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Original Article

Risk of Extubation Failure in Patients With Myasthenic Crisis

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Abstract

Introduction: Weaning patients with myasthenic crisis (MC) from mechanical ventilation is often difficult, and the ideal time for extubation is often uncertain. However, little is known about the risk of extubation failure and the factors that may affect its occurrence. The goals of this study were to assess the risk of extubation failure in patients with MC and to determine which clinical variables may predict unsuccessful extubation.

Materials and Methods: Retrospective review of consecutive patients admitted for MC. Weaning method was categorized as T-piece or continuous positive airway pressure (i.e., T-piece trials not performed). Extubation failure was defined as need for reintubation or tracheostomy due to persistent neuromuscular insufficiency. Functional outcome was assessed using the modified Rankin score.

Results: We identified 26 episodes of MC in 20 patients. Median age was 42.1 years (range 14–83 years). Most patients were treated with immunomodulatory therapy (73%). There were seven episodes of extubation failure (prevalence rate 27%). Median time to reintubation was 36 hours. Older age ($p = 0.05$), atelectasis ($p < 0.01$), and pneumonia ($p = 0.02$) were significantly associated with extubation failure. Patients with failed extubation had considerably prolonged intensive care unit stays (median 28 versus 7 days; $p < 0.01$) and hospital stays (median 40 versus 12 days; $p < 0.01$).

Conclusion: Extubation failure may often complicate MC. Older age and development of pulmonary complications during mechanical ventilation increase the risk of extubation failure.

Key Words: Myasthenia; crisis; mechanical ventilation; extubation; weaning.

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Introduction

Myasthenic crisis (MC) is defined by the occurrence of neuromuscular respiratory failure requiring mechanical ventilation. The outcome of patients with MC has remarkably improved in recent years because of better respiratory assistance and immunomodulatory treatments (plasmapheresis and intravenous immunoglobulin) *(1–5)*. Still, the ventilatory management of these patients remains largely empirical and, at best, is guided by local protocols *(5–7)*.

Predictors for prolonged intubation have been reported *(4)*, but there is very little research focused on elucidating the best strategies to achieve successful weaning and extubation. Weaning patients with MC from mechanical ventilation is often complicated as a result of fluctuating degrees of weakness and the development of pulmonary complications, such as atelectasis and pneumonia. The right time for extubation may be difficult to establish, and need for reintubation is not uncommon.

The aim of this study is to assess the risk of extubation failure in patients with MC and to determine which clinical factors may predict unsuccessful extubation.

Table 1
Comparison Between Successful Extubation and Failed Extubation in Patients With Myasthenic Crisis

Variable	*Extubation failure*	*Successful extubation*	p-*Value*
Age, years (median, range)	60 (32–80)	33 (14–83)	0.05
Duration of MG, months (median, range)	2.5 (0–120)	24 (0–228)	0.82
Infectious cause of crisis, %	42.8	52.6	0.50
Use of IVIg/PE, %	71.4	78.9	0.63
Duration of MV,[a] days (median, range)	5 (1–22)	6 (2–17)	0.75
Duration of weaning [a] days (median, range)	2 (0.5–4)	2 (0.5–8)	0.33
Use of T-piece, %	44.4	26.3	0.36
$PaCO_2$ pre-extubation, mmHg (mean ± SD)	40.8 ± 7	42.4 ± 8	0.70
Atelectasis, %	100	38	<0.01
Pneumonia, %	86	28	0.02

IVIg, intravenous immunoglobulin; MG, myasthenia gravis; MV, mechanical ventilation; $PaCO_2$, partial pressure of carbon dioxide in arterial blood; PE, plasma exchange.

[a]Durations considered to end at the time of the index extubation.

Patients and Methods

We identified all patients admitted to our medical center with MC between 1996 and 2003. MC was defined by the requirement of mechanical ventilation due to neuromuscular respiratory failure. Postthymectomy crises were excluded. We collected information regarding patients' demographics, coexistent illnesses, date of myasthenia gravis (MG) diagnosis, history of previous intubations due to MC, precipitant of current crisis, treatment during the crisis, length of stay, and clinical condition upon discharge (with functional dependence defined as a modified Rankin >2). All complications during hospitalization were recorded, and chest X-ray films were reviewed for the presence of atelectasis or consolidation. Pneumonia was defined by the presence of radiological infiltrate in association with fever or leukocytosis and a positive culture result in respiratory secretions. When available, we also gathered data on arterial blood gases, serum bicarbonate, peak vital capacity, and negative inspiratory pressure before extubation.

Weaning strategy was decided by the treating intensivist in conjunction with the neuromuscular consultant on a case-by-case basis. Weaning method was categorized as T-piece or continuous positive airway pressure (CPAP) (i.e., T-piece trials not performed). Duration of weaning was tabulated in all cases (onset of weaning was defined as the time when the patient was first changed to CPAP or T-piece from assist-control or intermittent mandatory ventilation) and time to reintubation in those who failed extubation. Extubation failure was defined as need for reintubation within 72 hours from extubation due to persistent respiratory insufficiency. Need for reintubation after self-extubation was not classified as extubation failure. Patients in whom unsuccessful weaning prevented any extubation attempt were excluded from further analysis. We noted when bilevel positive airway pressure (BiPAP) was used after extubation to prevent reintubation or to complete weaning in patients with persistent requirements of ventilatory support.

We used the Fisher exact test to compare categorical variables and unpaired *t*-test to compare continuous variables. Level of significance was established at $p < 0.05$.

Results

Twenty-nine episodes of MC in 22 patients were identified. One patient already had a tracheostomy at the time of the admission resulting from a previous refractory MC, and two patients underwent tracheostomy without any preceding extubation attempts, and they were excluded from the analysis. Median age was 42.1 years (range 14–83 years), and 79% were women. Median time from diagnosis of MG was 1 year (range 0–21 years), including 4 out of 19 (21%) patients diagnosed with MG at the time of the crisis. Seven patients (37%) had previous history of MC. Before the crisis, all patients with previous diagnosis of MG were being treated with pyridostigmine, 68% were receiving steroids and 45% were receiving other immunosuppressants (azathioprine, cyclosporine, cyclophosphamide, or mycophenolate mofetil). Infections were deemed precipitants in 42% of the crises but no obvious reasons were noted in 46%. Intravenous immunoglobulin or plasmapheresis were administered in most crises (19/26; 73%). Mean number of days with mechanical ventilation was 8.9 (median 5; range 2–27), excluding two patients who became ventilator dependent and underwent tracheostomy. CPAP was the weaning method in 18 cases (69%), and T-piece was used in 8 (31%). There were three episodes of self-extubation (11%), two of which were followed by reintubation. BiPAP was used after extubation in only four cases (15%).

There were seven episodes of extubation failure (27%) excluding two patients who required reintubation after self-extubation. Median time to reintubation was 36 hours. Older age, atelectasis, and pneumonia were associated with extubation failure. The distribution of clinical variables in patients who failed extubation in comparison with those successfully extubated is presented in Table 1. Episodes of failed extubation were followed by complications in three cases (43%); pneumonia, lobar collapse, and subsequent tracheo-bronchial fistula occurred in one case each. Tracheostomy placement was required in four episodes of crisis (14%) owing to weaning failure, including two cases in which extubation was not even attempted (excluded from the rest of the analysis).

Serial bedside respiratory tests (forced vital capacity and negative inspiratory pressure) were obtained in 20/26 (77%) of all episodes, but they were performed less frequently before episodes of failed extubation (3/7; 43%). Therefore, there were insufficient measurements to compare both groups. Among the three cases with measurements before initially failed and subsequently successful extubation, two

of them had better forced vital capacity before the failed attempt (30 versus 21 and 12 versus 10 mL/kg), and the third had the same values at both times (19 mL/kg). BiPAP was used infrequently after extubation (4/26; 15%) and in only one case before reintubation (1/7; 14%).

No patient died during the admission for MC. Median length of stay in the intensive care unit (ICU) was 28 days (range 4–45 days) in the group with extubation failure and 7 days (range 3–21 days) in the group with successful extubation ($p < 0.01$). Hospital stay was similarly more prolonged in cases with failed extubation (median 40 versus 12 days; $p < 0.01$). Functional status upon discharge tended to be worse after extubation failure (mean Rankin score 2.3 versus 1.7), but the difference was not statistically significant ($p = 0.3$). Functional dependence was present in 29% of patients with extubation failure versus 16% in the group with successful extubation ($p = 0.4$).

Discussion

Our results show that extubation failure is common in patients with MC (35% in this series). The risk of extubation failure increases with age and with the presence of atelectasis or pneumonia. Duration and method of weaning and pre-extubation blood gases did not correlate with extubation outcome. Patients who experienced failure of extubation had much longer ICU and hospital stays.

Our cohort was similar to other recently described series of patients except for a younger median age *(4,5)*. These previous series reported rates of tracheostomy of 40% *(4)* and 14% *(5)*, the latter figure being identical to ours. However, these series do not mention the total number of cases in which failed extubation complicated the hospital course. Our rates of pulmonary complications (mainly atelectasis and pneumonia) in successfully extubated patients were comparable with other series, but the prevalence of these complications was much higher in our subgroup of patients who failed extubation. Aggressive respiratory treatment may prevent these complications *(5)* and could reduce the frequency of failed extubations.

It has been recommended to follow serial measurements of forced vital capacity and maximal inspiratory pressure to monitor the recovery of ventilatory strength and to decide when to proceed with extubation *(4–7)*. However, repeated measurement of vital capacity has been found to be a poor predictor of the need for mechanical ventilation in myasthenic patients *(8)*, and there is no proof that it becomes more reliable during the recovery phase of the crisis. Unfortunately, our data are insufficient to determine the usefulness of bedside respiratory measurements to predict extubation outcome. Nonetheless, we observed pronounced variability of the results of these tests over time, probably reflecting the fluctuating nature of the disease.

BiPAP use may avert reintubation in myasthenic patients with respiratory insufficiency after extubation *(9)*. BiPAP was rarely used in our patients but, when used, it prevented reintubation in three of four cases. In light of the complications related to reintubation and the associated lengthening of the ICU stay, we suggest that this option deserves to be explored in controlled studies.

In conclusion, extubation failure may complicate often the clinical management of patients with MC. The risk of extubation failure is higher in older patients and in those who develop pulmonary complications during the hospital course. Failed extubation is associated with considerably prolonged ICU and hospital stays and may have a negative impact on functional outcome. Standardized weaning protocols designed specifically for patients with MC and intensive protocols of respiratory therapy and BiPAP may help achieve timely and successful extubation. The use of these strategies deserves to be formally evaluated.

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