Weaning in ventilated patients in the intensive care unit of the "Joaquin Albarran" Hospital

Pérez-Verea Lits, Rodríguez Méndez-Ariadne, Carlos-Guillermo Pupo Rojas, Karen del Rosario Abreu Vázquez, Alcalde Mustelier Rafael, Fernández Méndez Amnerys

Pérez-Verea L, Rodríguez MA, Carlos-Guillermo PR, et al. Weaning in patients ventilated in the intensive care unit of the Joaquín Albarrán Hospital. 2018;2(1): 18-21.

ABSTRACT

INTRODUCTION: Necessity of mechanical ventilation is one of de most frequent cause of admission to the intensive care and mortality rate is still elevated for this reason.

OBJECTIVE: To identify some factors determine in a successful weaning.

METHODS: A prospective descriptive and longitudinal trial in the Joaquin Albarran hospital´s intensive care unit was carried out from January 2015 to June 2016. From 253 patients who needed mechanical ventilation were selected 70 of them in which was started the weaning process. It was created a database using SPSS and it was used the X^2 test to analyse relation between variables.

RESULTS: More than 80% of patients with a successful weaning had controlled the cause of beginning the mechanical ventilation (p=0,000), higher consciences level, they were not in sepsis (p=0,038), with adequate hemodynamic status, without acid-basic and electrolyte disturbance and adequate level of haemoglobin. Oxygen indexes more used were arterial oxygen pressure, PaO_2/FiO_2 index, and alveolus-arterial oxygen gradient) which were between normal records, in relation with a successful.

CONCLUSION: It was demonstrated that better general basic conditions and a Tobin's index less than 105, were related with a successful weaning.

Key Words: *Weaning; Prediction indexes; Hyperthermia; Ventilation*

Now-a-days, it is impossible to maintain a critical care patient's life without the use of mechanical ventilation. This replaces a patient's breathing for however long necessary until their own respiratory system is capable of breathing on its own, and allows for the exchange of gases which ensures proper oxygenation of tissues and avoids the retention of carbon dioxide (CO_2) (1).

Despite being an effective method for sustaining life, mechanical ventilation produces physiological changes in the respiratory system leading to the development of undesirable side effects, with hemodynamic and renal repercussion that make the management of the patient more complex. The need to establish and maintain an artificial airway results in complications for 18 to 80 percent of the patients undergoing this procedure, and often can increase mortality.

Because of this, physicians focus their efforts in removing the ventilation as soon as the patient is able to breathe on their own. The medical term for this is procedure is weaning. Withdrawal of mechanical ventilation can be done abruptly or gradually, once the cause of respiratory insufficiency is on the way of resolution.

Weaning of mechanical ventilation usually involves two separate but closely related aspects, the discontinuance of the mechanical ventilation and the removal of the artificial airway. Predicting when to remove respiratory assistance is the process of estimating the probability of success or failure of it and/or extubating a given patient at a given moment in time (1,2).

To improve predicting the success or failure of the weaning process, a series of multi-predictors variables were developed. Before weaning, one must confirm that the patient meets a series of conditions that will make withdrawal feasible (2,3).

1. Resolution or improvement of the cause of the respiratory failure;

2. Stopping sedative drugs and neuromuscular blockers;

3. Acceptable state of consciousness (arousable, Glasgow score ≥13 points);

4. Absence of severe sepsis or marked hyperthermia;

5. Hemodynamic stability (FC <130 lpm, stable blood pressure, without use of vasopressor drugs);

6. Absence of electrolyte or metabolic disturbances;

7. Adequate level of hemoglobin (≥ 8-10 g/dl);

8. No need to carry out surgical procedures under general anesthesia within 24-48 hours immediately following;

9. Adequate oxygenation;

10. Adequate ventilatory function.

Before starting the withdrawal trial, pulmonary gas exchange should be evaluated. The minimum PaO_2 required must be greater than or equal to 60 mmHg, FiO_2 less than or equal to 0.4, and PEEP less than or equal 5 cm H_2O. Other useful determining factors include, an alveolar-arterial oxygen difference ($A\text{-}aO_2$) less than 250 mmHg, or a PaO_2/FiO_2 greater than 200 (1-7).

Recently, combined indices have been proposed. Yang and Tobin proposed the rapid and shallow breathing index or relationship between respiratory rate and the tidal volume (f/VT) as the best predictor of withdrawal failure. Weaning takes please without great difficulties in more than 77% of the patients in a period around the first 72 hours; however, there is a group of 9 to 20% of patients who experience serious difficulties that require the use of different strategies for achieving this goal. This present a challenge to doctors who are forced to study pathophysiological factors of acute respiratory insufficiency and the use of a series of clinical and laboratory studies that have transformed the "art" of weaning to the "science of freedom". If we accept that the establishment of mechanical ventilation (MV) should be done precociously, this is the way we should approach weaning. It is not sensible to unnecessarily extend the period of respiratory support given the known complications linked to MV (4,5).

Oftentimes, the decision to wean is made empirically, starting with the doctor's experience, but more and more each day protocols are being used and validated for weaning, which has led to better results, lowered complications related to MV, and improved the stay in respiratory support units. When the literature is reviewed for this purpose, one can appreciate

Hospital Docente Clínico Quirúrgico, Joaquín Albarrán Domínguez. La Habana, Cuba

Correspondence: Dr Pérez Verea Lits, Joaquin Albarran Hospital, 3rd Avenue # 407, Beach, Havana, Cuba. Telephone 72028456, 53543002, e-mail litsperez@infomed.sld.cu

Received: April 20, 2018, Accepted: April 26, 2018, Published: April 30, 2018

the fact that in the last 25 years, many different prediction protocols have been studied with an attempt to identify when the best time to restart spontaneous ventilation is.

This reflects the importance and confusion that still lingers around this matter. None of these protocols have been powerful enough to predict in isolation, their use is limited, and require the clinical judgment of the doctor, even though the decision to stop ventilation support is not based on the doctor's experience, but in common sense. The prediction index measure whether a patient can or cannot be disconnected from MV according to results of a test (2-7).

Identifying the factors that influence the success or failure of weaning, which are reliable, reproducible, low cost and simple enough to be done on the next patient has been the motivation of numerous studies. The decision to wean a patient from mechanical ventilation requires a wide and accurate assessment by the medical team, and despite the patient' meeting all or most of the universally accepted requirements, success continues to be a challenge. This is why we embarked on this study, with the objective to identify factors that can influence such important process.

MATERIALS AND METHODS

An observational, analytical and prospective study was carried out in patients within the period from January 2015 to June 2016, in the intensive care unit of Dr. Joaquín Albarrán Hospital.

Of 253 patients, 70 were identified in whom it was possible to start the weaning process, and excluded those deceased before the weaning process was initiated.

The analyzed variables were: cause for mechanical ventilation, state of acceptable conscience (arousal, Glasgow score ≥ 13 points), absences of severe sepsis or marked hyperthermia, hemodynamic stability (FC < 130 bpm, stable blood pressure, no vasopressors), absence of electrolyte or metabolic disorder, suitable hemoglobin level (≥ 8-10 g/dl) and adequate oxygenation given by a minimum PaO_2 required greater than or equal to 60 mmHg, FiO_2 less than or equal to 0.4, and a PEEP equal to or less than 5 cm H_2O, an A-aO_2 less than 250 mmHg, or a PaO_2/FiO_2 greater than 200, and a rapid and shallow breathing index or relationship between respiratory rate and the tidal volume (f/VT) <105.

The dependent variable weaning is defined as: successful discontinuation in those cases in which the patient was able to ventilate spontaneously, without any support, for a period greater than or equal to 48 hours, without any of the following: anticipating having to stop trial of spontaneous breathing due to signs of respiratory failure and need to re-intubate in less than 48 hours, which it was considered failure.

The collected data was analyzed by the statistical processor SPSS version 18.0. The clinical history of the patients was used as the source of information.

Summary measures were determined for qualitative variables (number and percent) and the association was determined between some factors and the quality of weaning by calculating the statistic Chi square graph X2, in cases when variables or factors had a significant statistical association, the Odd Ratio test was performed.

All procedures were performed taking into account a type I error α=0.05 to guarantee reliability of 95% results. Ethical principles were strictly followed throughout the research, approval was granted by the institution, and its scientific advice was followed for the development and presentation.

No written informed consent was needed since the care received by patients in the study did not differ from the standard care offered in the service to those who required withdrawal of mechanical ventilation

RESULTS

Of the 253 patients who required mechanical ventilation and that were admitted into the intensive care unit of the Dr. Joaquín Albarrán Hospital during the period of study, weaning was started on 70 patients, with an average age of 58 years, with a minimum of 21 and maximum 91 years old. 55.7% were female. 84.3% were successfully weaned from ventilation, and 15.7% failed the weaning process. Of the 60 patients in which the underlying cause that prompted MV was fully controlled, 96.7% were successfully weaned from ventilation, indicating there is a statistical significant relationship between both variables, with a value of p = 0.000 (Table 1).

TABLE 1

Weaning and underlying cause for MV controlled

Controlled condition	Successful Weaning	Failed Weaning	Total
Yes	58	2	60
	96.70%	3.30%	100%
No	1	9	10
	10.00%	90%	100%
Total	59	11	70
	84.30%	15.70%	100%
(p=0.000)			

In the present study of the 64 patients with Glasgow score ≥ 13 points, 82.8% were successfully weaned from mechanical ventilation. (Table 2).

TABLE 2

Weaning and adequate level of arousal

Adequate level of arousal	Successful Weaning	Failed Weaning	Total
Yes	53	11	64
	82.80%	17.20%	100%
No	6	0	6
	100%	0%	100%
Total	59	11	70
	84.30%	15.70%	100%
(p=0.603)			

Of the 51 patients in whom there was evidence of sepsis at the time of weaning, 89.5% had a successful weaning, thereby indicating there is a statistically significant relationship amongst the variables (0.038). (Table 3).

TABLE 3

Weaning and absence of sepsis

Absence of sepsis	Successful Weaning	Failed Weaning	Total
Yes	51	6	57
	89.50%	10.50%	100%
No	8	5	13
	61.50%	38.50%	100%
Total	59	11	70
	84.30%	15.70%	100%
(p=0.038)			

Of the 70 patients studied, 100% were hemodynamically prior to initiating weaning; with 84.3% being successfully weaned (Table 4).

TABLE 4

Weaning and hemodynamic stability

Hemodynamically stable	Successful Weaning	Failed Weaning	Total
Yes	59	11	70
	84.30%	15.70%	100%
Total	59	11	70
	84.30%	15.70%	100%

In 39 of the studied patients, there were hemogasometric alterations and ionogram alternations, however, most were successfully weaned from mechanical ventilation, 90.3% and 61.5%, respectively. (Table 5).

TABLE 5
Weaning and electrolyte and pH imbalances

Absence of electrolyte and pH imbalances	Successful Weaning	Failed Weaning	Total
Yes	28	3	31
	90.30%	9.70%	100%
No	31	8	39
	61.50%	38.50%	100%
Total	59	11	70
	84.30%	15.70%	100%
(p=0.365)			

Adequate hemoglobin values guarantee an adequate level of oxygen transport to the cells and tissues. In 67 of patients studied, hemoglobin values were above 80 g/l, and successful weaning was achieved in 83.6% of them (Table 6).

TABLE 6
Weaning and adequate hemoglobin levels

Adequate hemoglobin values	Successful Weaning	Failed Weaning	Total
Yes	56	11	67
	83.60%	16.40%	100%
No	3	0	3
	100%	0%	100%
Total	59	11	70
	84.30%	15.70%	100%
(p=1.000)			

One of the basic respiratory conditions taken into account was oxygen pressure measured by gasometry, with appropriate values in 69 patients, with weaning successful in 84.1% of them (p = 1.000). The PO_2/FiO_2 ratio, oxygen transfer index is often used, in 64 patients said relationship was above 200 and 82.8% were successfully weaned from the ventilator (p = 0.603).

Another index to calculate is the difference in alveolar-arterial oxygen. 68 of the patients were below 250 mmHg and 83.8% were weaned successfully (p=1,000) (Table 7).

TABLE 7
Weaning and oxygen variables

Oxygenation		Successful Weaning		Failed Weaning		Total	
		#	%	#	%	#	%
PO_2	Adequate	58	83.2	11	15.9	69	100
	Below	1	100	0	0	1	100
PO_2/FiO_2	Adequate	53	82.8	11	17.2	64	100
	Below	6	100	0	0	6	100
$(A-a)O_2$	Adequate	57	83.8	11	17.2	68	100
	Below	2	100	0	0	2	100

Of the 68 patients who showed favorable rapid and shallow breathing, 83.4% were successfully weaned from the respirator and only in 17.2% weaning failed (Table 8).

DISCUSSION

This work found that in more than 80% of patients who are successfully weaned from mechanical ventilation, the underlying reason that led to mechanical ventilation was controlled. This was a fundamental premise to start weaning.

TABLE 8
Weaning and Tobin Index

Tobin Index	Successful Weaning	Failed Weaning	Total
Yes	57	11	68
	83.80%	17.20%	100%
No	2	0	2
	100%	0%	100%
Total	59	11	70
	84.30%	15.70%	100%
(p=1.000)			

In addition, they had a Glasgow ≥ 13 points, where the literature consulted states that patients with normal levels of arousal and that can tolerate a spontaneous breathing test of two hours can be extubated with a chances of success greater than 80% (1-6,8).

Hemodynamic stability is of great value, in terms of achieving adequate oxygen transport to tissues; and secondly because once spontaneous breathing is initiated, the O_2 consumption of the respiratory musculature increases and requires an adequate contribution to avoid muscular fatigue.

The use of amines to achieve the hemodynamic stability is not a contraindication to start weaning (9-17).

Of the oxygen transfer rates indexes, the ones used daily were selected evaluate said condition.

More than 80% of patients who are weaned successfully from the ventilator, had values within those generally accepted as appropriate internationally (1-3,9,10).

One of the most used indexes currently used to predict a successful or failed weaning is Yang and Tobin rapid shallow breathing index due to the relatively ease to measure. It has been determined that when your value is less than 105 resp/min/l, weaning is satisfactory in a high percentage of cases, according to some works it can amount to 83% high predictive value (1-3,10-18).

CONCLUSION

The study showed that in most patients in whom a successful weaning process was carried out, more than 50% had the cause which lead to mechanical ventilation controlled, and met basic general conditions favorably which enabled it, such as an adequate level of arousal, absence of sepsis, hemodynamic stability, absence of pH and electrolyte disorders, and adequate hemoglobin levels. Of the indexes of oxygenation most frequently used, oxygen pressure, PO_2/FiO_2 ratio, and alveolo-arterial oxygen; most patients were found to be within appropriate values that favored a successful weaning. The Tobin index served in a similar fashion.

CONFLICT OF INTEREST

None

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