Soraia Genebra Ibrahim[1], Joyce Michele Silva[1], Luis Guilherme Alegretti Borges[1], Augusto Savi[1], Luiz Alberto Forgiarini Junior[2], Cassiano Teixeira[1,3]

Use of a noninvasive ventilation device following tracheotomy: an alternative to facilitate ICU discharge?

Utilização de equipamentos de ventilação não invasiva na traqueostomia: uma alternativa para alta da UTI?

1. Hospital Moinhos de Vento - Porto Alegre (RS), Brazil.
2. Centro Universitário Metodista - IPA - Porto Alegre (RS), Brazil.
3. Universidade Federal de Ciências da Saúde de Porto Alegre – UFCSPA - Porto Alegre (RS), Brazil.

ABSTRACT

Objective: We aimed to assess the use of noninvasive ventilation devices in patients with prolonged weaning following tracheotomy.

Methods: We performed a retrospective observational study using data collected from the clinical records of tracheotomized patients diagnosed with prolonged weaning. The participants were hospitalized in the adult intensive care unit of Moinhos de Vento Hospital, Porto Alegre (RS) between December 2007 and December 2008.

Results: In the data collection period, 1,482 patients were admitted to the intensive care unit. In total, 126 patients underwent tracheotomies, and 26 of these patients met the inclusion criteria for participating in the study. The average age of the patients in our sample was 73 ± 12 years. In our sample, 57.7% of the participants were female, and 80.8% were admitted as a result of acute hypoxemic respiratory failure. After the tracheotomy, the patients remained under mechanical ventilation for an average of 29.8 days. After the initiation of the experimental protocol, the tracheotomized patients remained under ventilation for an average of 53.5 days on a portable noninvasive device connected to the tracheotomy. There were three possible outcomes for the patients. They were discharged, were weaned from the noninvasive ventilation, or died in the intensive care unit or hospital ward. In total, 76.9% (20/26) of the patients were discharged from the intensive care unit, and 53.8% (14/26) of the patients were discharged from the hospital.

Conclusion: The use of noninvasive portable ventilators connected to the tracheotomy may represent an alternative for discontinuing ventilationand discharging tracheotomized patients with prolonged ventilatory weaning from intensive care unit.

Keywords: Tracheotomy; Ventilator weaning; Respiration, artificial

INTRODUCTION

Respiratory system injury progressing to acute respiratory failure (ARF) is common in intensive care units (ICU). In many such cases, the use of mechanical ventilation (MV) is indispensable. Recent technological and organizational advances in intensive care have allowed more patients to survive acute injury. However, these advances have also increased the number of chronic critical patients who become dependent on MV and other modalities of intensive care.[1]

Approximately 10% of the patients dependent on MV for prolonged periods of time undergo tracheotomies, considered an alternative to facilitate ventilator weaning.[2] Tracheotomies reduce anatomical dead space, airway resistance, and respiratory effort. These procedures also allow better access to the airway for removing secretions.[2,3] Following the tracheotomy procedure,

This study was conducted at the intensive care unit, Hospital Moinhos de Vento - Porto Alegre (RS), Brazil.

Conflicts of interest: None.

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Corresponding author:
Cassiano Teixeira
Rua Riveira, 355/403
Zip Code: 90670-160 - Porto Alegre (RS), Brazil
E-mail: cassiano.rush@gmail.com

patients are more comfortable and mobile. They are also more effective at communicating and staying out of bed. The patients often have better nutrition and are more safely discharged from the ICU.[3,4]

Recently, patients undergoing MV weaning have been classified into three subgroups according to the patient's difficulties and prognosis following MV withdrawal.[5] Within this classification scheme, the prolonged weaning diagnosis is assigned to patients who have failed three or more spontaneous breathing trials, or weaning attempts for more than seven days.[5] These patients require alternative treatments to become weaned from the ventilator and discharged from the ICU, and they are chronically dependent on intensive care. This dependence is associated with worse prognosis and higher rates of complications and mortality. In addition, these patients mean a significant financial burden to the healthcare system.[1,5]

Recently, pressure support ventilation (PSV) has been used with noninvasive ventilation equipment [PSV combined with positive end-expiratory pressure (PEEP)] in caring for tracheotomized patients with chronic ARF.[5] Similar to MV, these portable noninvasive ventilation (NIV) devices may also reduce respiratory rate, increase tidal volume (Vt), improve gas exchange, and thus reduce respiratory effort.[5,6] NIVs are being increasingly applied to manage patients chronically dependent on MV such that they can be safely discharged from the ICU sooner.

The purpose of the present study was to examine the prognosis of tracheotomized patients with prolonged weaning and patients who were characterized as being unweanable. The patients were subjected to pressure support ventilation through a NIV device, and their ICU discharge rates were recorded.

METHODS

A retrospective observational design was adopted for the present study. We collected data from the clinical records of tracheotomized patients (1) diagnosed with prolonged weaning (≥ three failures at spontaneous breathing trials or failed MV weaning attempts for seven days or more) and (2) patients with advanced neuromuscular diseases who were considered by the routine ICU physicians to be unweanable. All of the participants were patients in the adult ICU of Moinhos de Vento Hospital, Porto Alegre (RS) between December 2007 and December 2008. The present study was approved by the Research Ethics Committee of the institution waiving the need of obtaining a signed informed consent.

Protocol for using the NIV device in tracheotomized patients

Routine criteria for starting pressure support ventilation and use of specific NIV device included: (1) age ≥ 18 years old and either being diagnosed with prolonged weaning or advanced neuromuscular disease. In the latter case, the clinical history was required to indicate that the patient would be indefinitely dependent on ventilator support.

The patients meeting the inclusion criteria were spontaneously ventilated using a NIV device (VPAP II, Resmed®, San Diego, USA) connected to a tracheotomy cannula. All of the patients used a tracheotomy cannula (size 8 or larger) with a cuff and an inner-cannula. These patients were assisted by the ICU physiotherapists, who supervised an institutionally standardized rehabilitation program for these patients. This program consisted of exercises for the lower and upper limbs that could be performed in a bed or an armchair. The patients were also taught techniques for bronchial cleansing and pulmonary expansion.

Data collection

We collected data on the demographics (gender and age) of the patients. Their underlying diseases and the causes of their respiratory failure were also recorded. Additionally, were noted the length of their invasive ventilation support, as well as the length of their NIV support following tracheotomy. Finally, the outcome of the patients at the ICU and the hospital were recorded.

Statistical analysis

Descriptive statistical analyses were performed. Total values, group percentages, and means ± standard deviation (SD) of the parameters of interest were calculated.

RESULTS

From December 2007 to December 2008, 1,482 patients were admitted to the ICU. From these, 126 were tracheotomized, and 26 of these patients met the inclusion criteria for the study (Figure 1). The mean age of the patients in our sample was 73±12 years, being 57.7% female. Additionally, 80.8% of the participants were admitted to the hospital for acute hypoxemic respiratory failure (AHRP). Table 1 describes the patients' characteristics. Mean MV time following tracheotomy was 29.8 days. After the initiation of NIV, the tracheotomized patients remained under NIV for an average of 53.5 days before they were discharged, the NIV was discontinued, or died in the ICU or hospital.

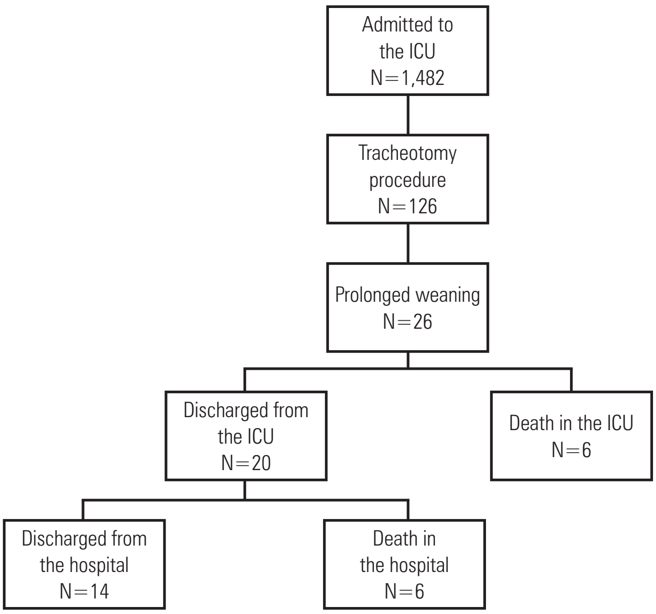

Figure 1 - Patients included in the study. ICU – intensive care unit.

Of the patients undergoing the NIV protocol, 76.9% (20/26) were discharged from the ICU, and 53.8% (14/26) were discharged from the hospital.

DISCUSSION

The most important finding in this study was that the use of NIV devices in tracheotomized patients allowed that 76.9% of the patients were discharged from the ICU, and 53.8% were discharged from the hospital. This was seen in a special population of patients who are dependent on ventilator support. The usage of these devices has not yet been extensively documented in the literature.

Chronic critically ill patients, a current epidemics, reflect both the improvement in patient care, consequently reducing mortality rates and the increased number of patients dependent on intensive care.[1,7] Patients with chronic critical illnesses who have been dependent on ventilator support for ≥ 21 days are associated with greater morbidity, hospital expenses, and mortality rates, both inside and outside of the hospital.[1,7-10] In addition to their dependence

Table 1 – Characteristics and prognoses of the patients

Patient	Gender	Age	Diagnosis	MV duration after tracheotomy	NIV duration after tracheotomy	ICU outcome	Hospital outcome
1	F	56	ALS	5	24	Death	
2	M	37	Vascular disease	5	12	Death	-
3	F	78	COPD	50	14	Death	-
4	F	89	PO	13	89	Death	-
5	M	56	Parkinson	6	56	Death	-
6	F	63	Multiple myeloma	12	68	Death	-
7	M	76	ALS	5	41	Discharge	Discharge
8	M	68	PO	40	25	Discharge	Discharge
9	F	85	Multiple myeloma	56	240	Discharge	Death
10	M	85	COPD	25	41	Discharge	Discharge
11	F	81	COPD	45	38	Discharge	Discharge
12	F	86	COPD	5	180	Discharge	Death
13	F	80	CAP	13	187	Discharge	Death
14	F	89	Porphyria	90	27	Discharge	Discharge
15	F	87	CKF	85	34	Discharge	Death
16	F	64	Stroke	74	38	Discharge	Death
17	F	84	ALS	5	13	Discharge	Death
18	F	77	Stroke	15	57	Discharge	Discharge
19	F	85	Alzheimer	25	34	Discharge	Discharge
20	M	65	Muscular dystrophy	18	24	Discharge	Discharge
21	F	66	COPD	34	19	Discharge	Discharge
22	M	78	COPD	38	49	Discharge	Discharge
23	M	73	Stroke	36	29	Discharge	Discharge
24	M	62	ALS	21	22	Discharge	Discharge
25	M	70	PO	38	19	Discharge	Discharge
26	M	69	COPD	18	12	Discharge	Discharge

MV - mechanical ventilation; NIV - noninvasive ventilation; ICU - intensive care unit; F - female; ALS - amyotrophic lateral sclerosis; M - male; COPD - chronic obstructive pulmonary disease; PO - postoperative following major surgery; CAP - severe community-acquired pneumonia; CKF - chronic kidney failure.

on MV, patients with chronic critical diseases are more susceptible to severe weakness attributable to myopathy, neuropathy, or bodily changes;[5] infection;[7,9] coma or delirium;[10] and nutritional deficits. These patients are also vulnerable to pain, thirst, dyspnea, depression, and anxiety, as well as the inability to communicate during tracheal intubation.[11]

In these patients, weaning is often associated with the inability to spontaneously breathe during attempted extubation. These patients frequently require tracheotomies.[1,7] Many of these patients can be transferred to respiratory care units, intermediate care units, and home care services. However, because of the disorganization of the Brazilian healthcare system, these types of units are often unavailable.[1] Therefore, alternatives are needed to ensure that the ICU beds are occupied by patients who truly require intensive care. Nava and Hill[12] suggested that patients with chronic, severe, and irreversible diseases should not be subjected to invasive ventilatory support when they develop ARF. In these situations, using NIV devices and other similar equipment may be indicated to treat the ARF symptoms. These devices may help make better use of the available ICU beds and increase patient survival.[12]

Noninvasive ventilation can give continuous positive airway pressure (CPAP) or pressure support (characterized by applying two disparate airway pressures). Pressure support seems to be a better alternative for ICU patients with the exception of patients with cardiogenic pulmonary edema.[13]

NIV can be used as a weaning strategy, especially when applied for the prophylactic treatment of special populations. This technique may reduce the duration of MV,[13] accelerate ventilator weaning,[12,13] reduce the risk of MV-related pneumonia,[14,15] and decrease patient mortality.[12-14] However, few reports about the use of different ventilator modes and NIV devices in tracheotomized patients that are dependent on invasive ventilatory support have been published. Patel and Petrini[16] studied patients undergoing MV weaning. They compared the positive pressure exerted by conventional ventilators in the CPAP mode (5 cm H_2O) to that exerted by a bilevel positive airway pressure (BiPAP) ST/D device. They examined the BiPAP settings of 5 and 10 cm H_20 for the expiratory positive airway pressure (EPAP) and inspiratory positive airway pressure (IPAP), respectively. The authors showed that both methods were equally efficient and safe even in tracheotomized patients.[16] Hill also asserted that patients could be maintained using ventilators with PSV and PEEP applied noninvasively or through a tracheotomy.[17] Thus, we analyzed the outcome of patients with tracheotomies using this mode of ventilation. These patients were diagnosed with prolonged weaning. We assessed their discharge rates from the ICU and hospital.

Though the average time for discontinuing MV depends on the severity and nature of the patient's disease or injury, patients with prolonged weaning are usually kept on MV for 16 to 37 days.[5,6,18,19] In our study, the patients required an average of 83 days of ventilator support between the tracheotomy and their discharge from the hospital. The patients were discharged from the hospital as a result of NIV use (3/26), ventilator weaning (11/26), or death (12/26). Our patients underwent tracheotomies to accelerate MV weaning. However, they remained under MV with PSV for an average of 29.8 days before pressure support using a NIV device was indicated. Previously, Scheinhorn et al.[20] showed that tracheotomies reduced the average time to discontinuing ventilator support from 29 to 17 days. The weaning protocols for critical, MV-dependent, tracheotomized patients commonly involve changing the ventilator mode to the PSV setting (10 to 15 cm H_2O). Next, the patient is subjected to spontaneous breathing trials through a T-tube in the tracheotomy.[8,21,22] The average stay in the ICU of the patients with prolonged weaning ventilated using pressure support on a NIV device was 53 days. The patients were subsequently transferred to a hospital ward.

Patients who remain dependent on ventilation are vulnerable to death. Successful weaning, however, does not guarantee long-term survival. Most patients with severe chronic diseases have comorbid disorders, residual organic dysfunction, and other concurrent complications. The mortality rate of these patients varies between 20 and 49%.[22,23] There results are consistent with the findings in our study: 23.1% of the patients in our sample died in the ICU, and 46.1% of the patients died during their hospitalization.

Our study has two strengths. There have been few studies published on our reported topic. Furthermore, we are investigating chronic critical care patients who are dependent on MV, which is a population that is rapidly increasing in number. However, our sample size is restricted. In addition, the data that we collected is retrospectively derived from incomplete medical records.

Any mechanical ventilator developed for invasive or noninvasive ventilation may be used in practice, unless it leaks.[22] NIV devices contain a single circuit and a distal orifice designed to minimize CO_2 re-inhalation during inspiration. We applied this specific NIV device to our chronic critical patients because of these characteristics. We hoped to facilitate the transfer of these patients to the wards under this type of support because the hospital at which the study was conducted did not have an intermediate care unit. Further, we aimed to encourage the patient's relatives to participate in the patient's care.

Similarly, Nava and Hill[12] observed that one of the main advantages of using NIV is that patients who are not at risk of death may be safely managed outside of the ICU. For this advantage to be practical, the healthcare teams in the hospital wards must be adequately trained. The hospital at which this study was conducted successfully implemented this idea. The participants were put on ventilators equipped with alarms and previously adjusted parameters. Physiotherapeutic care was provided every day (three sessions per day). In addition, there was a fast response team that was ready to assist the patients in less than two minutes in case of emergency.

The results of the present study suggest that the ventilation strategy that we implemented facilitates weaning and ICU discharge in chronic critical patients and for patients requiring skilled assistance. Nevertheless, we will need to examine a larger patient sample over a longitudinal period to assess the significant predictors of ICU discharge.

CONCLUSION

NIV devices may be used to facilitate ventilation withdrawal and ICU discharge in tracheotomized patients with prolonged ventilator weaning.

RESUMO

Objetivo: Avaliar a utilização de equipamentos para realização de ventilação não invasiva em pacientes crônicos traqueostomizados com desmame prolongado.

Métodos: Estudo observacional retrospectivo, por meio de levantamento de dados de prontuários, em pacientes traqueostomizados com diagnóstico de desmame prolongado, os quais estiveram internados na unidade de terapia intensiva para adultos do Hospital Moinhos de Vento, em Porto Alegre (RS), no período de dezembro de 2007 a dezembro de 2008.

Resultados: Durante o período pré-estabelecido para a coleta dos dados, 1.482 pacientes estiveram internados na unidade de terapia intensiva. Destes, 126 pacientes foram traqueostomizados e 26 preencheram os critérios de inclusão no estudo. A média idade dos pacientes foi de 73 ± 12 anos, 57,7% eram do gênero feminino e 80,8% dos casos internaram por insuficiência respiratória aguda hipoxêmica. Após a realização de traqueostomia, os pacientes permaneceram, em média, 29,8 dias ainda em ventilação mecânica e, após o início do protocolo nos traqueostomizados, 53,5 dias em ventilação com ventilador portátil de ventilação não invasiva na traquestomia até a alta, desmame da ventilação não invasiva ou óbito durante a internação na unidade de terapia intensiva ou no hospital. De todos os pacientes protocolados, 76,9% (20/26) receberam alta da unidade de terapia intensiva e 53,8% (14/26) alta hospitalar.

Conclusão: A utilização de ventiladores portáteis utilizados para a realização de ventilação não invasiva conectados a traqueostomia pode ser uma alternativa para a descontinuação da ventilação e alta da unidade de terapia intensiva em pacientes traqueostomizados com desmame ventilatório prolongado.

Descritores: Traqueostomia; Desmame do respirador; Respiração artificial

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