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Clinical impacts of extubation failure in critically ill patients admitted to the Intensive Care Unit

Impactos clínicos da falha de extubação em pacientes críticos internados na Unidade de Terapia Intensiva

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ABSTRACT

Introduction: Extubation failure and the need for reintubation occur in up to 30% of patients and are associated with increased mortality. **Objective:** To evaluate the frequency of extubation failure at 48 hours and 7 days in patients who underwent more than 24 hours of invasive mechanical ventilation and planned extubation in the intensive care unit; and to identify risk factors and clinical outcomes associated with extubation failure within 7 days. **Methods:** This was an observational, longitudinal, and comparative study, with both retrospective and prospective analysis, including patients admitted to the intensive care units of a public hospital in northern Santa Catarina, between October 2021 and September 2024. Patients admitted to the intensive care unit of either sex, aged 18 years or older, who required invasive mechanical ventilation for more than 24 hours and underwent the institutional weaning and extubation protocol, were included. **Results:** A total of 683 patients (527 retrospective and 156 prospective) who underwent planned extubation during the study period were included. The frequency of extubation failure at 48 hours and 7 days was 20% and 27%, respectively. Patients with extubation failure had longer intensive care unit and hospital stays, as well as higher intensive care unit and hospital mortality. Risk factors associated with extubation failure within 7 days included liver disease as the cause of intensive care unit admission, the presence of comorbidities such as neurological disease, age greater than 65 years, ineffective cough, upper airway problems, use of invasive mechanical ventilation for more than 72 hours, and the need for non-invasive ventilation after extubation. **Conclusion:** These findings highlight the importance of careful and individualized assessment of patients at risk, aiming to optimize weaning and extubation strategies to improve clinical outcomes and reduce associated mortality. However, the associations observed in this study should be interpreted as hypothesis-generating, and causal relationships need to be confirmed in prospective studies.

Keywords: Weaning; Airway Extubation; Risk Factors; Intensive Care Units; Mechanical Ventilation.

RESUMO

Introdução: A falha de extubação e necessidade de reintubação ocorre em até 30% dos pacientes e está associada a aumento da mortalidade. **Objetivo:** Avaliar a frequência de falha de extubação em 48 horas e 7 dias em pacientes com mais de 24 horas de ventilação mecânica invasiva e submetidos à extubação planejada na unidade de terapia intensiva; e identificar os fatores de risco e desfechos clínicos associados à falha de extubação em 7 dias. **Métodos:** Estudo observacional, longitudinal e comparativo, com análise de caráter retrospectiva e prospectiva, de pacientes internados nas unidade de terapia intensiva de um hospital público do norte de Santa Catarina, no período de Outubro de 2021 à Setembro de 2024. Foram incluídos no estudo pacientes internados na unidade de terapia intensiva, de ambos os sexos, com idade igual ou superior a 18 anos, em ventilação mecânica invasiva por tempo superior a 24 horas e submetidos ao protocolo de desmame e extubação da instituição. **Resultados:** Foram incluídos 683 pacientes (527 retrospectivos e 156 prospectivos) submetidos à uma extubação planejada no período do estudo. A frequência de falha de extubação em 48 horas e 7 dias foi de 20% e 27%, respectivamente. Os pacientes com falha de extubação apresentaram maior tempo de permanência e maior mortalidade na unidade de terapia intensiva e hospitalar. Foram identificados como fatores de risco associados à falha de extubação em 7 dias: doenças hepáticas como causa de admissão na unidade de terapia intensiva, a presença de comorbidades como doenças neurológicas, da idade acima de 65 anos, tosse ineficaz, problemas de vias aéreas superiores, o uso da ventilação mecânica invasiva por

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mais de 72 horas e uso de ventilação não invasiva após extubação. **Conclusão:** Esses achados evidenciam a importância de uma avaliação cuidadosa e individualizada dos pacientes em risco, visando a otimização das estratégias de desmame e extubação, com o intuito de melhorar os desfechos clínicos e reduzir a mortalidade associada. Contudo, os achados das associações deste estudo devem ser interpretados como geradores de hipóteses e a relação de causalidade necessita de confirmação em estudos prospectivos.

Palavras-chave: Desmame; Extubação; Fatores de Risco; Unidade de Terapia Intensiva; Ventilação Mecânica.

INTRODUCTION

Invasive mechanical ventilation (IMV) is a key support in the intensive care unit (ICU), being used in up to 58% of patients admitted to the ICU[1]. Weaning comprises the process of discontinuing IMV, accounting for up to 50% of the total time on IMV[2-4], and should be initiated as soon as the cause that led the patient to require invasive ventilatory support is resolved[5]. Delayed weaning and increased IMV time are associated with complications such as ventilator-associated pneumonia, muscle weakness, increased length of stay, and higher mortality[4,6-9].

Meanwhile, extubation failure and the need for reintubation occur in up to 30% of patients and are associated with increased mortality[8,10-16]. Studies have shown that patients with risk criteria for extubation failure may have a failure and reintubation rate of up to 40%, suggesting greater caution in weaning these patients[14,17]. The presence of comorbidities such as respiratory, liver, kidney, neuromuscular, and immune dysfunction has been independently linked to a higher risk of weaning failure[18]. However, there is only limited information available on extubation failure in patients with liver disease.

Given this scenario, some steps can be taken to lower the risk of extubation failure and successfully wean patients off IMV, such as: spontaneous breathing trials (SBT) to check how well patients handle losing invasive ventilatory support and identify those who are suitable for extubation[5,19-25]; weaning protocols with daily screening of patients eligible for weaning and SBT[23,26-29]; use of noninvasive ventilation (NIV) or high-flow nasal cannula (HFNC) after extubation in patients at high risk of reintubation[17,30-42]; or return to positive pressure ventilation for one hour using the ventilatory parameters before SBT for rest before extubation[43,44].

Despite the available evidence, IMV discontinuation practices vary widely between centers[45,46], with little data available on adult patient discontinuation in Brazilian ICUs. Therefore, we conducted a retrospective and prospective observational study aiming to: 1) Assess the frequency of extubation failure at 48 hours and seven days in patients with more than 24 hours of IMV and undergoing scheduled extubation in the ICU; 2) Identify risk factors and clinical outcomes associated with extubation failure at seven days.

METHODS

Study design and population

This is an observational, longitudinal, and comparative study involving retrospective and prospective analysis of patients admitted to the ICUs of a public hospital in northern Santa Catarina, Brazil, from October 2021 to September 2024.

The study comprised ICU patients of both sexes aged 18 years or older who had been on invasive mechanical ventilation for more than 24 hours and underwent the protocol for weaning and extubation established by the institution. Patients who had undergone accidental or palliative extubation and those with incomplete medical records were excluded from the sample.

All patients included in the study were extubated after careful assessment using a checklist designed to determine suitability for weaning and extubation (Table S1). It was only in October 2023 that an institutional weaning protocol was implemented, adding an assessment of the risk of laryngeal edema by using corticosteroids to prevent stridor and post-extubation laryngeal edema in at-risk patients with a positive leak test, and using NIV to prevent extubation failure in patients with high-risk criteria for extubation failure (Table S2).

Sample calculation

A convenience sample was selected to include patients admitted to the ICUs of a public hospital in northern Santa Catarina state, between October 2021 and September 2024, eligible for the study.

Data collection

Data collection was performed prospectively and retrospectively by the research team from the MVPEP® electronic medical record through a collection instrument (Table S2) and subsequently transferred to a Microsoft Excel® spreadsheet.

The following variables were collected: age, gender, Simplified Acute Physiology Score 3 (SAPS 3) on admission to the ICU[47], Charlson Comorbidity Index[48-50], criteria for high risk of reintubation, date of hospital and ICU admissions, date and cause of intubation, date of extubation, number of SBTs performed, duration and type of SBT, whether NIV was performed after extubation, whether a return to positive pressure ventilation was performed for one hour according to the ventilatory parameters before SBT for rest before extubation, date of reintubation, cause of reintubation, time of IMV, whether tracheostomy was performed, dates of ICU and hospital discharges, ICU Mobility Scale (IMS) at ICU discharge[51,52], and death (date and location).

Patients who met one or more of the following criteria were considered at risk of extubation failure: age > 65 years; congestive heart failure as the cause of intubation; moderate or severe chronic obstructive pulmonary disease; SAPS 3 > 50 on the day of extubation; body mass index > 30 (calculated as weight in kilograms divided by height in square meters); occurrence of at least two comorbidities; ineffective cough or abundant airway secretions (at least two aspirations within eight hours before extubation); failure in at least one SBT; IMV for > seven days; and upper airway problems (including risk of developing laryngeal edema)[14,17,34-38].

Outcomes

The primary outcome was extubation failure at 48 hours and at seven days in patients undergoing pre-planned extubation in the ICU. Secondary outcomes were risk factors and clinical outcomes associated with extubation failure at seven days.

Data analysis

Data analysis was performed on MedCalc Statistical Software® version 22.014[53]. Data distribution was assessed by the Kolmogorov-Smirnov test. Means were compared by Student's t-test, and variables with asymmetric distribution were compared by the nonparametric Mann-Whitney U test. Categorical variables were expressed as absolute and relative frequencies and compared by the chi-square test. *P*-values < 0.05 were considered significant.

A multivariate logistic regression analysis was performed to determine the factors associated with extubation failure, estimating the odds ratio (OR) and respective 95% confidence intervals (95% CI). The analysis included variables considered clinically significant (such as risk factors for extubation failure, use of NIV after extubation, and reconnection to MV for one hour after successful Spontaneous Breathing Test (SBT) followed by extubation) or with a P value < 0.1 in the univariate analysis. A p-value < 0.5 was considered significant.

Ethical issues

This study was approved by the research ethics committee of Hospital Municipal São José (HMSJ) under opinion CAAE 77102824.4.0000.5362. Participants were exempted from signing the Free and Informed Consent form.

RESULTS

Over the study period, 683 patients (527 retrospective and 156 prospective) underwent scheduled extubation and were included in the study. Table 1 shows the clinical data for the sample. The most common reasons for intubation were medical conditions (39%) and emergency surgery (20%). Regarding the causes of ICU admission, neurological ($p = 0.006$), surgical ($p < 0.001$), and liver ($p = 0.008$) pathologies were more frequent in patients with extubation failure compared to successfully extubated

Table 1. Clinical characteristics of the sample, group with successful extubation, and group with extubation failure at seven days.

	Total (n = 683)	Successful extubation (n = 499)	Extubation failure (n = 184)*	*p*-value
Male, n° (%)	410 (60%)	296 (59%)	114 (62%)	0.47
Age, med (IQR)	58 (41-68)	55 (39-67)	62 (49-71)	<0.001
SAPS3, med (IQR)	68 (59-79)	68 (59-77)	71 (62-81)	<0.001
ICU admission, n° (%)				
Neurological	177 (26%)	115 (23%)	62 (34%)	0.006
Surgical	244 (36%)	198 (40%)	46 (25%)	<0.001
Respiratory	11 (16%)	78 (16%)	33 (18%)	0.51
Sepsis	90 (13%)	68 (14%)	22 (12%)	0.52
Cardiovasculary	25 (4%)	17 (3%)	8 (4%)	0.58
Oncological	14 (2%)	10 (2%)	4 (2%)	0.90
Kidney/metabolic	15 (2%)	11 (2%)	4 (2%)	0.96
Liver disease	7 (1%)	2 (0%)	5 (3%)	0.008
IOT cause, n° (%)				
Clinical diseases	269 (39%)	177 (35%)	92 (50%)	<0.001
Elective surgery	62 (9%)	47 (9%)	15 (8%)	0.57

* Extubation failure: set as reintubation within seven days after extubation.

Med: median; IQR: interquartile range; ICU: intensive care unit; OTI: orotracheal intubation; DM: diabetes mellitus; SAH: systemic arterial hypertension; SAPS 3: Simplified Acute Physiology Score 3; COPD: chronic obstructive pulmonary disease; BMI: body mass index.

Table 1. Continued...

	Total (n = 683)	Successful extubation (n = 499)	Extubation failure (n = 184)*	*p*-value
Emergency surgery	140 (20%)	118 (24%)	22 (12%)	<0.001
Respiratory diseases	85 (12%)	58 (12%)	27 (15%)	0.31
Trauma	127 (19%)	99 (20%)	28 (15%)	0.14
Comorbidities, n° (%)				
DM	170 (25%)	113 (23%)	57 (31%)	0.03
Respiratory disease	89 (13%)	59 (12%)	30 (16%)	0.14
Cancer	128 (19%)	99 (20%)	29 (16%)	0.19
Peripheral artery disease	4 (1%)	2 (0%)	2 (1%)	0.30
SAH	261 (38%)	170 (34%)	91 (49%)	<0.001
Liver disease	30 (4%)	18 (4%)	12 (6%)	0.10
Kidney disease	45 (6%)	30 (6%)	15 (8%)	0.34
Heart disease	95 (14%)	65 (13%)	30 (16%)	0.30
Neurological disease	102 (15%)	60 (12%)	42 (23%)	<0.001
Other diseases	249 (36%)	181 (36%)	68 (37%)	0.97
Risk of extubation failure, n° (%)				
Age > 65 years	216 (32%)	135 (27%)	81 (44%)	<0.001
Moderate/severe COPD	47 (7%)	26 (5%)	21 (11%)	0.005
BMI > 30	43 (6%)	28 (6%)	15 (8%)	0.24
Ineffective cough	38 (5%)	20 (4%)	18 (10%)	0.004
> 1 SBT failure	220 (32%)	157 (31%)	63 (34%)	0.57
ICC as OTI cause	10 (1%)	6 (1%)	4 (2%)	0.36
VAS problems	32 (5%)	20 (4%)	12 (6%)	0.18
> 2 comorbidities	298 (44%)	208 (42%)	90 (48%)	1.12
MV > 7 days	332 (49%)	240 (48%)	92 (50%)	0.78
SBT time, min, med (IQR)	50 (40-60)	50 (40-60)	50 (40-60)	0.20

* Extubation failure: set as reintubation within seven days after extubation.

Med: median; IQR: interquartile range; ICU: intensive care unit; OTI: orotracheal intubation; DM: diabetes mellitus; SAH: systemic arterial hypertension; SAPS 3: Simplified Acute Physiology Score 3; COPD: chronic obstructive pulmonary disease; BMI: body mass index.

patients. Compared to successfully extubated patients, those with extubation failure showed older age (62 [49-71] vs. 55 [39-67] years), higher SAPS 3 (71 [62-81] vs. 68 [59-77]), and a higher frequency of Diabetes Mellitus (DM), Subarachnoid Hemorrhage (SAH), and neurological diseases as associated comorbidities. The presence of risk factors for extubation failure was found in 79% of the sample, being more frequent in reintubated patients, especially those aged > 65 years ($p < 0.001$), moderate/severe Chronic Obstructive Pulmonary Disease (COPD) ($p = 0.005$), and ineffective cough ($p = 0.004$).

Table 2 shows the study results, with 136 patients (20%) failing extubation within 48 hours and 184 patients (27%) being reintubated within seven days after extubation. The main causes for reintubation were increased respiratory effort (36%), decreased level of consciousness (21%), and presence of laryngeal stridor (19%). Analyzing the clinical outcomes related to extubation failure, by comparing the group that successfully extubated with the group that failed to extubate within seven days, we found longer ICU stays (25 days vs. 10 days, $p < 0.001$), longer hospital stays (40 days vs. 23 days, $p < 0.001$), higher ICU mortality (27% vs. 4%, $p < 0.001$), and higher hospital mortality (41% vs. 8%, $p < 0.001$).

According to the multivariate analysis by logistic regression (Table 3), the factors associated with an increased probability of extubation failure within seven days were liver disease as the cause of ICU admission, the presence of comorbidities such as neurological diseases, age over 65 years, ineffective cough, upper airway

Table 2. Sample outcomes, group with successful extubation and group with extubation failure in seven days.

	Total (n = 683)	Successful extubation (n = 499)	Extubation failure (n = 184)*	*p*-value
Extubation failure within 48 hours, n° (%)	-	-	136 (20%)	-
Extubation failure within 7 days, n° (%)			184 (27%)	-
Indication for reintubation, n (%)				
Increased respiratory effort	-	-	67 (36%)	-
Ineffective cough	-	-	24 (13%)	-
Bronchospasm	-	-	6 (3%)	-
Stridor	-	-	34 (19%)	-
RLC	-	-	39 (21%)	-
Atelectasis	-	-	3 (2%)	-
Bronchoaspiration	-	-	4 (2%)	-
CPA	-	-	3 (2%)	-
Clinical worsening	-	-	3 (2%)	-
Procedure	-	-	1 (0%)	-
MV time, days, mean (IQR)	6 (3-10.5)	6 (3-10.5)	6.5 (4-10)	0.15
TQT, n° (%)	124 (18%)	16 (3%)	108 (59%)	<0.001
NIV after extubation, n (%)	74 (11%)	37 (7%)	37 (20%)	<0.001
Length of stay in the ICU, med (IQR)	12 (7-20)	10 (6-14)	25 (16-35)	<0.001
Length of hospital stay, med (IQR)	28 (17-44)	23 (15-38)	40 (28-66)	<0.001
Mortality in the ICU, n (%)	70 (10%)	21 (4%)	49 (27%)	<0.001
Hospital mortality, n (%)	113 (16%)	38 (8%)	75 (41%)	<0.001

* Extubation failure: set as reintubation within seven days after extubation.

Med: median; IQR: interquartile range; RLC: reduced level of consciousness; CPA: cardiopulmonary arrest; MV: mechanical ventilation; TQT: tracheostomy; ICU: intensive care unit.

problems, the use of MV for more than 72 hours, and NIV after extubation.

DISCUSSION

In our study, the frequency rates of extubation failure at 48 hours and seven days were 20% and 27%, respectively, in patients undergoing planned extubation in the ICU. Among patients with extubation failure, we observed longer ICU and hospital stays and higher ICU and hospital mortality. The following were identified as risk factors associated with extubation failure at 7 days: liver disease as the cause of ICU admission, the presence of comorbidities such as neurological diseases, age over 65 years, ineffective cough, upper airway problems, use of MV for more than 72 hours, and NIV after extubation.

Among the strengths of our study, it is worth highlighting that all participants were extubated after careful evaluation based on a checklist designed to assess readiness for weaning and extubation. Furthermore, the study benefited from an extended data collection period and a large sample size. The presence of a weaning protocol results in a 25% reduction in IMV time and a 10% reduction in ICU length of stay[29]. The institution where this study was conducted has a weaning protocol implemented, with daily use of a screening checklist and assessment of readiness for weaning and SBT. However, it was only in October 2023 that the institution implemented protocols for assessing the risk of laryngeal edema using corticosteroids to prevent stridor and post-extubation laryngeal edema in at-risk patients with a positive escape test, and for using NIV to prevent extubation failure in patients with high-risk criteria for extubation failure.

It is also worth mentioning some of the limitations of our study: despite the considerable size of the sample, most of the data collection was retrospective, based on information extracted from electronic medical records, which may contain incomplete or inconsistent information or errors. This factor also limited access to data on the number of ICU admissions over the study period, as well

Table 3. Univariate and multivariate analyses of factors associated with extubation failure within seven days.

	Univariate		OR	Multivariate	
	CI 95%	*p-value*		CI 95%	*p-value*
ICU admission referral					
Surgical	-0.19 to -0.06	<0.001	0.84	0.51 to 1.39	0.52
Liver disease	**0.10 to 0.79**	**0.01**	**2.41**	**1.08 to 5.33**	**0.03**
OTI indication					
Clinical diseases	0.05 to 0.19	<0.001	1.44	0.91 to 2.27	0.11
Emergency surgery	-0.20 to -0.07	<0.001	0.69	0.37 to 1.29	0.25
Comorbidities					
DM	0.003 to 0.17	0.04	0.90	0.57 to 1.42	0.66
SAH	0.05 to 0.20	<0.001	1.29	0.82 to 2.04	0.26
Neurological disease	0.05 to 0.28	0.003	2.01	1.22 to 3.29	0.005
Risk of extubation failure					
Age > 65 years	0.06 to 0.22	<0.001	1.70	1.12 to 2.58	0.01
Moderate/severe COPD	0.02 to 0.35	0.02	1.89	0.95 to 3.74	0.06
BMI > 30	-0.05 to 0.27	0.18	1.55	0.75 to 3.20	0.22
Ineffective cough	0.05 to 0.42	0.009	2.40	1.17 to 4.91	0.01
> 1 TER failure	-0.06 to 0.07	0.80	0.88	0.60 to 1.31	0.54
ICC as OTI cause	-0.20 to 0.47	0.44	0.81	0.19 to 3.30	0.77
VAS problems	-0.04 to 0.33	0.14	2.78	1.21 to 6.36	0.01
> 2 comorbidities	0.17 to 0.26	0.004	1.07	0.69 to 1.65	0.75
MV > 7 days	-0.05 to 0.08	0.65	0.88	0.59 to 1.31	0.53
MV > 72 hours	0.02 to 0.18	0.007	2.10	1.11 to 3.96	0.02
NIV after extubation	0.12 to 0.39	<0.001	2.79	1.60 to 4.85	0.001
Reconection	-0.16 to 0.13	0.86	0.47	0.19 to 1.12	0.09

Variables with *P*<0.1 in the univariate analysis or considered clinically significant (such as risk factors for extubation failure, use of NIV after extubation, and reconnection to MV for 1 hour after successful SRT followed by extubation) were included in the multivariate analysis.

95% CI: 95% confidence interval; OR: odds ratio; ICU: intensive care unit; OTI: orotracheal intubation; DM: diabetes mellitus; SAH: systemic arterial hypertension; SAPS3: Simplified Acute Physiology Score 3; COPD: chronic obstructive pulmonary disease; BMI: body mass index; CHF: congestive heart failure; UA: upper airway; MV: mechanical ventilation; SBT: spontaneous breathing trial; NIV: noninvasive ventilation.

as exclusions and their reasons. The lack of randomization prevents the control of exposure variables and the outcome of extubation failure. Thus, the associations found in this study should be interpreted as hypothesis-generating, as they are subject to biases (of selection, measurement, and confounding), and the causal relationship should be confirmed in prospective studies. In addition, regarding data related to post-extubation NIV, the prophylactic NIV protocol was only implemented at the institution in October 2023, which corresponds to the last year of data collection for this study.

Our study revealed a high seven-day extubation failure rate compared to that reported in previous studies[19,54]. Given that this is an observational study and its inherent limitations, our findings may be attributable to bias or chance. However, some characteristics of our sample may explain a high extubation failure rate, such as the severity of the participants (median SAPS score 68 [Interquartile Range (IQR) 59–79]) and median duration of mechanical ventilation of six days (IQR 3–10.5). Prolonged periods of IMV are associated with more severe conditions, which require longer periods of sedation, analgesia, and, in some situations, the use of neuromuscular blockers[9]. In addition, patients undergoing IMV for more than five days may suffer adverse effects on the diaphragm, including decreased force generation and muscle atrophy, resulting in diaphragmatic dysfunction[55,56]. Furthermore, the presence of risk factors for extubation failure was found

in 79% of the sample, being more frequent in reintubated patients. Previous studies have shown that patients with risk criteria for extubation failure may have a reintubation rate of up to 40%[14,17], with an increased risk according to the number of associated risk factors[39,40].

Our study identified the following risk factors associated with extubation failure within seven days: liver disease as the cause of ICU admission, the presence of comorbidities such as neurological diseases, age over 65 years, ineffective cough, upper airway problems, use of MV for more than 72 hours, and NIV after extubation. Data analysis from the WEAN-SAFE study, a prospective multicenter observational study that evaluated 4,523 patients on IMV or NIV, showed that the proportion of patients with IMV weaning failure increases progressively with the number of comorbidities. The presence of respiratory comorbidities (Odds Ratio (OR) 1.38; 95% CI 1.10 to 1.74; $p = 0.01$), liver comorbidities (OR 1.76; 95% CI 1.19 to 2.56; $p < 0.01$), kidney comorbidities (OR 1.52; 95% CI 1.15 to 2.01; $p < 0.01$), neuromuscular (OR 1.32; 95% CI 1.06 to 1.66; $p = 0.01$), and immune dysfunction (OR 1.78; 95% CI 1.39 to 2.27; $p < 0.01$) were independently associated with an increased risk of weaning failure[18]. However, the impact of comorbidities on the main events of the weaning process and weaning outcomes is yet to be fully grasped.

In a prospective observational study, Cinotti et al.[57] reported an extubation failure rate of 19% in neurocritical patients, with the following factors predicted to be associated with successful weaning: head injury, vigorous coughing, gag reflex, swallowing attempts, endotracheal aspiration less than twice per hour, a Glasgow motor score of six, and body temperature on the day of extubation. In addition to the aforementioned associated factors, multivariate analysis found NIV to be linked to extubation failure. The use of prophylactic NIV in high-risk patients to prevent extubation failure is well established in the literature[31-33]. However, in our total sample, only 11% of patients used this resource. In addition, the prophylactic NIV protocol was only implemented at the institution in October 2023, suggesting that NIV may have been mistakenly used in patients who developed acute respiratory failure after extubation. In such cases, there is no evidence of benefit from the use of NIV, which may increase mortality by delaying intubation[58].

Extubation failure is associated with increased mortality rates, longer mechanical ventilation time, longer ICU stay, and worse clinical outcomes[14,17,59]. In our study, length of stay and mortality were considerably higher in the extubation failure group. We also found that 41% of patients who failed to extubate passed away during hospitalization, while 27% passed away before being discharged from the ICU. This mortality rate matches that found in other studies, with mortality ranging from 15% to 52% in the ICU and from 15% to 70% in the hospital[4,11-14,60-64].

FINAL REMARKS

In our study, the rate of extubation failure in patients undergoing planned extubation in the ICU reached 27% within seven days. This condition was associated with longer stays and higher mortality rates in the ICU and hospital. The following were identified as risk factors associated with extubation failure: liver disease, neurological disease, age over 65 years, ineffective cough, upper airway problems, use of MV for more than 72 hours, and NIV after extubation.

These findings highlight the advantage of a careful and individualized assessment of patients at risk, aiming to optimize weaning and extubation strategies to improve clinical outcomes and reduce associated mortality. However, our findings should be interpreted as hypothesis-generating, requiring confirmation of causality in prospective studies.

FUNDING

Nothing to declare.

CONFLICT OF INTERESTS

Nothing to declare.

RESEARCH DATA AVAILABILITY

The data supporting the conclusions of this study are stored in spreadsheets on a password-protected drive and are available upon request to the corresponding author. The data are not available in a public domain repository at the authors' discretion.

AUTHOR CONTRIBUTIONS

Ana Clara Budal: Conceptualization; Investigation; Data Curation; Formal Analysis; Methodology; Writing – Original Draft.

Michelli Marcela Dadam: Conceptualization; Investigation; Formal Analysis; Methodology; Supervision; Writing – Review & Editing.

Aline Braz Pereira: Formal Analysis; Methodology; Writing – Review & Editing.

Daniela Delvan: Investigation.

Graziela de Vila de Luca Tonon: Investigation.

Larissa Bedendo Pires da Luz Alexandre: Investigation.

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Supplementary Material

This article includes supplementary material.

Table S1. Daily checklist for assessing readiness for weaning from VM and TRE

Table S2. Data collection instrument

This material is available as part of the online version of the article on the website https://doi.org/10.47066/2966-4837.e00522025pt