactions with other medications [23]. Carbamazepine and gabapentin were useful for pain management in GBS [24].

Tracheostomy for mechanicaly ventilated patients

Tracheostomy might be considered for patients with prolonged mechanically ventilation [25]. Older patients with underlying pulmonary disease were more likely to need longer ventilation periods. Tracheostomy was indicated in a significant proportion of patients even after specific treatments, implying its necessity in severe GBS with respiratory insufficiency [26]. In a case report, a 12-year-old boy with GBS required tracheostomy due to rapid progression of respiratory muscle paralysis, suggesting early tracheostomy as an option in cases where conventional treatments do not improve respiratory strength and quality of life [27]. Additionally, a nationwide observational study explored the link between early tracheostomy and outcomes in mechanically ventilated GBS patients but it was not associated with improved outcomes [28].

Conclusion

In conclusion, the decision to initiate mechanical ventilation in GBS patients is tailored to individual considerations, including clinical condition, blood gas parameters, neuromuscular weakness severity, and the risk of respiratory failure. Key indications for mechanical ventilation in GBS include acute respiratory distress or arrest, hypoxia, hypercarbia, and acidosis. Early Mechanical Ventilation might be indicated for impaired swallowing, and non-invasive ventilation failure could necessitate invasive ventilation. In terms of ventilation settings, SIMV is preferred over assist-control ventilation, and increasing PEEP strategies are used to optimize support. Anesthesia management presents challenges, with altered responses to neuromuscular blocking drugs in GBS patients. Tracheostomy is considered for patients requiring prolonged mechanical ventilation,

particularly in cases of severe GBS with respiratory insufficiency. While older patients with underlying pulmonary disease might require longer ventilation and tracheostomy, a case report suggests early tracheostomy as an option when conventional treatments fail to improve respiratory strength and quality of life. However, a nationwide observational study did not associate early tracheostomy with improved outcomes. Pain management in GBS involves a variety of medications, but caution is advised when using opioid analgesics due to potential side effects and interactions.

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Table & Figure:

Table 1. Practice in mechanical ventilation in GBS

PaO2/FIO2 (median mm Hg)	Vital Capacity (median L)	Tidal volume (median mL/kg)	PEEP (median cm H2O)	Peak Airway Pressure (median cm H2O)
348	2.2	10.9	5	24