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Comparison of International Consensus Conference guidelines and WIND classification for weaning from mechanical ventilation in Brazilian critically ill patients
A retrospective cohort study

Alessandra Fabiane Lago, PT, MS[a,b,*], Ada Clarice Gastaldi, PT, PhD[b], Amanda Alves Silva Mazzoni, PT[b], Vanessa Braz Tanaka, PT[b], Vivian Caroline Siansi, PT[b], Isabella Scutti Reis, MD[b], Anibal Basile-Filho, MD, PhD[c]

Abstract
The knowledge of weaning ventilation period is fundamental to understand the causes and consequences of prolonged weaning. In 2007, an International Consensus Conference (ICC) defined a classification of weaning used worldwide. However, a new definition and classification of weaning (WIND) were suggested in 2017. The objective of this study was to compare the incidence and clinical relevance of weaning according to ICC and WIND classification in an intensive care unit (ICU) and establish which of the classifications fit better for severely ill patients. This study was a retrospective cohort study in an ICU in a tertiary University Hospital. Patient data, such as population characteristics, mechanical ventilation (MV) duration, weaning classification, mortality, SAPS 3, and death probability, were obtained from a medical records database of all patients, who were admitted to ICU between January 2016 and July 2017. Three hundred twenty-seven mechanically ventilated patients were analyzed. Using the ICC classification, 82% of the patients could not be classified, while 10%, 5%, and 3% were allocated in simple, difficult, and prolonged weaning, respectively. When WIND was used, 11%, 6%, 26%, and 57% of the patients were classified into short, difficult, prolonged, and no weaning groups, respectively. Patients without classification were sicker than those that could be classified by ICC. Using WIND, an increase in death probability, MV days, and tracheostomy rate was observed according to weaning difficult. Our results were able to find the clinical relevance of WIND classification, mainly in prolonged, no weaning, and severely ill patients. All mechanically ill patients were classified, even those sicker with tracheostomy and those that could not finish weaning, thereby enabling comparisons among different ICUs. Finally, it seems that the new classification fits better in the ICU routine, especially for more severe and prolonged weaning patients.

Abbreviations: ARDS = acute respiratory distress syndrome, ICC = International Consensus Conference, ICU = intensive care unit, LOS = length of stay, MV = mechanical ventilation, SAPS 3 = simplified acute physiology score, SBT = spontaneous breathing trials, WIND = weaning according to a new definition.

Keywords: ICU setting, mechanical ventilation, outcome, weaning

1. Introduction

Mechanical ventilation (MV) is an important life support technique used worldwide in intensive care units (ICUs). It is indicated for patients who have pneumonia, postoperative acute respiratory failure, trauma, sepsis, chronic obstructive pulmonary disease, and acute respiratory distress syndrome.[1] Regardless of the reasons, weaning from MV should start as soon as possible when the patient's disease begins to stabilize and reverse,[2] and unnecessary delays can increase complications, such as prolonged ICU stay, oversedation, high mortality, and consequently increased costs.[3,4] Despite this, premature weaning from MV may occur and leads to loss of airway protection, aspiration, respiratory

fatigue, compromised gas exchange, and extubation failure.[5,6] It makes weaning process a period of great challenge for patients and clinicians, especially after long periods of MV.

In 2007, an International Consensus Conference (ICC) on weaning from MV proposed a patient classification into three groups (simple, difficult, and prolonged weaning) according to weaning duration and the necessary number of spontaneous breathing trials (SBTs) to achieve extubation success.[7] ICC only classifies patients who were submitted to SBT and were weaned successfully, while patients who underwent tracheostomy before the weaning process has been finished could not be categorized and analyzed. Also, a multicenter multinational prospective observational study, the Weaning according to New Definition (WIND) study, proposed a modification of ICC classification, suggesting four groups (no, short, difficult, and prolonged weaning). The weaning start point was defined as any withdrawal trial method from MV. Another point was a modification on the successful weaning criteria, such as extubation without death, reintubation within the next 7 days, ventilation without any MV during 7 days or discharge in cases of tracheostomy.[8]

ICC classification has been evaluated in different studies, but without results from prolonged weaning patients with extubation failure, while WIND has been evaluated only in ICUs with most patients with short weaning.[8,9] Thus, the objective of this study was to compare the incidence and clinical relevance of weaning according to ICC and WIND classification in an ICU and establish which classification fit better for an ICU with the majority of severely ill patients in prolonged and no weaning.

2. Methods

2.1. Study design and setting

A retrospective cohort study was conducted in an ICU in a Tertiary University Hospital.

2.2. Patients

All patients admitted to the ICU and requiring MV were enrolled.

2.3. Ethical and legal aspects

This study was approved by the Research Ethics Committee and clinical research unit of the Hospital das Clínicas da Faculdade de Medicina de Ribeirão Preto (Protocol CEP-HCRP 7076/2016).

2.4. Data collection

Patient data such as population characteristics, MV duration (days), weaning classification, mortality, SAPS 3, and death probability[10,11] were obtained from a medical and physiotherapy records database of all patients who were admitted at this ICU between January 2016 and July 2017.

2.5. Weaning classifications
2.5.1. ICC classification.

- Simple weaning: patients who obtained successful extubation on the first SBT.
- Difficult weaning: patients who required up to three SBT or up to 7 days from the first SBT to achieve successful weaning.
- Prolonged weaning: patients who failed at least three weaning attempts or required 7 days of weaning after the first SBT.[7]

2.5.2. WIND classification.

- Group no weaning: patients who never underwent any separation attempt from MV.
- Group 1 (short weaning): patients who ended the weaning process within 1 day after the first attempt.
- Group 2 (difficult weaning): patients who completed the weaning after more than 1 day and in <1 week after the first separation attempt.
- Group 3 (prolonged weaning): 3a - patients who achieved successful weaning at 7 days or more after the first attempt. 3b - patients who did not achieve success (with unsuccessful weaning).[8]

2.6. Statistical analysis

The data were presented as numbers and percentages for categorical variables and as mean and standard deviation for continuous variables. Continuous variables were compared using the Student t test and qualitative variables by the Fisher test. ANOVA with Bonferroni post-test was used for multiple comparisons of quantitative variables. In addition, P-values lower than .05 expressed evidence that at least one group differed from the others. The analyses were performed with the statistical software R Core Team (2016) (Foundation for Statistical Computing, Austria) and SAS Statistical Software (version 9.3; SAS Institute, Cary, NC). The sample size was performed by convenience sampling.

3. Results

During the study period, 327 mechanically ventilated patients were retrospectively studied, and their main characteristics are shown in Table 1. Patients were divided into simple, difficult, and prolonged weaning according to ICC definition and short, difficult, prolonged 3a and 3b, and no weaning according to WIND, shown in Figure 1.

The main characteristics of patients according to weaning classification and multiple comparisons within weaning groups are detailed in Table 2.

4. Discussion

This retrospective cohort study of Brazilian mechanically ventilated patients compared the incidence and clinical relevance of weaning according to ICC and WIND classification. The main findings of this study were that WIND application allowed classifying all patients, enabling comparisons among different ICUs. It differed from ICC classification, in which only 18% of the patients were classified. In addition, the second finding was that patients without classification were sicker than those classified by ICC and presented different weaning outcomes, all gathered in the without classification group. WIND allowed recognizing and classifying this population and identifying different strategies for weaning. Finally, the third main finding was that WIND application led to an increase of death probability, MV days, and the proportion of patients who underwent tracheostomy, according to weaning difficult.

In our study, only 18% could be classified by ICC. Other studies[3,4,12–15] have shown that the proportion of patients classified by ICC varied from 24% to 50%. It allowed classifying only successfully weaning patients that completed an SBT,

Table 1

Characteristics of patients.

Variables	Category	Number (%) or mean ± (SD)
Sex	Male	162 (49%)
	Female	165 (51%)
Admission type	Medical	196 (60%)
	Surgical	131 (40%)
Outcome	Discharge	154 (47%)
	Death	173 (53%)
Extubation	Yes	75 (22%)
	No	252 (78%)
ICC classification	Simple weaning	33 (10%)
	Difficult weaning	16 (5%)
	Prolonged weaning	9 (3%)
	Without classification	269 (82%)
WIND classification	Simple weaning G1	36 (11%)
	Difficult weaning G2	18 (6%)
	Prolonged weaning G3a	27 (7%)
	Prolonged weaning G3b	61 (20%)
	No weaning	188 (57%)
Age, y		56.09 (16.99)
SAPS 3		74.38 (18.64)
Death probability		63.62 (27.34)
Mechanical ventilation, days		10.60 (9.75)
Length of stay ICU, days		10.83 (9.31)

ICU = intensive care unit, SAPS = Simplified Acute Physiology Score.

intubated patients, and those that not receive non-invasive ventilation at 48 h after extubation.[7] It is different from WIND classification, in which was possible to classify all patients and consequently perform a comparison among different ICUs.

Previous epidemiology studies have demonstrated that most patients were classified as simple weaning, followed by difficult and prolonged weaning.[3,4,8,12–14] The same was observed in our study when ICC classification was applied, but the majority of patients were classified as no weaning and prolonged 3b weaning when using WIND. A high number of patients could not be

classified by ICC because more than half of all those mechanically ventilated never had any separation attempt from MV (57%).

This number is higher than that found in the study of Béduneau, who observed that about 25% of the patients never had a separation attempt. A plausible explanation for this high number of patients who never had any separation attempt could be related to our sample composed of severely ill patients, in which more than half of patients died. The study was conducted in a highly complex specialized hospital that receives critically ill patients from other tertiary hospitals. Thus, our patients already arrive with a severe condition. It is different from a previous cohort study on mechanically ventilated patients, which showed mortality in ICU of only 28% to 31%.[16]

Surveys have shown that 50% to 75% of mechanically ventilated patients could not be classified by ICC because most of them died before ready to wean, had tracheostomy or unplanned extubation.[3,4,12–15] However, tracheostomy and unplanned extubation are frequent events in ICUs. Many studies reported a high rate of unplanned extubation, varying from 2% to 22.5%.[17,18] In the United States, 34% of the patients who required MV received a tracheostomy,[19] being beneficial when it occurs early in some groups of patients.[20–22] In our study, 123 (38%) patients could not be classified by ICC due to a tracheostomy. Among tracheostomized patients, 12 had successful weaning, and 47 had no success, but with at least an opportunity to wean.

The second main finding demonstrated that patients without classification presented high mortality, SAPS 3 score, and death probability. Nevertheless, we could not recognize who these patients were when analyzing ICC only. Among them, there were extubated, others underwent a tracheostomy, some with weaning success and others that had a discharge from ICU with MV, or patients that never had any separation attempt from MV. It is crucial to note that patients with different outcomes were gathered in the without classification group. WIND allowed recognizing and classifying this population and identifying different strategies for weaning. Thus, it seems that the new classification fits better in the ICU routine with severe patients.
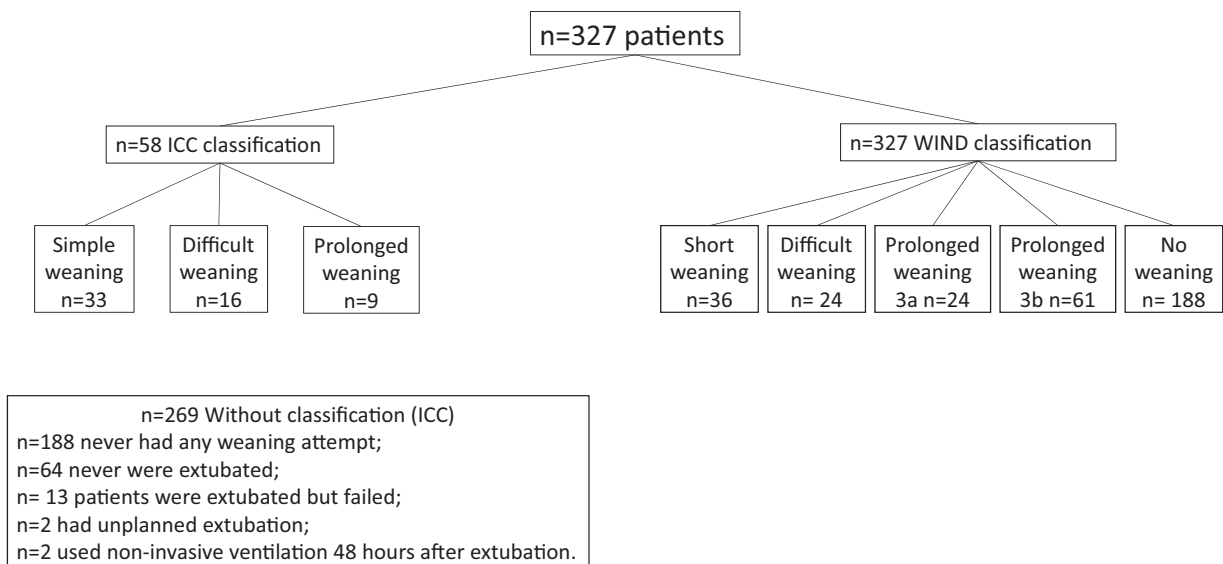

Figure 1. Number of participants according to WIND and ICC classification. ICC = International Consensus Conference, WIND = Weaning according to New Definition.

Table 2

Characteristics of patients according to weaning classification and multiple comparisons within weaning groups.

| | | ICC classification | | | | | | WIND classification | | | | | |
Variable	Category	Simple n=33 (10%)	Difficult n=16 (5%)	Prolonged n=9 (3%)	Without classification n=269 (82%)	P-Value	Category	Short n=36 (11%)	Difficult n=18 (5%)	Prolonged 3a n=24 (7%)	Prolonged 3b n=61 (20%)	No weaning n=188 (57%)	P-Value
Age (mean ± SD)	–	48.81 (±16.60)	58.43 (±12.32)	49.11 (±19.82)	57.03 (±16.84)	.0644	–	49.47 (±18.76)	54.44 (±14.59)	55.08 (±16.30)	59.31 (±15.17)	56.25 (±17.25)	.82
Gender	Male	15	9	3	135	.68	Male	16	10	9	32	95	.82
	Female	18	7	6	134		Female	20	08	15	29	93	
Admission	Medical	16	10	5	165	.52	Medical	17	11	15	28	125	.03
	Surgical	17	6	4	104		Surgical	19	7	9	33	63	
Outcome	Discharge	33	15	9	97	.0001	Discharge	36	17	23	40	38	.001
	Death	0	1	0	172		Death	0	1	1	21	150	
Extubation	Yes	33	16	9	17	.0001	Yes	35	16	9	15	0	.0001
	No	0	0	0	252		No	1	2	15	46	188	
Tracheostomy	Yes	–	–	–	123	–	Yes	1	2	12	47	61	.001
	No	–	–	–	204	–	No	35	16	12	14	127	
SAPS 3 mean ± (SD)	–	59.68† (±18.93)	66.86* (±15.06)	53.44† (±17.58)	77.39 (±17.41)	.0001	–	60.42† (±18.71)	67.29† (±16.96)	66.34† (±19.35)	75.05† (±16.86)	78.61 (±17.54)	.0001
Death probability mean ± (SD)	–	40.91† (±29.23)	54.22 (±27.60)	38.43† (±25.41)	67.89 (±25.20)	.0001	–	41.93*,†,‡ (±29.32)	53.72† (±29.47)	55.85† (±28.13)	63.61 (±25.58)	69.83 (±24.66)	.0001
MV, days mean ± (SD)	–	4.27*,† (±3.23)	6.93 (±4.23)	11.88 (±4.22)	11.54 (±10.31)	.0001	–	4.86*,†,‡ (±4.26)	6.88*,† (±4.26)	13.20‡ (±7.74)	17.52† (±10.65)	9.46 (±9.57)	.0001
ICU LOS, days mean ± (SD)	–	6.84* (±3.97)	10.87 (±5.27)	14.55† (±5.02)	11.19 (±9.93)	.0477	–	7.38* (±4.59)	10.83‡ (±5.58)	14.45† (±8.62)	17.72† (±10.80)	8.79 (±8.60)	.0001

ICC = International Consensus Conference, ICU = intensive care unit, LOS = length of stay, MV = mechanical ventilation, SAPS = Simplified Acute Physiology Score, WIND = Weaning according to New Definition.

* Significant difference for the comparison of prolonged or prolonged 3a with simple/short or difficult weaning patients.

† Significant difference for the comparison of patients without classification or no weaning with simple/short, difficult, prolonged, prolonged 3a, or 3b weaning patients.

‡ Significant difference for the comparison of prolonged 3b with simple/short, difficult or prolonged 3a weaning patients.

The third main finding could show us that when WIND was used, death probability, MV days, and the proportion of patients submitted to tracheostomy increased progressively according to weaning difficult. This result could not be observed among ICC groups in this study nor in that of Funk and colleagues, in which death probability was also used.[3] Some studies have shown a progressive increase of scores for predicting mortality (SAPS 2 and SAPS 3) from simple to prolonged weaning.[4,8,13,14] However, when SAPS 3 was observed in our study, there was no difference between weaning groups by applying ICC and WIND.

We could observe in our study that in tracheostomy rate, MV days sharply increased from difficult to prolonged 3b (WIND) according to weaning severity. Therefore, based on these data, we could suggest the intensification of care and strategies from the sixth day of MV or even to think about an early tracheostomy to patients gathered in group 3b. Strategies to improve weaning outcomes such as SBT, non-invasive ventilation in patients at risk for failing weaning, inspiratory muscle training, and early mobilization can help patients to conclude weaning ventilation.[23–25]

The main limitation of this study is undoubtedly its retrospective and single-center design. We were unable to get some information about the ventilator discontinuation process, patient characteristics which could affect weaning outcomes. Our study might be applied specifically to other ICUs with severely ill patients, which have most patients in prolonged weaning. However, a prospective multicenter study would be interesting to better evaluate this kind of patients and study the complications throughout the weaning process, which may be responsible for its failure.

In conclusion, based on these data, we reinforce that WIND classification could help the ICU team to intensify the care and strategies to improve weaning outcomes from the sixth day of MV. Furthermore, WIND allowed us to classify all patients, even those sicker with tracheostomy and those that could not finish weaning, thereby enabling comparisons among different ICUs. The new classification should be considered not only in the critically ill patient with high SAPS 3 score and high morbidity admitted to ICUs of tertiary hospitals, but also for all patients of general wards who require weaning from MV. Finally, it seems that the new classification fits better in the ICU routine, especially for more severe and prolonged weaning patients.

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Author contributions

Conceptualization: Anibal Basile-Filho.
Data curation: Isabella Scutti Reis, Anibal Basile-Filho.
Formal analysis: Ada Clarice Gastaldi.
Funding acquisition: Anibal Basile-Filho.
Investigation: Alessandra Fabiane Lago, Amanda Alves Silva, Vanessa Bras Tanaka, Vivian Caroline Siansi.
Methodology: Alessandra Fabiane Lago, Anibal Basile-Filho.
Project administration: Alessandra Fabiane Lago, Ada Clarice Gastaldi.
Resources: Alessandra Fabiane Lago, Vivian Caroline Siansi, Isabella Scutti Reis.
Software: Vivian Caroline Siansi.

Supervision: Anibal Basile-Filho.
Validation: Vivian Caroline Siansi.
Visualization: Vivian Caroline Siansi.
Writing – original draft: Alessandra Fabiane Lago.
Writing – review & editing: Alessandra Fabiane Lago, Ada Clarice Gastaldi, Anibal Basile-Filho.

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