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Literature review

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Evaluation of the use of non-invasive ventilation in the weaning of mechanical ventilation in adult patients – integrative review

Avaliação do uso de ventilação não-invasiva no desmame da ventilação mecânica em pacientes adultos – revisão integrativa

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RESUMO | INTRODUÇÃO: Pacientes com quadro de insuficiência respiratória aguda ou crônica necessitam de suporte através da Ventilação Mecânica Invasiva (VMI), após a correção do evento que levou o paciente a necessitar de VMI é iniciado o processo de desmame, definido como a transição da ventilação artificial para a espontânea. A Ventilação Não-Invasiva (VNI) tem-se mostrado eficiente no processo de desmame, otimizando o processo de transição e evitando a reintubação. **OBJETIVO:** Avaliar o uso da VNI no processo de desmame da VMI em pacientes adultos. **MÉTODOS:** Revisão integrativa, o levantamento de pesquisas indexadas se deu nos meses de março a maio de 2018, através do acesso as bases de dados: PubMed/MEDLINE, SciELO e LILACS, utilizando os descritores: *weaning mechanical ventilation* e *ventilator weaning*, *non-invasive*, *non-invasive ventilation*, *continuous positive airway pressure*, *CPAP ventilation*, *bilevel continuous positive airway pressure*, *intervention studies* e *clinical trials*, *extubation*, *extubation failure*, *reintubation*, *reintubation failure* e *weaning*. Os descritores foram utilizados de maneira individual e cruzada. **RESULTADOS:** Um total de 123 artigos foram encontrados com a busca nas bases de dados, 60 artigos foram excluídos após a leitura dos resumos por não se enquadrarem nos critérios de inclusão do estudo, 63 artigos foram lidos na íntegra, de onde 10 foram eleitos para integrar esta revisão integrativa. **CONCLUSÃO:** A VNI é uma terapêutica que se mostrou viável em alguns estudos para reduzir os riscos de reintubação em pacientes com diversidade diagnóstica que apresentaram insuficiência respiratória aguda após a extubação. Porém, esse resultado não foi unanimidade, o que dificulta sua recomendação.

PALAVRAS-CHAVE: Extubação. Desmame. Ventilação Não Invasiva. Prevenção.

ABSTRACT | INTRODUCTION: Patients with diagnosis of acute or chronic respiratory insufficiency need support through invasive mechanical ventilation (IMV), after the correction of the event that led the patient to need IMV, the weaning process is started , defined as the transition from artificial to spontaneous ventilation. Non-invasive ventilation (NIV) has been shown to be efficient in the weaning process, optimizing it and avoiding reintubation. **OBJECTIVE:** To evaluate the use of NIV in the weaning process of IMV in adult patients. **METHODS:** Integrative review, the survey of indexed researches was carried out from 2018 March to May, through the databases: PubMed/MEDLINE, Scielo and LILACS, using the descriptors: "weaning mechanical ventilation" and "ventilator weaning", "noninvasive", "non-invasive ventilation", "continuous positive airway pressure", "CPAP ventilation", "bilevel continuous positive airway pressure", "intervention studies" and "clinical trials", "extubation", "extubation failure", "reintubation", "reintubation failure" and "weaning". The descriptors were used individually and cross-checked. **RESULTS:** A total of 123 articles were found with the search in the databases, 60 articles were excluded after reading the abstracts because they did not fit the inclusion criteria of the study, 63 articles were read in full, from where 10 were elected to integrate this integrative review. **CONCLUSION:** NIV is a therapy that has proven feasible in some studies to reduce the risk of reintubation in patients with diagnostic diversity who presented acute respiratory failure after extubation. However, this result was not unanimous, which hinders its recommendation.

KEYWORDS: Airway extubation. Weaning. Noninvasive ventilation. Prevention and control.

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Introduction

Patients with severe acute or chronic respiratory failure are indicated for artificial ventilatory support through mechanical ventilation (MV), aiming at the maintenance of gas exchange, hypoxemia correction and respiratory acidosis associated with hypercapnia, promoting rest for the respiratory musculature[1]. The ventilatory support provided by the MV is classified as: Invasive Mechanical Ventilation (IMV) and Non-Invasive Ventilation (NIV). The first one offers ventilatory support through oro or nasotracheal tube, while the second modality uses a mask as an interface between the patient and the artificial ventilator[2].

IMV is the most efficient way to promote adequate oxygenation in patients with acute respiratory failure (ARF); however, an extended stay in IMV can cause damage to patients, such as ventilator-induced lung injury (VILI), ventilator-associated pneumonia (VAP), increased length of stay in the Intensive Care Unit (ICU) and increased mortality rates[3].

In order to avoid the installation of consequences of prolonged MV time, the patient should be adequately monitored to identify the appropriate time for withdrawal of ventilatory support[4]. The weaning process of MV is defined as the transition period of artificial ventilation to spontaneous in patients who remained in IMV for a time greater than 24 hours. MV weaning begins when the patient presents improvement in the condition that led to artificial ventilatory support. In addition, the patient should have hemodynamic stability, absence of signs of myocardial ischemia, heart failure, decompensated coronary insufficiency or arrhythmias with hemodynamic repercussion and adequate gas exchange[5].

The weaning process of MV performed early helps to improve the patient's condition, reducing the occurrence of VAP and the performance of a tracheostomy. When success occurs in the weaning process, patients tolerate spontaneous breathing tests satisfactorily, removal of the ventilatory prosthesis, or extubation of the orotracheal tube, is indicated. Success at weaning is achieved after the patient stay 48 hours in spontaneous breathing, without the need to return to MV[6]. Optimization of extubation time is a way to reduce ICU mortality, not prolonging the time of permanence in the MV, however, early extubation, when the patient haven't adequate conditions to be extubated, is inappropriate and harmful. The reintubation or failure of extubation is the need to reinstitute the artificial area via[3,4].

To aid the weaning process of the MV as well as the extubation of the patients, NIV has been shown to be an efficient alternative therapy. NIV is useful for reducing IMV time in patients with recurrent weaning failures, decreasing the risk of acquiring nosocomial infections and length of stay in the ICU[1,7]. NIV has been used to reduce the need for orotracheal intubation in patients with exacerbation of chronic obstructive pulmonary disease (COPD), acute pulmonary edema (APE), immunosuppressed patients and patients with neuromuscular diseases[8].

In the weaning process, some patients develop respiratory insufficiency after extubation, increasing morbidity and mortality rates, prolonging ICU stay, in some cases requiring reintubation, these patients could benefit from NIV[9]. Some studies have shown the benefits of NIV in the weaning process of MV, patients with the most varied clinical conditions that present difficulty in weaning MV and postoperative patients. However, there is still a lack of clarity regarding the appropriate time of institution, as well as the parameters of the NIV[1,6,10]. In view of the above, the article aimed to evaluate the use of NIV in the weaning process of MV in adult patients.

Methods

This study is an integrative review of the literature, which aims to contribute to the discussions about methods and results as well as reflections for the conduct of new researches[11]. Thus, the guiding question of the research consisted of: Is it beneficial to use NIV in the process of weaning the MV? The survey of indexed researches was carried out in the months from March to May 2018, through access to databases: PubMed / MEDLINE, SciELO and LILACS.

The PICO strategy was used research question construction and bibliographical search[12]. The key terms of the research were established through

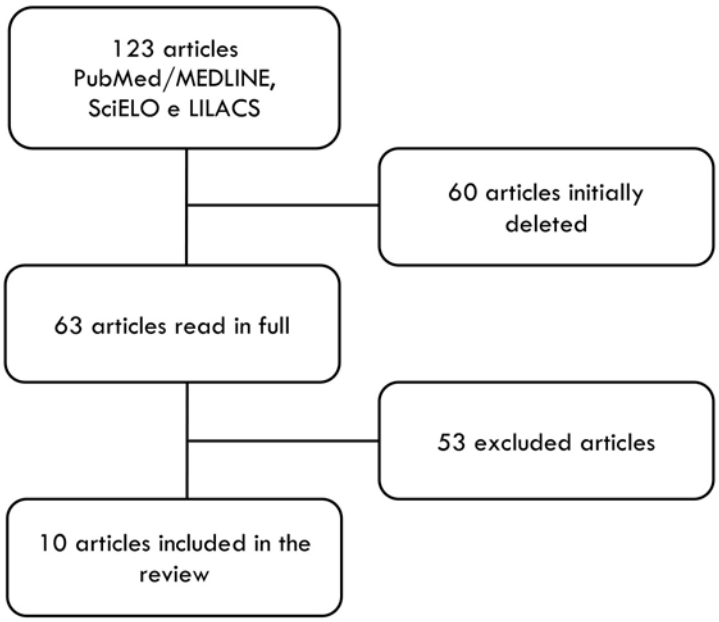
PICO strategy variables, defined as: Population / Patient / Problem - P: IMV weaning; Interest - I: NIV; Context - C: use of NIV in the IMV weaning process; Outcome - O: success or failure in the weaning process. After this step, the descriptors and keywords related to the terms of the PICO strategy were identified. The term P covered the descriptors "weaning mechanical ventilation" and "ventilator weaning"; I covered the descriptors "non-invasive", "non-invasive ventilation", "continuous positive airway pressure", "CPAP ventilation", "bilevel continuous positive airway pressure"; the term C the descriptors "intervention studies" and "clinical trials"; and the term O "extubation", "extubation failure", "reintubation", "reintubation failure", and "weaning". The search was performed with the descriptors used individually and crossed.

The inclusion criteria were articles with complete texts available and related to the referent search, clinical trials in which the patients were submitted to NIV during the weaning process, Studies in Portuguese and / or English, studies included in the last ten years (2008 to 2018). The non-inclusion criteria adopted were review articles, duplicates, dissertations and / or theses. The articles were analyzed both in their content and in the theoretical reference, in order to cover the universe of interest's subject and to facilitate the access potentially usable articles.

Results

A total of 123 articles were found with the search in the databases, these had their summaries read and initially 60 articles were excluded because they did not fit the inclusion criteria of the study, 13 were duplicated and 47 did not clearly describe the use of NIV, and some used it before the intubation procedure. 63 articles were read in full, of these 10 were elected to integrate this integrative review. Figure n° 01 exemplifies the search strategy.

Figure 1. Search strategy adopted for research on the use of NIV in the weaning process of VM, 2008 - 2018



Charts 1 and 2 summarize the studies included in the sample.

Chart 1. Studies that address the use of Non-Invasive Ventilation in the weaning process of Mechanical Ventilation regarding the objectives and sample, 2008-2018 (to be continued)

Author/year	Title	Objective	Sample
Trevisan et al., 2008 [13]	Noninvasive mechanical ventilation may be useful in treating patients who fail weaning from invasive mechanical ventilation: a randomized clinical trial.	To evaluate the use of non-invasive positive pressure ventilation of two levels in patients who had failed mechanical ventilation weaning.	156 ICU patients who were in the process of weaning the MV. 91 were satisfactorily extubated and 65 failed in the spontaneous breathing test with the T-tube.
Girault et al., 2011 [14]	Noninvasive ventilation and weaning in patients with chronic hypercapnic respiratory failure.	To investigate the effectiveness of NIV in the weaning and extubation process of MV in patients with ARF. To assess the potential for recovery of NIV when post-extubation ARF occurs.	208 patients who failed the weaning process and who presented clinical stability were included in the study. 69 were included in the typical MV weaning group, 70 in the oxygen therapy group and 69 in the NIV group.
Su et al., 2012 [15]	Preventive use of noninvasive ventilation after extubation: a prospective, multicenter randomized controlled trial.	To evaluate the preventive function of the post-extubation NIV and the reduction of the reintubation index.	406 patients from 3 Taiwanese hospitals who were in MV for at least 48 hours. 202 patients were included in the NIV group.
Ornico et al., 2013 [16]	Noninvasive ventilation immediately after extubation improves weaning outcome after acute respiratory failure: a randomized controlled trial.	It compares the effectiveness of NIV with the oxygen mask in preventing reintubation of patients who remained for more than 72 hours in the MV.	162 patients who required MV for more than 3 days were evaluated and 40 met the inclusion criteria. 20 patients received NIV immediately after extubation and completed the study. 20 patients received oxygen therapy after weaning, 18 of these completed the study.
Preisig et al., 2014 [17]	Ventilação não invasiva após cirurgia cardiovascular: um ensaio clínico randomizado.	To evaluate gas exchange and hemodynamic changes of hypoxemic patients submitted to NIV in the immediate postoperative period of cardiovascular surgery.	Patients aged 18-80 years in MV in the postoperative period of cardiovascular surgery (valve replacement, correction of thoracic aortic aneurysm and / or myocardial revascularization) who were weaned from MV in PSV mode. 102 initially eligible patients, only 42 presented oxygenation index between 300 and 150 and were included in the study.
Yamauchi et al., 2015 [18]	Ventilação não invasiva com pressão positiva pós-extubação: características e desfechos na prática clínica.	To describe the use of noninvasive post-extubation positive pressure ventilation in ICU clinical practice and to identify associated factors with the failure of its use after extubation.	Initially, 407 adult patients admitted to the ICU who had NIV by positive pressure after extubation were evaluated, after exclusion of 15 patients due to lack of data, 392 patients composed the sample.

Chart 1. Studies that address the use of Non-Invasive Ventilation in the weaning process of Mechanical Ventilation regarding the objectives and sample, 2008-2018 (conclusion)

Author/year	Title	Objective	Sample
Adiyeke et al., 2016 [19]	Ventilação não invasiva após o desmame bem-sucedido: uma comparação com a máscara de Venturi.	To determine if prophylactic NIV applied to patients who were extubated according to standardized weaning criteria and who were in appropriate conditions to proceed with Venturi mask would make some difference in terms of insufficiency after extubation, reintubation, ICU length of stay and mortality .	62 adult patients hospitalized in the ICU with ARF and who remained for more than 48 hours in the MV.
Sancho et al., 2016 [20]	Noninvasive ventilation during the weaning process in chronically critically ill patients.	To determine the profile of NIV use during the weaning process of MV of critically ill patients with prolonged MV time and whether clinical or functional parameters can predict the use of NIV.	40 critically ill patients with MV prolongation received NIV to assist in the weaning process of MV.
Duan et al., 2016 [21]	Noninvasive ventilation for avoidance of reintubation in patients with various cough strength.	To determine if the use of NIV prophylactically is beneficial for patients with varying degrees of coughing strength.	356 patients who had successful weaning of the MV.
Thille et al., 2016 [22]	Easily identified at-risk patients for extubation failure may benefit from noninvasive ventilation: a prospective before-after study.	To assess the risk of reintubation seven days after extubation in patients at high risk of post-extubation ARF after implementation of a specific program of NIV use prophylactically.	132 patients in the control group; 225 patients in the intervention group.

Chart 2. Categorization of the studies that address the use of Noninvasive Ventilation in the weaning process of Mechanical Ventilation in methods and conclusions, 2008-2018 (to be continued)

Author/year	Methods	Results	Conclusions
Trevisan et al., 2008 [13]	Following the extubation criteria, 28 patients were allocated to the noninvasive positive pressure ventilation group 37 patients in IMV. Immediately after extubation the participants of the experimental group were submitted to NIV with two pressure levels, monitoring clinical and respiratory parameters.	Both groups presented similar clinical characteristics, although the NIV group presented a more advanced age. There were no differences between the groups for cardiorespiratory parameters, O_2 saturation and length of stay in the ICU, although the NIV group presented a reduction in IMV time.	It is suggested that the combination of early extubation and NIV is a good alternative for a heterogeneous group of patients who initially had failed the weaning process. Significant reduction in the incidence of pneumonia and the need for tracheostomy.
Girault et al., 2011 [14]	Patients of 13 ICUs during a 5-year period who presented chronic hypercapnic respiratory insufficiency and at least 48 h of intubation in MV were evaluated for the spontaneous breathing test after presenting the clinical parameters for weaning of the MV.	There were no significant differences in the clinical characteristics of the groups, the probability of reintubation was not significantly different between the three weaning strategies. NIV significantly reduced the incidence of post-extubation ARF.	NIV used early in difficult weaning in patients with chronic hypercapnic respiratory failure did not reduce the reintubation rate within 7 days compared to oxygen therapy and conventional weaning. However, NIV may improve the risk of post-extubation ARF.
Su et al., 2012 [15]	Patients who met the weaning criteria and spent 2 hours on the spontaneous breathing test in the T-tube were randomly randomized to the control and NIV groups. Daily Maximum Inspiratory Pressure (MIP), Minute Volume (MV), Current Volume (CV), Respiratory Rate (RR), Rapid Shallow Breathing Index (RSBI) are measured daily. If the patient met the minimum criteria, the weaning of the MV was conducted, otherwise they were reconnected to the ventilator.	The groups did not present significant differences for clinical characteristics, such as the APACHE II, MIP or RSBI score. The NIV group presented post-extubation ARF index similar to the control group, there was no difference in the RSBI of patients who presented extubation failure in the control and NIV groups. In patients who developed post-extubation ARF, NIV prevented reintubation by 30%.	The use of NIV did not reduce the rate of extubation failure and should not be routinely used after extubation. Patients with higher APACHE II score, lower MIP and higher RSBI before extubation were at greater risk for extubation failure.
Ornico et al., 2013 [16]	During 12 months, patients from an ICU of a University Hospital were evaluated, those who fulfilled the inclusion criteria were randomly assigned to two groups, one received NIV after MV weaning and another oxygen therapy. NIP was applied in BIPAP mode for 24 hours after weaning of the VM. Arterial blood gases were monitored 15 minutes, 2 h and 24 h after extubation in all patients.	The groups did not present differences regarding days of MV before extubation, APACHE II score and diseases that led to ARF. PaO2 and PaCO2 averages were higher 15 min after extubation in the NIV group, 8 patients were reintubated, 1 in the NIV group and 7 in the oxygen therapy group. There was no statistically significant difference for ICU stay in both groups. The mortality rate showed a statistically significant difference between the groups, and no death was observed in the NIV group and there were 4 deaths in the oxygen mask group.	NIV compared to oxygen mask prevented reintubation and decreased hospital mortality if performed immediately after elective extubation.

Chart 2. Categorization of the studies that address the use of Noninvasive Ventilation in the weaning process of Mechanical Ventilation in methods and conclusions, 2008-2018 (continuation)

Author/year	Methods	Results	Conclusions
Preisig et al., 2014 [17]	Patients in postoperative cardiovascular surgery after meeting the extubation criteria remained for one hour in a Venturi mask (FiO2 0,31) and those with an oxygenation index between 300 and 150 were divided into two groups. After randomization, those assigned to the control group remained with the Venturi mask (FiO2 0.4) and the intervention group received NIV by two pressure levels.	There were no sample losses, the patients in the intervention group had a significant improvement in the oxygenation index compared to the patients in the control group. There were no differences between groups for length of stay in the ICU and for length of hospital stay. Two patients died, one in each group.	The NIV applied for 3 consecutive hours improved the oxygenation of the immediate postoperative patients of cardiovascular surgery and the benefits were maintained even one hour after treatment discontinuation, however, no changes were observed in the clinical outcomes. Patients who used NIV did not present clinically important hemodynamic changes.
Yamauchi et al., 2015 [18]	Study carried out in 11 ICUs, totaling 140 beds, information collected from the analysis of medical records. Patients were divided into 2 groups, success or failure in the use of positive pressure NIV. Day and time of intubation, extubation and beginning of NIV were collected.	Patients who only used positive pressure NIV after extubation made up 44% of the sample. The post-extubation NIV was applied in three different events, due to a new acute respiratory event (26%), early weaning (10%), and preventive application of NIV (64%). 69% of patients received NIV on the same day after extubation. The NIV failure group had higher mean length of stay in the ICU and higher mortality rate.	Patients with positive inspiratory pressure in the airway ≥ 13 cmH2O had a three-fold increased risk of positive pressure NIV failure.
Adiyeke et al., 2016 [19]	Patients with APACHE score above 25 and Glasgow Coma Scale (GCS) less than 13 were excluded as well as those contraindicated for use of NIV. Patients under weaning conditions and those who underwent spontaneous breathing in the T-tube were extubated and received O2 support by the Venturi mask, after 1 h the patients were divided into two groups, one of the groups remained in the support O2 the other was assigned to receive NIV.	50 patients composed the sample. There were no differences between the groups regarding age, gender and APACHE score. 19 patients from the Venturi mask group developed ARF, while only 3 from the NIV group developed it. 14 Venturi mask patients received NIV after ARF.	Patients submitted to NIV after extubation had lower ARF rates and shorter ICU stay. The use of NIV may prevent reintubation.
Sancho et al., 2016 [20]	A multicenter study conducted in the ICU between December 2013 and December 2014. Patients who were on MV for more than 6 days and less than 21 days and who were unable to disconnect from the MV were directed to NIV therapy, success at weaning was considered when the patient did not need the ventilator, or when NIV was used overnight for a period of 7 days.	198 patients were successful at weaning VM with an average of 25 days. 40 patients required NIV during the weaning process of the MV. Statistical differences were found among patients who used NIV and those who did not, for the APACHE II score and the PaCO2 on admission. The group that used NIV had higher rates of obstructive sleep apnea, heart and renal failure.	For critically ill patients who presented a PaCO2> 45 mmHg after 24 in the spontaneous breathing test or who could not increase their stay in the spontaneous breathing test beyond 18 h, the use of NIV can be safely indicated for success in the weaning of the MV. Hypercapnia is the main predictor for the use of NIV.

Chart 2. Categorization of the studies that address the use of Noninvasive Ventilation in the weaning process of Mechanical Ventilation in methods and conclusions, 2008-2018 (conclusion)

Author/year	Methods	Results	Conclusions
Duan et al., 2016 [21]	Patients who were successful in the spontaneous breathing test, over 18 years of age and without tracheostomy were	The mean cough value by Peak Flow was 70 L / min. The proportion of patients receiving NIV was 60% over those with a Peak Flow cough	The use of NIV in a prophylactic and beneficial way for patients with weak cough
	included. The cough was evaluated through the Peak Flow and a portable spirometer. After extubation the doctor decided whether the patient would receive NIV or conventional oxygen therapy.	≤ 70 L / min and 40% for those with> 70 L / min. In patients with Peak Flow ≤ 70 L / min NIV reduced reintubation up to 72 h after extubation. In patients with Peak Flow> 70 L / min, the use of NIV did not reduce reintubation.	with or without COPD, but not for patients with a good cough.
Thille et al., 2016 [22]	Patients who met extubation criteria were directed to two groups, those receiving NIV and those using the T-tube.	All patients were extubated, 61 of whom required reintubation. ARF was the main cause of reintubation and the mortality of patients requiring reintubation was 51%. 150 patients presented a high risk for reintubation.	NIV used prophylactically shortly after extubation may reduce reintubation rates in a population presenting a high risk for reintubation.

Discussion

Strategies that assist in the weaning of MV and reinstitution of effective spontaneous breathing are of paramount importance, in this context NIV has been used to reduce MV time and in patients who present ARF after extubation. The release of IMV involves the discontinuation of the artificial ventilator and removal of the ventilatory prosthesis, the decision of the exact moment in which the patient can be discontinued from IMV is crucial, since both the delay and the prolongation of the MV time are directly related to the appearance of adverse effects and increased mortality[24].

Trevisan et al.[13] evaluated the use of NIV in patients who presented failures in the weaning process and concluded that NIV reduces the incidence of VAP and the need for tracheostomy in patients. The results of Girault et al.[14] demonstrated that NIV did not reduce reintubation rate within 7 days, compared to conventional weaning oxygen therapy, but NIV reduced the risk of post-extubation ARF. The studies evaluated different, but significant, outcomes.

NIV presents level of evidence A for the treatment of clinical conditions such as APE and COPD, however, its use in the weaning process of the MV lacks further evidence. A series of cases evaluated the use of NIV after extubation in 18 patients, with neuromuscular disease and clinical pneumonia (PNM), who were in IMV for a period exceeding 24h. Patients who had failed conventional weaning were directed to receive NIV after extubation, the authors concluded that NIV helps in the weaning process of MV in patients with neuromuscular disease and reduces the risk of reintubation[25]. One of the discussed points in the articles selected in the sample of the present review is the diagnostic variety of patients under MV and the difficulty in standardizing the use of NIV in the weaning process of the MV[13,15,19]. All studies chose similar parameters to choose patients at weaning, such as resolution or improvement of the cause of ARF, minute volume ≤ 10 - 15 L / min, Positive End-Expiratory Pressure (PEEP) ≤ 5 - 8 cmH_2O, Inspired Oxygen Fraction (FiO_2) ≤ 0.4, partial pressure of oxygen / fraction of inspired oxygen (PaO_2 / FiO_2)> 150 mmHg, pH> 7.25, preserved respiratory mechanics and hemodynamic stability with low doses of vasoactive drugs[26]. The NIV modality used in most studies had two pressure levels and parameters such as PaO_2, PaO_2 / FiO_2, FiO_2, pH and blood pressure were constantly monitored during the application of NIV, the changes were evaluated and interpreted as success or failure in the application of NIV[14,18].

The researches of Su et al.[15] and Ornico et al.[16] evaluated the use of NIV in the prevention of reintubation of patients in the weaning process of MV, with divergent conclusions. While the first study did not find favorable results for the use of NIV after extubation, the second one demonstrated that

NIV prevented reintubation and decreased hospital mortality. Adiyeke et al.[19] in his study found results similar to those of Ornico et al.[16], where patients submitted to NIV after extubation had lower ARI rates and shorter ICU stay, and also affirmed that the use of NIV may prevent reintubation. However, these results should be observed using the methodologies adopted in each study.

The use of NIV is beneficial under clinical conditions and its use is discussed after extubation in the weaning process[5,9]. A systematic review[27] discussed the weaning process of NIV, this is often performed after clinical improvement and stabilization of heart and respiratory rate, as well as the analysis of complementary tests. The authors concluded that there is a paucity of studies reporting weaning protocols of NIV in hospitalized and elderly patients, with a large variation in how weaning progression, due to the heterogeneity of the protocols used it is not possible to make recommendations on the implementation of weaning protocols of the NIV.

Yamauchi et al.[18] and Sancho et al.[20] sought to describe the use of NIV and determine its use after extubation, the first used information collected from medical records and the second performed a multicenter prospective study. Both studies have shown that the use of NIV reduces the chances of reintubation and reduces the rates of ARF after extubation. A survey conducted at a public hospital in Fortaleza-CE sought to identify the main weaning strategies of the MV, 77% of the volunteers presented weaned as easy from the MV and the most used modality to perform the weaning was the PSV mode, the authors concluded that the assessment of respiratory muscle strength, the spontaneous breathing test and the Tobin Index contributed to optimize weaning and extubation. The study, however, does not mention the use of NIV to aid the weaning process of the MV[28].

An observational cohort study conducted at a university hospital in France evaluated the rates and predictive factors of NIV failure in ICU patients with ARF, the major implications of the study are to identify hypoxemic patients who may benefit from NIV and that this can be used as the first treatment in patients with mild acute respiratory distress syndrome (ARDS). A randomized cohort study conducted in eight countries with patients who after 48 hours of MV were extubated and had post-extubation ARF assessed the effects of NIV on the mortality of these patients, the NIV treated group had a higher mortality rate and a mean time for reintubation. These findings led the authors to conclude that NIV does not prevent reintubation and does not reduce mortality[30]. The study presented limitations such as the non-availability of articles in full and the non-return of some authors with information about the manuscripts for inclusion in this review.

Conclusion

NIV is a therapy that has proven to be feasible in some studies to reduce the risk of reintubation in patients with diagnostic diversity who presented ARF after extubation. However, this result was not unanimous, which hinders its recommendation. Clinical trials with inclusion criteria and more unique outcomes are required so that the analysis of NIV to facilitate the weaning process of the MV be concluded with effectiveness and whether its use in this condition is recommended or not. The study presented limitations such as the non-availability of articles in full and the non-return of some authors with information about the manuscripts for inclusion in this review.

Author contributions

Nascimento ALS and Silva JCA participated in the conception of the study, research in the databases, writing and review of the article. Da Silva LN and Rocha LPB participated in the critical review of the article. Mendonça AC and Matos DFA participated in the search in the databases and article writing.

Competing interests

No financial, legal or political competing interests with third parties (government, commercial, private foundation, etc.) were disclosed for any aspect of the submitted work (including but not limited to grants, data monitoring board, study design, manuscript preparation, statistical analysis, etc.).

References

1. Suzuki T, Kurazumi T, Toyonaga S, Masuda Y, Morita Y, Masuda J et al. Evaluation of nonivasive positive pressure ventilation after extubation from moderate positive end-expiratory pressure level in patients undergoing cardiovascular surgery: a prospective observational study. J Intensive Care. 2014;2(1):5. doi: 10.1186/2052-0492-2-5

2. Carvalho CRR, Toufen Junior C, Franca SA. Ventilação mecânica: princípios, análise gráfica e modalidades ventilatórias. J Bras Pneumol, 2007; 33(supl 2):54-70. doi: 10.1590/S1806-37132007000800002

3. Lopes JCS, Jesus PNLG, Machado TO, Reis HFC. Preditores de falha de extubação em unidade de terapia internsiva: uma revisão de literatura. Rev Pesqui Fisioter. 2016;6(2):179-188. doi: 10.17267/2238-2704rpf.v6i2.889

4. Gulini JHMB, Gazola NLG, Bonorino KC, Brascher CT. Critérios associados ao sucesso e insucesso do desmame da ventilação mecânica. Fisioter Bras. 2012;13(4):282-287.

5. Goldwasser R, Farias A, Freitas EEF, Saddy F, Amado V, Okamoto V. Desmame e interrupção da ventilação mecânica. J Bras Pneumol. 2007;33(supl 2):128-136. doi: 10.1590/S1806-37132007000800008

6. Silva MA, Silva VZM. Desmame da ventilação mecânica. Rev Eletrônica Saúde e Ciência, 2015;5(1):52-62.

7. Ferreira S, Nogueira C, Conde S, Taveira N. Ventilação não invasiva. Rev Port Pneumol. 2009;15(4):655-667.

8. Rahal L, Garrido AG, Cruz Jr RJ. Ventilação não-invasiva: quando utilizar? Rev Assoc Med Bras. 2005;51(5):241-55. doi: 10.1590/S0104-42302005000500007

9. Ou J, Chen H, Li L, Zhao L, Nie N. The role of non-invasive ventilation use immediately after planned extubation for adults with chronic respiratory disorders. Saudi Med J. 2018;39(2):131-136. doi: 10.15537/smj.2018.2.21942

10. Glossop AJ, Shepherd N, Bryden DC, Mills GH. Non-invasise ventilation for weaning, avoiding reintubation after extubation and in the postoperative period: a meta-analysis. Br J Anaesth. 2012;109(3):305-14. doi: 10.1093/bja/aes270

11. Botelho LLR, Cunha CCA, Macedo M. O método da revisão integrativa nos estudos organizacionais. Gestão e Sociedade 2011;5(11):121-36. doi: 10.21171/ges.v5i11.1220

12. Santos CMC, Pimenta CAM, Nobre MRC. A estratégia PICO para construção da pergunta de pesquisa e busca de evidências. Rev Latino-am Enfermagem. 2007;15(3).

13. Trevisan CE, Vieira SR. Noninvasive mechanical ventilation may be useful in treating patients who fail weaning from invasive mechanical ventilation: a randomized clinical trial. Crit Care. 2008;12(2):R51. doi: 10.1186/cc6870

14. Girault C, Bubenheim M, Abroug F, Diehl JL, Elatrous S, Beuret P et al. Noninvasive ventilation and weaning in patients with chronic hypercapnic respiratory failure. Am J Respir Crit Care Med. 2011;184(6):672-679. doi: 10.1164/rccm.201101-0035OC

15. Su CL, Chiang LL, Yang SH, Lin HI, Cheng KC, Huang YCT et al. Preventive use of noninvasive ventilation after extubation: a prospective, multicenter randomized controlled trial. Respir Care. 2012;57(2):204-210. doi: 10.4187/respcare.01141

16. Ornico SR, Lobo SM, Sanches HS, Deberaldini M, Tófoli LT, Vidal AM et al. Noninvasive ventilation immediately after extubation improves weaning outcome after acute respiratory failure: a randomized controlled trial. Crit Care. 2013;17(2):R39. doi: 10.1186/cc12549

17. Preisig A, Lagni VB, Almeida VL, Vieira FN, Lucio EA, Santos LJ at al. Ventilação não invasiva após cirurgia cardiovascular: um ensaio clínico randomizado. Rev Bras Cardiol, 2014;27(1):43-52.

18. Yamauchi LY, Figueiroa M, Silveira LTY, Travaglia TCF, Bernardes S, Fu C. Ventilação não invasiva com pressão positiva pós-extubação: características e desfechos na prática clínica. Rev Bras Tera Intensiva. 2015;27(3):252-259. doi: 10.5935/0103-507X.20150046

19. Adiyeke E, Ozgultekin A, Turan G, Iskender A, Canpolat G, Pektas A et al. Ventilação não invasiva após o desmame bem-sucedido: uma comparação com a máscara de venturi. Rev Bras Anestesiol. 2016;66(6):572-576. doi: 10.1016/j.bjan.2014.11.006

20. Sancho J, Servera E, Jara-Polamares L, Barrot E, Sanchez-Oro-Gómez R, Terreros FJG et al. Noninvasive ventilation during the weaning process in chronically critically ill patients. ERJ Open Res. 2016;2(4):00061-2016. doi: 10.1183/23120541.00061-2016

21. Duan J, Han X, Huang S, Bai L. Noninvasive ventilation for avoidance of reintubation in patients with various cough strength. Crit Care. 2016;20(1):316. doi: 10.1186/s13054-016-1493-0

22. Thille AW, Boissier F, Ben-Ghezala H, Razazi K, Mekontso-Dessap A, Brun-Buisson C et al. Easily identified at-risk patients for extubation failure may benefit from noninvasive ventilation: a prospective before-after study. Crit Care. 2016;20:48. doi: 10.1186/s13054-016-1228-2

23. Epstein SK, Durbin CG. Should a patient be extubated and placed on noninvasive ventilation after failing a spontaneous breathing trial? Respir Care. 2010;55(2):198-206.

24. Reis HFC, Almeida MLO, Silva MF, Moreira JO, Rocha MS. Associação entre o índice de respiração rápida superficial e o sucesso da extubação em pacientes com traumatismos cranioencefálico. Rev Bras Ter Intensiva. 2013;25(3):212-217. doi: 10.5935/0103-507X.20130037

25. Kim SM, Kang SW, Choi YC, Park YG, Won YH. Successful extubation after weaning failure by noninvasive ventilation in patients with neuromuscular disease: case series. Ann Rehabil Med. 2017;41(3):450-455. doi: 10.5535/arm.2017.41.3.450

26. Shoji CY, Figuereido LC, Calixtre EM, Rodrigues CDA, Falcão ALE, Martins PP et al. Reintubação de pacientes submetidos à cirurgia cardíaca: uma análise prospectiva. Rev Bras Ter Intensiva. 2017;29(2):180-187. doi: 10.5935/0103-507X.20170028

27. Adam CT, Vieira CT, Aguiar SC, Bündchen D, Vieira DSR. Protocolos para desmame da ventilação mecânica não invasiva: uma revisão sistemática. Fisioter Pesqui. 2017;24(4):453-460. doi: 10.1590/1809-2950/17542224042017

28. Muniz YA, Braide ASG, Moraes MCS, Maciera CL, Brito MSR, Viana MCC. Estratégias de desmame da ventilação mecânica em uma unidade de terapia intensiva. ASSOBRAFIR Ciência. 2015;6(1):31-39.

29. Thille AW, Contou D, Fragnoli C, Córdoba-Izquierdo A, Boissier F, Brun-Buisson C. Non-invasive ventilation for acute hypoxemic respiratory failure: intubation rate and risk factors. Crit Care. 2013;17(6):R269. doi: 10.1186/cc13103

30. Esteban A, Frutos-Vivar F, Ferguson ND, Arabi Y, Apezteguía C, González M et al. Noninvasive positive-pressure ventilation for respiratory failure after extubation. N Engl J Med. 2004;350:2452-60. doi: 10.1056/NEJMoa032736